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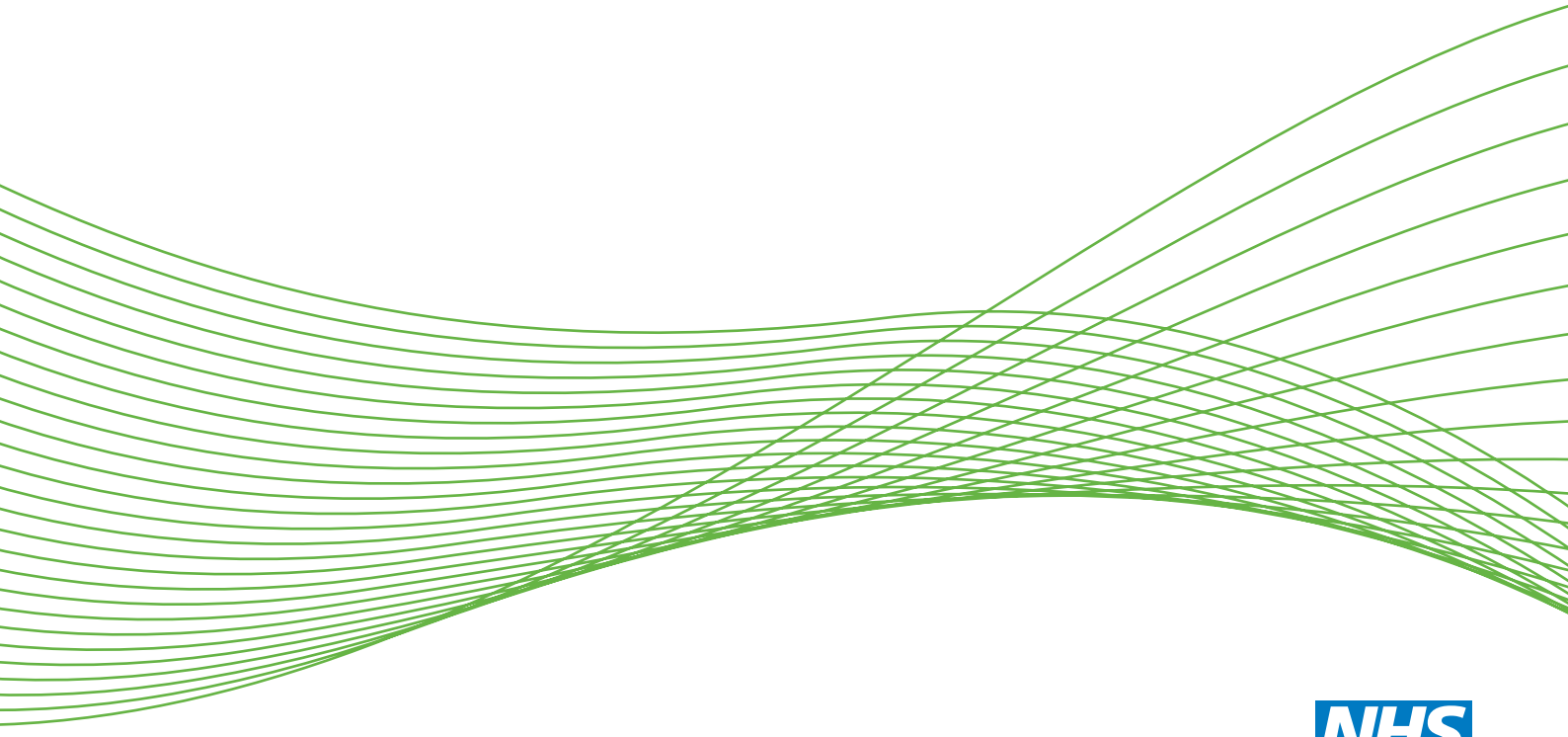

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Abstract

Organisational interventions to reduce length of stay in hospital: a rapid evidence assessment

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Background: Available evidence on effective interventions to reduce length of stay in hospital is wide-ranging and complex, with underlying factors including those acting at the health system, organisational and patient levels, and the interface between these. There is a need to better understand the diverse literature on reducing the length of hospital stay.

Objectives: This study sought to (i) describe the nature of interventions that have been used to reduce length of stay in acute care hospitals; (ii) identify the factors that are known to influence length of stay; and (iii) assess the impact of interventions on patient outcomes, service outcomes and costs.

Data sources: We searched MEDLINE (Ovid), EMBASE, the Health Management Information Consortium and System for Information on Grey Literature in Europe for the period January 1995 to January 2013 with no limitation of publication type.

Methods: We conducted a rapid evidence synthesis of the peer-reviewed literature on organisational interventions set in or initiated from acute hospitals. We considered evidence published between 2003 and 2013. Data were analysed drawing on the principles of narrative synthesis. We also carried out interviews with eight NHS managers and clinical leads in four sites in England.

Results: A total of 53 studies met our inclusion criteria, including 19 systematic reviews and 34 primary studies. Although the overall evidence base was varied and frequently lacked a robust study design, we identified a range of interventions that showed potential to reduce length of stay. These were multidisciplinary team working, for example some forms of organised stroke care; improved discharge planning; early supported discharge programmes; and care pathways. Nursing-led inpatient units were associated with improved outcomes but, if anything, increased length of stay. Factors influencing the impact of interventions on length of stay included contextual factors and the population targeted. The evidence was mixed with regard to the extent to which interventions seeking to reduce length of stay were associated with cost savings.

Limitations: We only considered assessments of interventions which provided a quantitative estimate of the impact of the given organisational intervention on length of hospital stay. There was a general lack of robust evidence and poor reporting, weakening the conclusions that can be drawn from the review.

Conclusions: The design and implementation of an intervention seeking to reduce (directly or indirectly) the length of stay in hospital should be informed by local context and needs. This involves understanding how the intervention is seeking to change processes and behaviours that are anticipated, based on the available evidence, to achieve desired outcomes ('theory of change'). It will also involve assessing the organisational structures and processes that will need to be put in place to ensure that staff who are expected to deliver the intervention are appropriately prepared and supported. With regard to future research, greater attention should be given to the theoretical underpinning of the design, implementation and evaluation of interventions or programmes. There is a need for further research using appropriate methodology to assess the effectiveness of different types of interventions in different settings. Different evaluation approaches may be useful, and closer relationships between researchers and NHS organisations would enable more formative evaluation. Full economic costing should be undertaken where possible, including considering the cost implications for the wider local health economy.

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Contents

List of tables

List of figures

List of abbreviations

A&E	accident and emergency
CI	confidence interval
COPD	chronic obstructive pulmonary disease
ED	emergency department
EHSD	early home-supported discharge
ESD	early supported discharge
EU	European Union
GP	general practitioner
GRADE	Grades of Recommendation, Assessment, Development and Evaluation
HELP	Hospital Elder Life Program
HMIC	Health Management Information Consortium
HR	hazard ratio
ICU	intensive care unit
IRR	incidence rate ratio
MeSH	Medical Subject Headings
OPAL	Older People Assessment Liaison
OR	odds ratio
PbR	payment by results
PPI	patient and public involvement
QIPP	Quality, Innovation, Productivity and Prevention
RCT	randomised controlled trial
REA	rapid evidence assessment
RR	risk ratio
SD	standard deviation
SIGLE	System for Information on Grey Literature in Europe
SMD	standardised mean difference
WMD	weighted mean difference

Plain English summary

Interventions that lead to a reduction in the length of time patients have to stay in hospital are widely considered as effective measures to increase the efficiency of hospitals and, potentially, reduce costs. However, a large number of interventions could contribute to achieving this goal, ranging from planned shorter stays, such as day surgery, to those involving complex organisational changes, such as stroke units.

In this study we sought to better understand the evidence base on whether or not, and how well, different types of organisational interventions in acute hospitals contribute to reducing length of stay, and other impacts these might have, for example on patient health status and experience, or on costs. We conducted a review of the literature published between 2003 and 2013, and carried out interviews with a small set of NHS managers to help place the findings of the evidence review in the current NHS context.

Our findings showed that several interventions could potentially help to reduce length of stay. These included multidisciplinary team care, which brings together different types of professionals to deliver, for example, stroke care or rehabilitation; improved processes facilitating early discharge from hospital through, for example, better communication between specialists in hospital, general practitioners and community services; and clinical care pathways, which describe, for example, the key elements of care and how these should be co-ordinated. We also found that several interventions contributed to improvements in patient outcomes, such as reducing mortality and complications rates, and organisational processes, such as better collaboration between teams, although they might not have resulted in reduced length of stay.

Scientific summary

Background

The NHS is under pressure to meet growing demand while ensuring continuous improvement in quality, and NHS organisations are expected to make large efficiency savings over the next decade. Efforts to reduce length of stay in hospital are considered an important measure to enhance efficiency. The existing evidence on effective interventions to reduce length of stay in hospital is wide-ranging and complex, however, with interventions ranging from planned shorter stays, such as day surgery, to those seeking to facilitate discharge of patients who have to stay in hospital longer. Factors driving length of stay are complex and include those acting at the health system, organisational and patient levels, and the interface between these.

There is a need to better understand the diverse literature on reducing the length of hospital stay. This study seeks to contribute to this effort by presenting a rapid evidence assessment (REA) of organisational interventions aiming to reduce length of stay, with a particular focus on patient management processes in hospital or hospital-initiated services delivered in the community.

Objectives

Principally drawing on a REA, we sought to:

- describe the nature of initiatives and interventions that have been used to reduce length of stay in acute care hospitals
- identify modifiable factors known to influence length of stay
- assess the impact of interventions to reduce length of stay on patient outcomes, service outcomes and costs.

Methods

We conducted a REA of the available literature. The review was informed by a conceptual framework, and in consultation with the advisors to the project we focused the review on organisational interventions, with a particular emphasis on patient management processes in hospital or hospital-initiated services delivered in the community to help identify the modifiable factors that have an impact upon length of stay.

Search terms were identified using the National Library of Medicine's Medical Subject Headings keyword nomenclature developed for MEDLINE. We searched MEDLINE (Ovid), EMBASE, the Health Management Information Consortium and System for Information on Grey Literature in Europe for the period January 1995 to January 2013.

We considered organisational interventions set in or initiated from acute hospitals, and excluded studies that examined a specific clinical intervention only (e.g. a surgical technique or new pharmacological treatment) or assessed enhanced recovery, fast-track or clinical care pathway initiatives related to elective surgery. We further excluded studies related to length of stay in obstetrics, psychiatric day hospitals, accident and emergency departments and intensive care units where this was the only aspect of hospital stay considered. We applied a cut-off of 10 years; systematic reviews published before 2003 were excluded from the review, as were primary studies reporting on data collected before 2003. We limited the

evidence to studies conducted in high-income countries and published in the English, French, German, Dutch and Spanish languages.

The primary outcome of interest was length of stay. Eligible studies had to report a quantified estimate of the impact of the intervention under study on length of stay. Secondary outcome measures were clinical outcomes and patient experience; carer and staff outcomes; utilisation; and costs.

Records identified by searches were assessed for inclusion by scanning titles and abstracts against inclusion and exclusion criteria to identify potentially relevant studies. This was led by two researchers who independently screened the same sample according to the initial set of selection criteria, with differences resolved through discussion. Data from studies identified as eligible for review were extracted into a data template, according to study design and objective(s), intervention(s) under study, methodological approach, reported outcomes and identified limitations. A minimum quality threshold was set based on clarity of reporting of research question(s), methods and results. A narrative synthesis approach was used and studies were analysed and reported according to the stage of the patient journey on which they sought to have an impact.

We supplemented the review with a series of exploratory key informant interviews with a small set of NHS managers and clinical leads in four acute NHS trust sites in England. This component of the research was designed to help place the findings of the evidence review in the NHS context, and so inform how our findings might best be used to meet the needs of the NHS.

Findings

A total of 53 studies met our inclusion criteria, comprising 19 systematic reviews and 34 primary studies. Primary studies included eight randomised controlled trials (RCTs), four non-RCTs, three controlled before-and-after studies, 17 before-and-after comparisons, one cross-sectional study and one retrospective cohort study. Primary studies were set mostly in the USA ($n = 12$), Australia ($n = 8$) and the UK ($n = 7$), with the remainder set in the Netherlands, Belgium, Italy, Spain, Sweden and Switzerland.

Of the studies identified, 29 assessed interventions targeted at the stay in hospital (11 systematic reviews, 18 primary studies); 15 evaluated interventions aimed at discharge (five systematic reviews, 10 primary studies); and nine examined clinical care pathways (three systematic reviews, six primary studies).

There was evidence of the potential for a range of interventions involving multidisciplinary teams or care models to reduce length of stay. These included some forms of organised stroke care delivered in dedicated units when assessed against alternative service provision, and multidisciplinary rehabilitation that included exercise for older patients with acute exacerbations of a medical condition. There was also, albeit somewhat weaker, evidence pointing to a beneficial impact on length of stay of multidisciplinary, hospital-initiated nurse-led case management for older people and, possibly, heart failure patients. Selected multidisciplinary interventions involving some form of geriatric assessment may also be promising in their potential to reduce length of stay; however, relevant evidence was based on small or uncontrolled studies only and needs to be interpreted with caution. Similarly, there may be potential for selected nurse-led interventions to reduce length of stay, although the impact of interventions is difficult to interpret in the absence of a controlled study design. In several instances, observed improvements were attributed to changes in best practice adherence.

There was evidence of the potential of selected staffing models to reduce length of stay, such as adding a specialist nurse, using midwifery teams, changing the frequency of consultant ward rounds or adding a pharmacist to the clinical team. The evidence remained inconclusive for the provision of additional physiotherapy out of hours and palliative care consultation services. In all cases, the authors cautioned

about the robustness of the available evidence and highlighted the need to interpret findings against the background of other outcomes, such as clinical outcomes, potentially benefited by the intervention.

Among interventions aimed at discharge, early supported discharge showed the greatest effect on length of stay, although discharge planning and supported discharge may lead to a range of other benefits whereas early supported discharge may be associated with greater subsequent hospital utilisation. There was also some, albeit limited, evidence that interventions could be associated with savings for early supported discharge and discharge planning with postdischarge support. There was some suggestion that individual or discrete interventions such as discharge planning or postdischarge medication review on their own may convey little beneficial effect in relation to length of stay, whereas a combination of interventions or sets of interventions are more likely to be effective with regard to this outcome.

Evidence from evaluations of clinical care pathways suggests a positive impact on length of hospital stay and patient outcomes such as mortality. Additional benefits were evident in terms of improvements in processes or teamwork, reduced delays in discharge and better collaboration within the team.

Interventions considered in the review highlighted the need to interpret length of stay in hospital in the context of hospital (re)admissions, noting that although length of stay might not necessarily be reduced as a consequence of the intervention, the overall number of patient-days might be lower as a result of observed reductions in (re)admission rates. Furthermore, where an intervention has been found to increase length of stay, it is not to say that such an increase is necessarily inappropriate, as other outcomes may have improved. In the case of nursing-led inpatient units, for example, although length of stay increased, ability to live independently and functional status were improved.

We also found that several interventions that did not appear to have an impact on length of stay contributed to improvements in patient outcomes, such as reducing mortality and complications rates, and organisational outcomes, such as streamlining processes and increasing inter- and intrateam collaboration. Overall, the potential for any particular intervention to reduce length of stay will be highly context dependent, depending on the underlying problem and the current model and quality of service provision.

Finally, evidence reviewed was mixed with regard to the extent to which interventions seeking to reduce length of stay were associated with cost savings. Much of the evidence from primary studies was from countries outside the UK, making transferability difficult, and information on costs was typically inferred rather than measured directly and assessed from a health perspective only. Understanding the cost consequences of reductions in length of stay for the wider health system and for patients and families will be important.

Conclusions

In this study we sought, by means of a review of the published literature, to describe the nature of strategies that have been implemented to reduce length of stay, identify modifiable factors known to influence length of stay, and assess the impact of these interventions on patient outcomes, service outcomes and costs. Evidence reviewed in this report points to selected types of interventions that have the potential to reduce length of hospital stay. These were:

- Multidisciplinary team care, for example some forms of organised stroke care. This may include care from specialist geriatricians and rehabilitation specialists.
- Improved discharge planning. This may lead to a range of benefits including more efficient and rapid processes in completing paperwork, better communication between primary and secondary care and increased satisfaction among patients.

- Early supported discharge programmes. These show potential for significant reductions in length of stay without an increase in subsequent readmissions. Postdischarge programmes without a focus on early discharge did not appear to reduce length of stay.
- Clinical care pathways. These include an explicit statement of goals and key elements of care, and the co-ordination of the care process by co-ordinating and sequencing the activities of the care team. This needs to include good communication among team members and with patients and families. The approach requires structured care plans detailing essential steps in the care of the patient.

We also found that nursing-led inpatient units were associated with some improved outcomes but, if anything, increased length of stay. However, there was also some evidence of potential adverse effects, suggesting the need for close monitoring if implemented as a strategy.

The diversity of evidence identified emphasises that the design and implementation of an intervention seeking to reduce (directly or indirectly) length of stay should be informed by local context and needs. This involves understanding how the intervention is seeking to change processes and behaviours that are anticipated, based on the available evidence, to achieve desired outcomes ('theory of change'). It will also involve assessing the organisational structures and processes that will need to be put in place to ensure that staff who are expected to deliver the intervention are appropriately prepared and supported.

Recommendations for research

Reviewing the evidence presented in this report, we have identified a number of gaps in the evidence that would benefit from further research to usefully inform practice. We offer a small set of recommendations for further research, relating to the design, implementation and evaluation of organisational interventions seeking to reduce length of hospital stay.

- Greater attention should be given to the theoretical underpinning of the design, implementation and evaluation of interventions or programmes. Only a small number of studies reviewed in this report provided detail on the design of the intervention(s) under study, and the extent to which this was informed by a 'theory of change' also guiding implementation and evaluation. Explicit definition and reporting would help to advance the literature in the field and improve learning from one context to another.
- There is a need for further research using appropriate methodology to assess the effectiveness of different types of interventions in different settings. Our review highlighted methodological shortcomings that prevented us from being able to confidently interpret some of the results. Future research should focus not only on the impact of such interventions on length of stay as the indicator of success, but should set this in relation to other impacts such as patient outcomes, service utilisation and costs more broadly. Careful consideration should be given to study design including treatment allocation and choice of comparator.
- Different evaluation approaches may be useful, and closer relationships between researchers and NHS organisations would enable more formative evaluation. One approach to address design and reporting shortcomings of current research lies in the capacity of stakeholders to embed evaluation in the design of an intervention, or at the early stages of the implementation phase. Benefits of such research practice would include the possibility of adapting the intervention protocol to the needs and resources of the organisation at different points in time. Other approaches such as a realist review have the potential to address the questions of what works, where, why and for whom – questions which were repeatedly raised through our review. Such an approach would aim to identify the drivers of and barriers to change, disentangling the influence of the local and organisational contexts from the impact of the interventions themselves, and contributing to the production of practical guidelines for health-care managers.

- Full economic costing should be undertaken where possible. Studies reviewed in this report provided some tentative evidence to support the assumption that interventions aimed at reducing length of stay may be associated with cost savings. However, costs were generally poorly reported, and findings are not easily transferable across settings, in particular from studies carried out in different health systems. Further research is needed that considers the cost implications for different stakeholders in the system, and takes a societal perspective to capture costs that affect the wider local health economy.

Funding

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Chapter 1 Introduction

Background

The NHS in England is operating in a tight financial climate. Following a decade of growth, of an average of 6% annually in real terms,[1] funding has slowed substantially since 2011–12 to an estimated average of 0.1% annually until 2015–16.[2] This places substantial pressures on the NHS to meet the growing demand for health care while ensuring continuous improvement of the quality of treatment and care as set out in the government's mandate to NHS England.[3] Strategies seeking to support this ambition include the Quality, Innovation, Productivity and Prevention (QIPP) initiative developed by the Department of Health. This aims to improve the quality and delivery of NHS care while reducing costs to make £20B of efficiency savings by 2014–15 (the QIPP challenge).[4,5] These savings are expected to cover the 'funding gap' that has arisen because of the reduced growth rate in health-care spending and to meet the additional demand for health care because of demographic changes and advances in technology, among other pressures.[6]

There are various options to enhance the value of how health-care services are financed and delivered.[7] These can broadly be divided into measures aimed at improving operational efficiency, for example by reducing duplication of services, decreasing the use of expensive inputs or reducing errors; those targeted at strengthening allocative efficiency through rebalancing services across the health system, such as moving care outside hospitals into the community, improving care co-ordination or strengthening preventative care; and those designed to enhance administrative efficiency through, for example, (de)centralising administrative functions, simplifying administrative procedures and introducing uniform standards.[8] Enhancing the value of how health-care services are being provided can also mean investing additional resources into areas in which future gains in efficiency are likely to exceed the amount spent; information technology is one such example.

Appleby *et al.*,[9] referring to productivity, differentiate improvement strategies into those concerned with 'doing things right', including minimising support and back office functions, and developing and incentivising the workforce, and 'doing the right things', namely changing clinical practice and commissioning and redesigning clinical care pathways such as priority setting, reducing unplanned admissions, integrating care and others.

About 40% of the savings to be achieved under the QIPP initiative are expected to come from driving efficiency in hospitals.[1] The National Audit Office[1] estimated that if all hospitals in England performed at the level of the top 25% in respect of staff costs, use of estate, control of emergency admissions and bed management, the NHS could save around £1.6B per year. Drawing on a wider range of hospital activity, the NHS Institute estimated that, in 2009, the scale of productivity opportunity in acute hospitals through reducing variation in selected core activities was around £4.6B.[9] One-quarter of these savings (or £1.2B) would derive from reducing the length of hospital stay.

Trends and patterns of length of hospital stay in England

The average length of stay in hospital is frequently used as an indicator of efficiency,[10] and measures to reduce length of stay can be seen to enhance both operational and allocative efficiency. A shorter stay reduces the cost per discharge and may shift care from the inpatient setting to alternative settings for the delivery of continued care after discharge that tend to be less expensive. At the same time, shorter hospital stays can be associated with a higher intensity of services delivered, and can also be more costly on a day basis.

In many countries, average length of stay has consistently fallen over the past decade or so. Among European Union (EU) member states, length of stay fell from just over 8 days in 2000 to just under 7 days in 2010.[10] This reduction has been attributed to a number of factors, including medical advances that have enabled a larger number of interventions to be carried out as day surgery or have reduced the need for longer hospitalisation. In a number of countries, the move to activity-based funding of inpatient care has also been associated with a reduction in the average length of stay in hospital,[11] including in England.[12]

In England, mean length of stay in acute hospitals has continually fallen since the early 2000s, from just under 8 days in 2002–3 to just over 5 days in 2011–12 (excluding day cases) (*Figure 1*). Among those aged 75 years and older, length of stay fell from around 16 days to just over 10 days during the same period. Median length of stay fell from 2 days to 1 day in 2007–8, and has remained stable since.

However, data suggest that average length of stay varies substantially by hospital provider and commissioners. Persistent variation suggests the need for the understanding and disseminating of effective initiatives to reduce the length of stay.

Approaches to reducing length of stay in hospital

At the outset, measures to reduce length of stay in hospital can be categorised into two broad groups: planned shorter stays (e.g. day surgery) and innovation in unscheduled or non-elective care.

There has been considerable growth in the use of day surgery over the past two decades in many countries, following the development of short-acting anaesthetics and new surgical techniques.[15] Day surgery is considered a safe approach to surgical health care for which there is evidence of cost-effectiveness, increased patient satisfaction and lower rates of infection.[16] However, availability of day surgery varies between and within countries. In the UK, the 2000 NHS Plan Department of Health. The NHS Plan: A Plan for Investment, A Plan for Reform. London: Department of Health; 2000. set out a target of 75% of elective surgery to be performed as day cases, although, given further advances in minimally invasive surgery since, it has been estimated that higher rates may be possible in future.[17] Recent figures suggest that by the fourth quarter of 2012–13, NHS trusts had achieved an overall day case rate of just over 79%, although proportions varied substantially across the 141 procedures considered.[18]

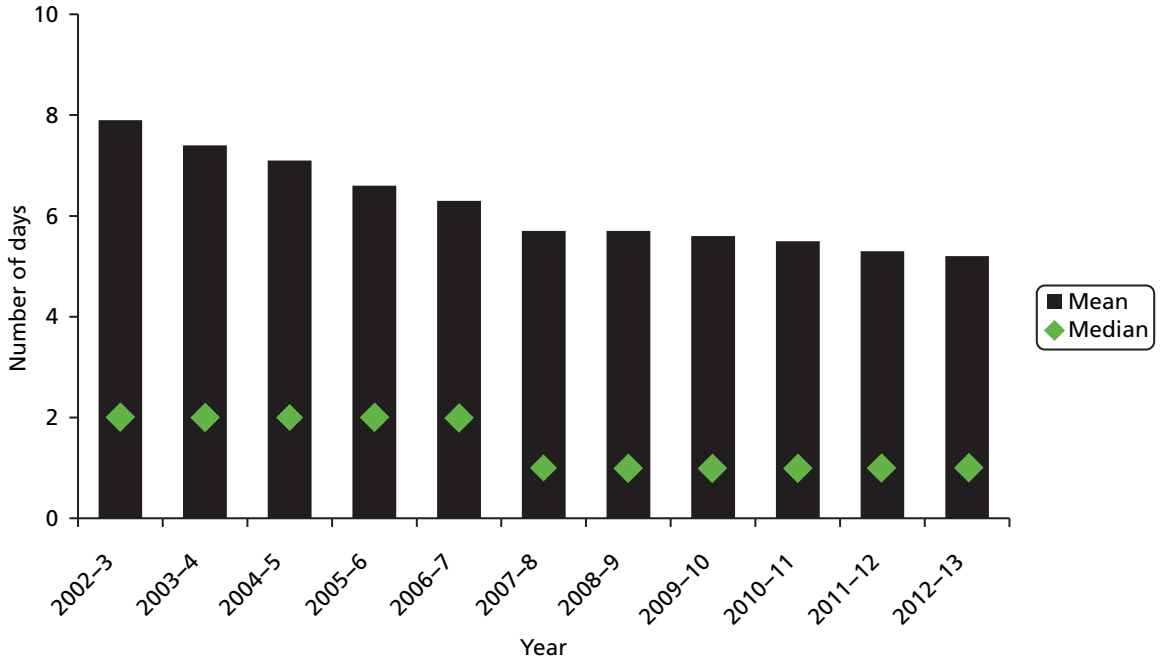

FIGURE 1 Length of stay in hospitals in England (excluding day cases): 2002–3 to 2012–13. Adapted from the Nuffield Trust (2013)[13] and Health and Social Care Information Centre (2013).[14]

Measures to shorten length of stay for those patients who have to stay in hospital longer or are admitted non-electively are more complex and diverse. These interventions include hospital-based case management and other arrangements that facilitate early discharge, such as comprehensive geriatric assessment,[19] structured discharge planning,[20,21] 'early discharge hospital at home'[21] and a range of interventions focused on specific clinical conditions. In addition, there is a range of interventions not directly targeted at reducing length of stay that have an impact on this outcome, such as the adoption of clinical care pathways (that is, structured care plans detailing the essential steps in the care of patients with a specific clinical problem in hospital[22]) or initiatives focusing on care interventions post discharge, such as intermediate care after acute care in nursing homes.[23]

Factors driving length of stay are multifaceted and include those acting at the health system, organisational and patient levels, and the interface between these. There is a need to draw together the diverse body of evidence of approaches to reducing length of stay in hospital, and to identify and help understand the modifiable factors that have been identified as having an impact on length of stay, such as the role of specialist care, capacity and placement, and staffing levels. This report seeks to contribute to filling this gap. It centres on organisational interventions that have an impact on length of stay, with a focus on patient management processes in hospital or hospital-initiated services delivered in the community.

Aims and objectives

The work presented in this report seeks to advance our understanding of the evidence of initiatives to reduce the length of stay in hospital. Principally drawing on a rapid evidence assessment (REA), we sought to:

- describe the nature of initiatives and interventions that have been used to reduce length of stay in acute care hospitals
- identify the modifiable factors that are known to influence length of stay
- assess the impact of interventions to reduce length of stay on patient outcomes, service outcomes and costs.

Structure of the report

This introductory chapter has briefly set out the aims of the research and the policy context within which it was commissioned. *Chapter 2* describes the methods used. *Chapter 3* presents the core findings of the work, structured according to the major types of interventions reviewed. *Chapter 4* discusses our overall findings, seeking to relate them to the wider health-care context, and develops recommendations for further research.

Chapter 2 Methods

The principal approach that we used is a review of the peer-reviewed literature based on REA. We complemented the evidence assessment with a series of interviews with a small set of NHS managers and clinical leads representing key stakeholder views, to help place the findings of the evidence review in the NHS context and so inform how our findings might best be used to meet the needs of the NHS.

Rapid evidence assessment

Rapid evidence assessment is a comprehensive, systematic and critical assessment of the scope and quality of available evidence which follows the general principles of conducting literature reviews in health care.[24] The choice of REA was informed by the requirements for this project as set out in the commissioning brief[25] and was based on the need to provide the best possible value for money within a relatively limited time frame (see *Appendix 1* for the original protocol). REAs follow the same structure and are as replicable and transparent as systematic literature reviews. In contrast to formal systematic reviews, REAs tend to place more explicit limits on the scope of the review, whether by number and type of databases or other sources searched, types of research included, or the language and time period in which the research was conducted. However, the REA follows the same principles as a systematic review, namely defining the research question; developing the review protocol, including defining inclusion and exclusion criteria, search terms and sources to be searched; undertaking the review, that is, study selection, data extraction, quality assessment and data synthesis; and reporting.

Defining the scope of the review

As indicated in *Chapter 1*, the range of interventions that have an impact on length of hospital stay is very diverse. We can principally distinguish planned shorter stays and planned discharge of patients who have to stay in hospital longer. Additionally, measures to reduce length of stay can be categorised as clinical interventions (e.g. newly introduced surgical techniques, clinical procedures, pharmaceutical treatments) and organisational interventions (e.g. nurse-led discharge management) which directly or indirectly have an impact on length of stay. Given the diversity of the topic and the potentially extensive body of literature on clinical interventions in particular, we developed a conceptual framework which served as a guide for developing the research protocol and performing the review (*Figure 2*).

In order to ensure that the framework captures the principal views of those delivering hospital services on a day-to-day basis, we invited a senior clinician and a senior manager from a local teaching hospital (Cambridge University Hospitals NHS Foundation Trust) to advise on the project and, specifically, to help in the conceptualising of the framework. This sought to place the indicator 'length of stay' into the wider context of inpatient care and its interaction with other core measures of hospital activity and capacity, such as bed occupancy and staffing. It also highlighted the need to interpret 'length of stay' in the context of the range of services available in the community.

In order to focus the review, we distinguished:

- the *nature* of the intervention: clinical, organisational
- the *principal provider* of the intervention: acute hospital trust, community services, primary care
- the *setting* within which the intervention is delivered: hospital, community or the patient's home
- the *stage in the patient journey* which the intervention is targeting: pre admission or on admission, during hospital stay, on or post discharge.

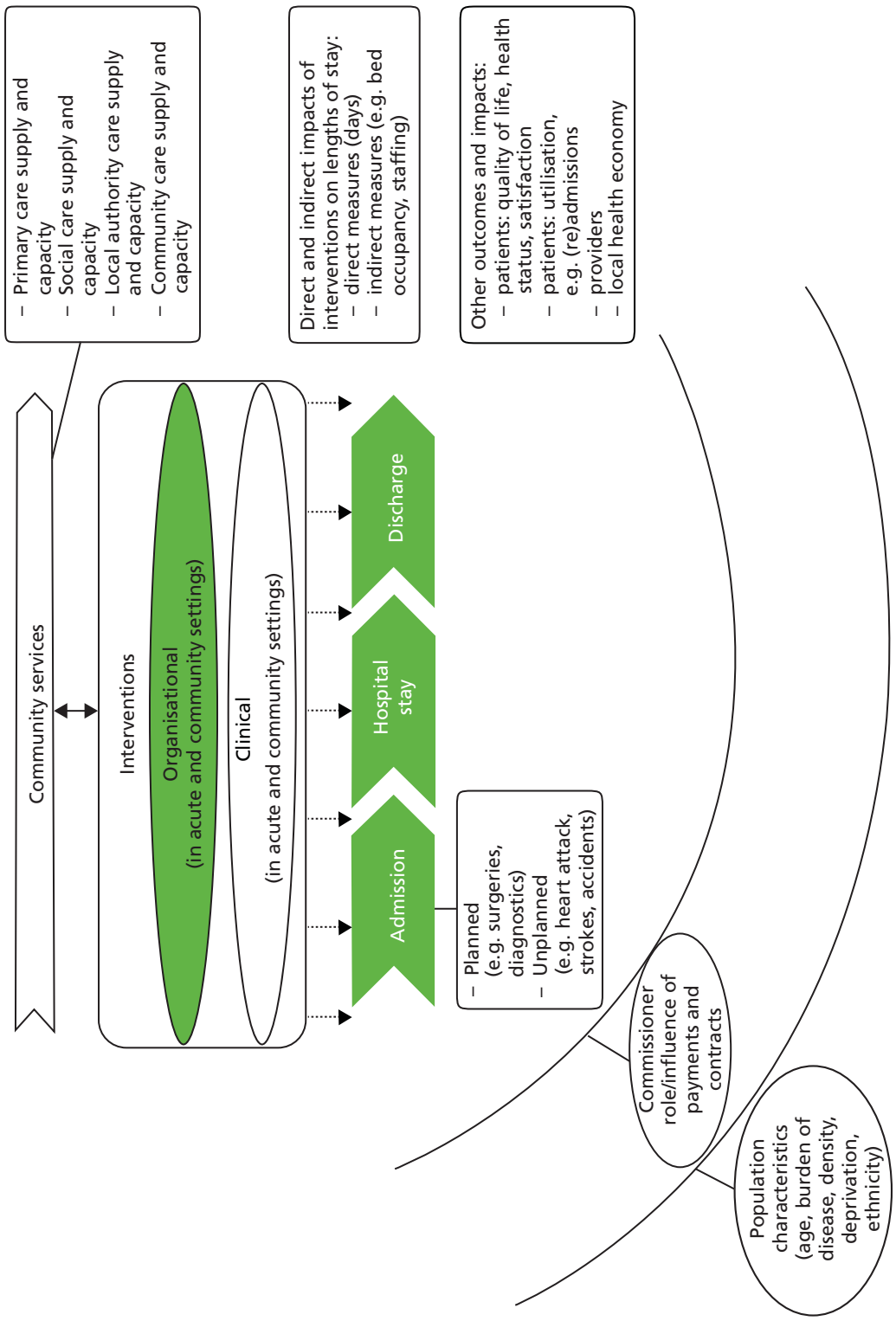

FIGURE 2 Conceptual framework.

It is important to note that these categories are not clear-cut or mutually exclusive. Indeed, under each heading multiple combinations will be possible, for example clinical care pathways will act across the entire patient journey from admission to discharge. Guided by this framework, and in consultation with the advisors to the project, we focused the review on organisational interventions, with a particular emphasis on patient management processes in hospital or hospital-initiated services delivered in the community, to help identify the modifiable factors that have an impact upon length of stay.

Search strategy

We identified search terms from the central concepts set out in the framework. We pilot-tested the initial terms to ensure that searches captured a range of potentially relevant studies. Search terms were identified using the National Library of Medicine's Medical Subject Headings (MeSH) keyword nomenclature, developed for MEDLINE. We searched both MEDLINE (Ovid) and EMBASE from January 1995 to January 2013. We also carried out searches of the Health Management Information Consortium (HMIC) and System for Information on Grey Literature in Europe (SIGLE) databases, using the keyword term 'length of stay', with no limitation on publication type. We searched for studies published in English, French, German, Dutch and Spanish languages. Full details of the search strategy are available in *Appendix 2*.

Inclusion and exclusion criteria

Type of study

We included systematic reviews and meta-analyses as well as randomised controlled trials (RCTs), controlled clinical trials, controlled before-and-after studies, interrupted time series and observational studies. We excluded trial protocols, feasibility studies, case reports, commentaries, editorials, guidelines and conference abstracts.

Interventions

We included organisational interventions set in or initiated from acute hospitals. We excluded studies that examined a specific clinical intervention only, such as a surgical technique, clinical procedure or new pharmacological treatment. We also excluded studies that assessed enhanced recovery, fast-track or clinical care pathway initiatives related to elective surgery. This follows consultation with Paton *et al.*,[26] who completed a review of the evidence on enhanced recovery after surgery (ERAS) programmes in secondary care, which was commissioned under the same call for proposals as the review presented in this report.

Paton *et al.*[26] describe 'enhanced recovery' as programmes 'which seek to design and then implement an optimal pathway (covering the pre-, intra- and postoperative periods) for patients that is focused on rapid recovery and discharge'.[26] More specifically, their review assessed the evidence for ERAS programmes for patients undergoing elective surgery. Initiated at the point of referral to assess individual patients' needs prior to surgery, this involves the selection of an enhanced recovery pathway involving multidisciplinary teams and follow-up of the patient at home after discharge from hospital.[27]

Against this background, and in order to minimise duplication, we principally focused on interventions aimed at non-elective hospital admissions.

We further excluded studies that:

- assessed interventions relating to obstetrics, because length of stay for normal delivery in England is among the lowest in the EU, at 1.8 days in 2010[10]
- evaluated psychiatric day hospitals, as this type of service is unlikely to be provided in acute hospital settings
- assessed short stay units in acute settings, because patients will be selected for admission on the basis of only requiring short hospitalisation

- were set in accident and emergency (A&E) or emergency departments (EDs) and assessed length of stay in A&E or ED only (which is typically measured in hours), because of the specific profile of patients seen in A&E or ED
- were set in intensive care units (ICUs) and assessed length of ICU stay only, because of the specific profile of patients admitted to ICU
- aimed at preventing (re)admission to hospital, and did not include a component explicitly targeted at the inpatient population
- were set in the community with no clear link to hospital. Although such interventions might have an impact on length of stay, and could indeed provide a viable alternative to inpatient care, such interventions were outside the scope of this review.

Outcomes

The primary outcome of interest was length of stay. Eligible studies had to report a quantified estimate of the impact of the intervention under study on length of stay. This could be reported as an absolute or relative figure, weighted or standardised mean difference (SMD), median, risk or odds ratio, or other measure of effect. We excluded studies that only reported a qualitative assessment of changes in length of stay and studies of planned short stays when these did not provide a quantified measure of length of stay.

Secondary outcome measures were clinical outcomes and patient experience (such as health status, quality of life, satisfaction, preferences and acceptability), carer and staff outcomes, utilisation (e.g. occupancy, readmission, waiting times, outpatient attendance) and costs (inpatient, primary care, community services and costs to patients).

Time period

Although searches were undertaken from 1995 onwards, we excluded systematic reviews published before 2003 and primary studies reporting on data collected before 2003. We applied this cut-off because the organisation and financing of inpatient care and health care more broadly in England has undergone substantial change since the early 2000s. We chose 2003 for pragmatic reasons, thereby covering 10 years of published work to 2013, although it is worth noting that this cut-off point coincides with the phased introduction of tariffs for hospital care (Healthcare Resource Groups) under the payment-by-results financing scheme in England.[12]

Transferability

We only considered studies conducted in high-income countries. Eligible studies had to report on an intervention that was potentially transferable to the NHS. For example, we excluded studies of hospitalist-led interventions, which are implemented in the USA but have little applicability to the NHS context.[28]

Study selection

Records identified by searches were assessed for inclusion by scanning titles and abstracts against inclusion and exclusion criteria to identify potentially relevant studies. Two researchers (SB and EP) led the selection process. To ensure consistency, the two researchers independently screened the same sample of 315 records (about 2.3%) according to the selection criteria, and discussed any differences between included studies. The initial aim was to undertake duplicate screening of 5–10% of records, but because agreement between the two reviewers was high, they performed independent screening of the remaining records. Full texts were retrieved for potentially eligible studies and assessed again against the inclusion and exclusion criteria. Any remaining uncertainties about the eligibility of studies were resolved through discussion and by consensus in the wider research team.

Data extraction

Data from studies identified as eligible were extracted into a Microsoft Excel 2010 spreadsheet template (Microsoft Corporation, Redmond, WA, USA). We extracted information on study design and objective(s), intervention(s) under study, methodological approach, reported outcomes and identified limitations. The data extraction template was piloted on a small number of studies and refined. Data extraction was

undertaken by three researchers. Consistency of data extraction across reviewers was checked through duplicate extraction of a random sample of studies by four reviewers independently. Disagreements and discrepancies were resolved by discussion or involvement of a further reviewer where necessary.

Quality assessment of studies

Given the heterogeneity of study designs considered in this review, we did not apply a formal quality rating system such as the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) system for evaluating the quality of evidence for reported outcomes.[29] The GRADE approach, which generally gives the highest quality rating for evidence from randomised trials, may not always be applicable to studies assessing sometimes complex interventions aimed, directly or indirectly, at reducing length of stay. Thus, restrictive application of GRADE might lead to exclusion of studies that would otherwise provide important insights, in particular where contextual factors enabling or hindering implementation of potentially promising interventions are concerned. We therefore considered the use of a set of hierarchical criteria, based on criteria recommended by the Centre for Reviews and Dissemination, to be more appropriate.[24] Building on this approach, we applied the following questions to assess the quality of primary studies and systematic reviews:

- Is the research question clearly stated?
- Is the intervention clearly defined?
- Is the study design rigorous and clearly reported?
    - *Systematic reviews* Were inclusion and exclusion criteria reported? Was the search adequate? Were the included studies synthesised appropriately? Was the quality of the included studies assessed? Did the review present sufficient detail about the individual included studies?
- Are the results clearly reported?

Each study was judged on whether each criterion was fully, partly or not met, with scores representing 'not met' (0), 'partly met' (1) and 'fully met' (2). We calculated a total score by simple adding up the individual scores; we did not apply a weighting to different criteria or a hierarchical approach. Studies obtaining a score lower than 4 were excluded.

Data synthesis

The heterogeneity of evidence in relation to interventions, settings and study design precluded a formal approach to analysis, such as meta-analysis. Instead, we applied a narrative synthesis approach in line with the stages we described, as guided by the conceptual framework (see *Figure 2*). We thus analysed studies according to whether the intervention under study was aimed at the hospital stay, postdischarge or across the patient journey (clinical care pathways). We distinguished between, and reported separately on, evidence from systematic reviews and primary studies.

Key informant interviews

The implementation of complex interventions depends on a range of system and contextual factors which are not easily identifiable or documented in the published literature. Interviews with a small number of key informants in a select number of settings sought to further our understanding of the more salient factors that enable or hinder the implementation of interventions seeking to reduce length of stay. This component of the research was designed to be exploratory only, to help place the findings of the evidence review in the NHS context and so inform how our findings might best be used to meet the needs of the NHS.

Study sites and participants were identified using a combination of purposive and 'snowball' strategies using official websites, the authors' professional networks and recommendations from our NHS advisors.

We wanted to understand the benefits and challenges of implementing interventions in day-to-day practice, and therefore approached senior staff involved in the actual delivery of interventions seeking to reduce length of stay, to capture a range of initiatives, rather than senior executive staff involved in strategic decision-making.

Potential study participants were invited by means of a letter explaining the background to the study. Depending on the location of the study site under consideration, interviews were undertaken face to face or by telephone, using a semistructured interview guide which was shared with the interviewee beforehand upon request. Interviews explored broad themes around length of stay interventions. They included questions about drivers behind intervention design and challenges to and enablers of implementation (the full interview protocol is presented in *Appendix 3*).

Interviews were carried out between February and July 2013. All but one interview were undertaken by a single researcher. Interviews lasted an average of 30 minutes; they were audio recorded following consent and transcribed verbatim. Transcripts were manually coded, with analyses informed by the key themes guiding the interviews (as described above) while also seeking to identify additional, emerging themes.

Ethics review

We received clearance from the National Research Ethics Service Research Ethics Committee, East of England – Cambridge Central, confirming that this study did not require ethics review. We further sought approval from the research and development department at Cambridge University Hospitals NHS Foundation Trust, which confirmed that the study was to be considered as service evaluation. Key informants were approached in their professional roles only and no sensitive personal information was collected. Consent forms were shared with the study participants in advance and consent was obtained before the interview.

Patient and public involvement

Patient and public involvement (PPI) did not form a significant component of our study. However, we consulted with members of the public from INsPIRE (patIeNt & Public Involvement in REsearch), a PPI in health and social care research group for Bedfordshire and Cambridgeshire,[30] on the research protocol and the conceptual framework. Three individuals shared comments, and we integrated comments and suggestions into the protocol. Examples of changes to the protocol following review by members of the public included recognition of the importance of reporting on outcomes for carers and staff. We considered these in the data extraction phase. Members of the public also highlighted the need to consider the possibility of readmissions as a consequence of efforts to reduce length of stay. We took account of this comment by reporting on readmissions as a secondary outcome.

Chapter 3 Findings

This chapter presents the findings of the study. We first document insights from the REA according to the stage in the patient journey targeted by the intervention: during the hospital stay, at or post discharge, or across the patient journey (clinical care pathways), in line with the conceptual framework guiding this review (see *Chapter 2*, *Figure 2*). We then report on our observations from interviews with NHS managers (see *Implementing interventions seeking to reduce length of stay in hospital: an exploratory analysis of experiences in the NHS*).

Description of studies

Our search identified a total of 15,397 records across the four databases searched. After removal of duplicates and initial screening of titles and abstracts, we considered 583 references for further evaluation. Of these, 53 studies were identified as eligible for inclusion in the review (*Figure 3*). Nineteen were systematic reviews or meta-analyses[22,23,31–47] and 34 were primary studies.[48–81] Among the primary studies, there were eight RCTs,[63,66,67,69,73–75,77] including one secondary analysis of RCT data[67] and one cluster RCT,[77] four non-randomised controlled studies,[48,58,61,62] three controlled before-and-after studies,[50,59,65] 17 before-and-after comparisons,[49,51–57,60,64,68,70,72,76,79–81] one cross-sectional study[71] and one retrospective cohort study.[78] Primary studies were set mostly in the USA ($n = 12$),[50–52,58,60,61,65,66,68,74,76,78] Australia ($n = 8$)[53,54,62,63,69,72,73,75] and the UK ($n = 7$);[49,57,59,67,70,71,81] two studies were set in the Netherlands[56,79] and one each in Belgium,[48] Italy,[77] Spain,[80] Sweden[55] and Switzerland.[64]

Of the studies identified, 29 could be categorised as assessing interventions targeted at the patient journey during hospital stay (11 systematic reviews,[23,32–41] 18 primary studies[48–65]); 15 evaluated interventions were aimed at discharge (5 systematic reviews,[31,42–45] 10 primary studies[66–75]); and nine examined clinical care pathways (three systematic reviews,[22,46,47] six primary studies[76–81]). *Figure 4* illustrates this categorisation by study type and *Table 1* presents a summary overview of the key characteristics and findings of studies included in our review. Further detail of individual studies is presented in *Appendix 4*. *Appendix 5* provides an overview of studies which we excluded from our review based on full-text review.

We note that two systematic reviews, updating or related to studies which we included in the present review, were published after we conducted our searches.[21,82] These include a systematic review by Deschodt *et al.*,[82] which relates to a primary study that we have included by the same authors,[48] and a systematic review by Shepperd *et al.*,[21] which updates their 2010 review of the same topic,[31] included in the present review. We have not included these two additional reviews in our synthesis but have confirmed that findings are consistent with those presented below.

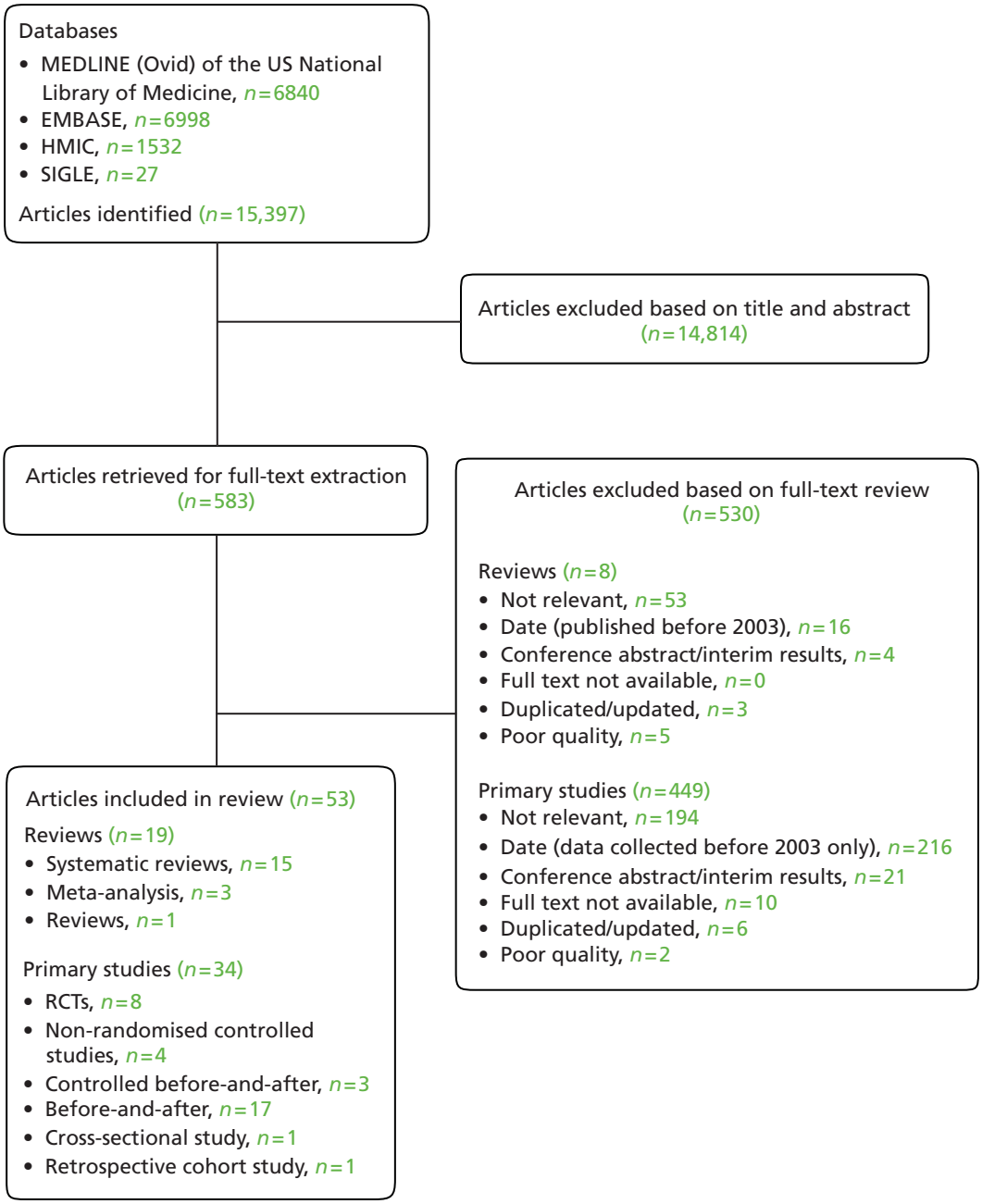

FIGURE 3 Peer-reviewed literature included in the study.

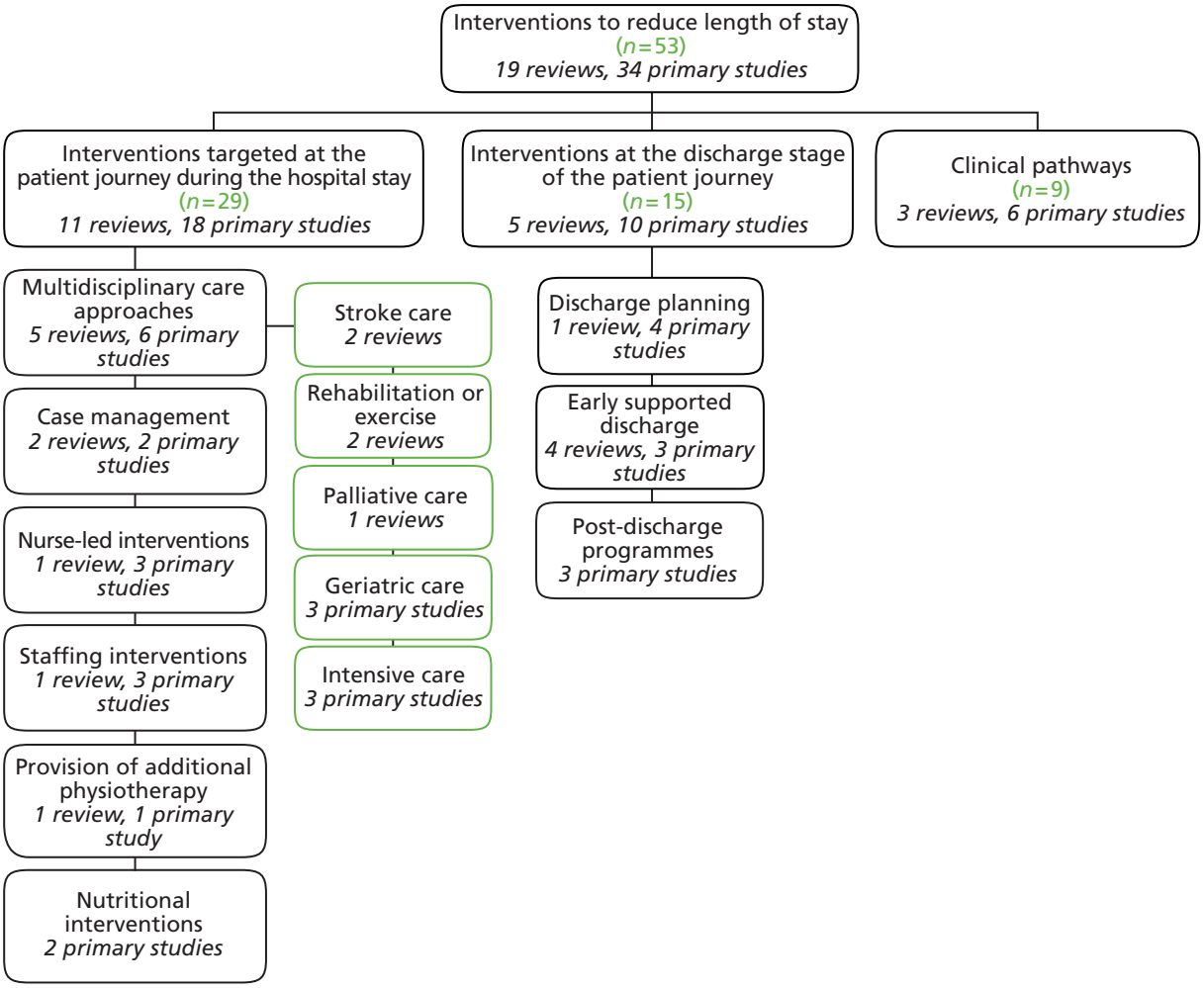

FIGURE 4 Categories of interventions and nature of studies included in the review.

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Hospital stay											
Multidisciplinary care											
Reviews											
Cassel *et al.* 2010[32]	N/A	N/R	N/R	Palliative care consultation services	Review	*n* = 12 studies (1204 patients); four quasi-experimental, six observational with retrospective cohort	Possible reduction in ICU subgroup		N/R	N/R	N/R
Foley *et al.* 2007[33]	N/A	2005	Stroke	Multidisciplinary stroke care	Meta-analysis	*n* = 14 studies (790 patients); 11 RCTs, three quasi-RCTs	Significant reduction: 2–6 days	Effect strongest for dedicated stroke wards	N/R	Significant reduction in mortality	N/R
Handoll *et al.* 2009[34]	N/A	2009	Hip fracture; patients aged 65+ years	Multidisciplinary rehabilitation	Systematic review	*n* = 13 studies (2498 patients); 12 RCTs, one quasi-RCT	Varied: reduction of 19 days to increase of 25.3 days		Readmissions: no effect	Non-significant reduction in mortality Change in functional status unclear	
de Morton *et al.* 2007[35]	N/A	2006	Acute exacerbation of medical condition; patients aged 65+ years	Multidisciplinary rehabilitation (exercise)	Systematic review	*n* = 9 studies (4223 patients); seven RCTs, two controlled trials	Significant reduction: 1.08 days	No effect for exercise-only interventions	Significant increase in proportion discharged home	Trend towards improved functional status	Possible saving for multidisciplinary exercise intervention
Stroke Unit Trialists, 2007[36]	N/A	2006	Stroke	Multidisciplinary stroke care	Systematic review	*n* = 31 studies (6936 patients); 31 RCTs	Significant reduction: 9.9 days	Effect strongest for combined acute and rehabilitation wards	N/R	Significant reduction in mortality	N/R

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Primary studies											
Deschodt *et al.* 2011[48]	Belgium	2007	Hip fracture; patients aged 65+ years	Multidisciplinary geriatric consultation	Non-RCT	$n = 171$ (intervention $n = 94$; control $n = 77$)	No effect	Usual care comparator included some intervention elements	No effect	No effect on mortality Significant reduction in dependency levels but not sustained	
Harari *et al.* 2007[49]	UK	2004; 2009	Acute medical; patients aged 70+ years	Geriatric interdisciplinary care (Older People Assessment and Liaison)	Before-and-after comparison	$n = 95$ (before $n = 49$; after $n = 46$)	Significant reduction: 4 days		Significant increase in proportion of transfers to elderly care	Significant increase in proportion of patients having problems identified and acted upon (e.g. falls, delirium, poor nutrition)	N/R
Lilly *et al.* 2011[50]	USA	2006–7	Adults aged 18+ years in ICU	Multidisciplinary care in ICU (tele-ICU clinical team)	Controlled before-and-after study	$n = 6290$ (pre-intervention $n = 1529$; postintervention $n = 4761$)	Significant reduction: 3.5 days		Significantly higher rates of adherence to best practice	Significant reduction in mortality Significant reduction in rates of preventable complications	N/R

continued

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital (*continued*)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Needham *et al.* 2010[51]	USA	2007	Acute respiratory failure, ICU	Multidisciplinary care in ICU	Before-and-after comparison	*n* = 57 (before *n* = 27; after *n* = 30)	Significant reduction: 3.1 days		Significantly higher rates of adherence to best practice	No effect on mortality Significant increase in proportion of days patients were not delirious	N/R
Rubin *et al.* 2011[52]	USA	2000–8	Adults aged 70+ years	Geriatric interdisciplinary care (Hospital Elder Life Program)	Before-and-after comparison	*n* = 27.196 (cumulative 2002–9)	Reduction among delirium patients of 1 day after 1 year and 2.8 days after 7 years	Statistical significance not reported		Fall in rate of delirium	N/R
Tobin and Santamaria 2008[53]	Australia	2003–6	Tracheotomy	Multidisciplinary care post ICU	Before-and-after comparison	*n* = 280	Significant reduction: 7.5 days (median length of stay)		N/R	Non-significant reduction in mortality	N/R
Hospital-based or -initiated case management											
Reviews											
Huntley *et al.* 2013[37]	N/A	2010	Unplanned admissions; patients aged 65+ years	Case management	Meta-analysis	*n* = 11 studies (4352 patients); 11 RCTs	Evidence from two RCTs • significant reduction: 9.2 days • significant reduction (not quantified)		Evidence on readmissions from two RCTs; significant reduction in one RCT but no change in the second RCT	N/R	Evidence from two RCTs; savings reported for both studies (to health insurer or total cost)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Kim and Soeken 2005[38]	N/A	2003	Heart failure, stroke, frail elderly patients	Case management	Meta-analysis	$n = 12$ studies (2876 patients); 12 RCTs	Significant reduction for heart failure, non-significant reduction for frail elderly, non-significant increase for stroke		Significant reduction in readmission rates for heart failure Reductions in readmissions in US-based studies only	N/R	N/R
Primary studies											
Curtis *et al.* 2006[54]	Australia	2002–3	Trauma patients aged 15+ years	Trauma case management	Before-and-after comparison	$n = 1541$ (before $n = 786$; after $n = 755$)	Non-significant reduction	Reduction was only significant for children aged 15 years	ICU unplanned admissions reduced Significant increase in proportion receiving allied health services Significant reduction in number of pathology tests	Significant reduction in some complications	N/R
Ekman *et al.* 2012[55]	Sweden	2008–10	CHF	Person-centred care	Before-and-after comparison	$n = 248$ (intervention $n = 125$; control $n = 123$)	Significant reduction: 2.5 days	Per protocol analysis only	No effect on readmissions	Significant improvement in activities of daily living at discharge	N/R

continued

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital (*continued*)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Nurse-led interventions											
Reviews											
Griffiths *et al.* 2007[23]	N/A	2007	Acute medical; patients aged 18+ years	Nursing-led inpatient units	Systematic review	*n* = 10 studies (1896 patients); eight RCTs, two quasi-RCTs	Significant increase: 7.4 days		Significant reduction in readmissions Significant reduction in likelihood of being discharged to institutional care	Non-significant increase in mortality Significant improvement in functional status and quality of life at discharge	Costs reported to be higher in UK studies but lower in US studies; not quantified
Primary studies											
Broers *et al.* 2009[56]	The Netherlands	2001–6	Stable postmyocardial infarction	Nurse-led intervention	Before-and-after comparison	*n* = 645 (before *n* = 500; after *n* = 145)	Significant reduction: 4.9 days		N/R	No effect on mortality	N/R
Flanagan *et al.* 2008[57]	UK	2001–6	Diabetes	Nurse-led inpatient diabetes team	Before-and-after comparison	N/A (all admissions)	Significant reduction: 0.6 days		Increase in readmissions not associated with intervention	N/R	N/R
Morris *et al.* 2008[58]	USA	2004–6	Acute respiratory failure; patients aged 18+ years, ICU	Nurse-led mobility team	Non-RCT	*n* = 330 (intervention *n* = 165; control *n* = 165)	Significant reduction: 3.3 days		No effect on readmissions	No effect on mortality Patients more likely to be out of bed earlier	Average cost/patient non-significantly lower in intervention

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Staffing interventions											
Reviews											
Butler *et al.* 2011[39]	N/A	2009	Hospital wide	Staffing models, staffing levels, skill mix, grade mix or qualification mix	Systematic review	$n = 15$ studies; eight RCTs, two controlled clinical trials, five controlled before-and-after studies	Significant reduction for addition of specialist nurse and team midwifery	Small number of studies permitted Limited pooling only	No effect on mortality of adding specialist nurse; significant reduction in one study of adding dietetic assistants	No effect on mortality of adding specialist nurse	Diverse trends, including cost neutral, no difference or increase
Primary studies											
Ahmad *et al.* 2011[59]	UK	2008–10	Medical wards	Twice-daily consultant ward rounds	Controlled before-and-after study	Four wards (treatment $n = 2$; control $n = 2$)	Significant reduction: 5 days	Same effect size between treatment group before and treatment group after the intervention, and between treatment group and control group after the intervention	No effect on readmission; significant increase in the number of discharges, significant decrease in bed occupancy	No effect on mortality	Cost neutral

continued

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital (*continued*)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Mains *et al.* 2009[60]	USA	1999–2006	Trauma; patients aged 18+ years	Trauma team composition	Before-and-after comparison	$n = 15,297$ (group 1 $n = 6365$; group 2 $n = 6599$; group 3 $n = 2333$)	Significant reduction in group 3 compared with group 1: 0.37 days (median length of stay)	Group 3 included core trauma panel plus physician assistants; group 1 independent general surgery attendings	N/R	Significant reduction in mortality in group 2 vs. group 1 and group 3 vs. group 2	N/R
Terceros *et al.* 2007[61]	USA	2004	General internal medicine; adults	Addition of pharmacy resident to internal medicine team	Non-RCT	$n = 80$ (intervention $n = 40$; control $n = 40$)	Significant reduction: 7.9 days		N/R	N/R	Estimated savings inferred from adherence to pharmacists' recommendations
Exercise interventions											
Reviews											
English and Hilier 2010[40]	N/A	2009	Stroke survivors	Circuit class therapy	Systematic review	$n = 6$ studies (292 patients); five RCTs, one non-RCT	Significant reduction: 19.7 days		Significantly improved mobility in one study	N/R	N/R

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Primary studies											
Nolan and Thomas 2008[62]	Australia	2006	Older people aged 70+ years	Functional maintenance programme	Non-RCT	$n = 220$ (intervention $n = 196$; control $n = 24$)	Significant reduction: 1.93 days		Greater average score improvement on Elderly Mobility Scale	Significant reduction in readmissions within 28 days	N/R
Provision of physiotherapy out of hours											
Reviews											
Brusco and Paratz 2006[41]	N/A	2005	Inpatients	Additional out-of-hours physiotherapy sessions	Systematic review	$n = 9$ studies (2013 patients); three RCTs, two quasi-RCTs, three historical cohort, one case–control	Non-significant reduction: 0.15 days	(Pooled data from two studies)	No significant effect on mobility at discharge	N/R	Evidence of cost savings in two studies (Australia, Canada) and increase in one (UK)
Primary studies											
Brusco *et al.* 2007[63]	Australia	2004–5	Inpatients aged 18+ years	Saturday physiotherapy sessions	RCT	$n = 262$ (intervention $n = 130$; control $n = 132$)	Non-significant reduction: 3.5 days ($p = 0.09$)		No evidence of difference in flexibility and strength at discharge	N/R	Potential savings inferred from observed reduction in length of stay

continued

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital (*continued*)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Nutritional interventions											
Primary studies											
Soguel *et al.* 2012[64]	Switzerland	2005–7	ICU	Nutrition protocol	Before-and-after comparison	*n* = 572 (group A baseline *n* = 198; group B intervention *n* = 179; group C intervention *n* = 195)	Non-significant reduction: 2.2 days		Observed increase in mortality not associated with intervention	Significant increase in days of nutrition therapy	N/R
Somanchi *et al.* 2011[65]	USA	2007–8	Inpatients	Nutrition screening and assessment	Controlled before-and-after study	*n* = 767 (intervention phase 1 *n* = 168, intervention phase 2 *n* = 196; control phase 1 *n* = 204, control phase 2 *n* = 199)	Significant reduction: 2.6 days	Effect stronger for the severely malnourished group	N/R	Increase in proportion of malnourished patients receiving nutrition consultation	Potential savings inferred from observed reduction in length of stay
Discharge											
Discharge planning											
Reviews											
Shepperd *et al.* 2010[31]	N/A	2009	Inpatients in all settings	Discharge planning	Systematic review and meta-analysis	*n* = 21 studies (7234 patients); 21 RCTs	Significant reduction: 0.91 days	(Pooled data from nine studies)	Significant reduction in 3-month readmission rates for elderly medical patients No significant difference in discharge destination	No significant difference in mortality	Evidence of cost savings from three studies; one study significant reduction in cost as a result of lower readmission rates

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Primary studies											
Finn *et al.* 2011[66]	USA	2008–9	Inpatients	Discharge facilitator (nurse practitioner) embedded in medical team	RCT	*n* = 872 (intervention *n* = 440; control *n* = 432)	No effect (median length of stay)		Evidence that discharge process was more efficient No effect on readmission rates	Significantly higher satisfaction with discharge process Greater awareness of postdischarge treatment plan	Likely to be higher, as cost of nurse practitioner not covered by gains in length of stay, etc.
Harris *et al.* 2007[67]	UK	Not reported	Postacute medical; patients aged 16+ years	Nursing-led inpatient unit	RCTs	*n* = 471 (intervention *n* = 257; control *n* = 214)	Significant increase: 4.7 days		No significant difference in readmission rates Significantly more likely to be discharged home	Significantly more functionally independent	N/R
Ornstein *et al.* 2011[68]	USA	2004–8	Patients discharged from programme	Nurse practitioner-led transitional care programme	Before-and-after comparison	*n* = 532	Weak evidence of increase	Significantly increased length of stay for readmissions	Significant reduction in readmission rates Positive feedback reported by all providers	N/R	Increased direct and indirect costs

continued

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital (*continued*)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Preen *et al.* 2005[69]	Australia	Not reported	Chronic cardiorespiratory	Hospital-co-ordinated discharge care plan	RCT	*n* = 189 (intervention *n* = 91; control *n* = 98)	Reduction from 12.4 days to 11.6 days	Statistical significance not reported	Significantly shorter period of time to make contact with GP	Significantly higher satisfaction with input into discharge process Significant increase in mental quality of life	N/R
(Early) supported discharge											
Reviews											
Fearon and Langhorne 2012[42]	N/A	2012	Stroke	Early supported discharge	Systematic review	*n* = 14 studies (1957 patients); 14 RCTs, 1 cluster RCT	Significant reduction: 7 days	Greater reduction for more severe stroke cases Greater reduction for hospital outreach team compared with community inreach team	No effect on readmission rates	Significant reduction in rate of death or dependency Significant improvement in activities of daily living	Varied results

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Larsen *et al.* 2006[43]	N/A	2005	Stroke	Early home-supported discharge	Systematic review	*n* = 7 studies (1108 patients); seven RCTs	Significant reduction: 10 days		Significant reduction in referrals to institution	Significant reduction in rate of death or referral to institution Significant reduction in incidences of poor outcomes	Evidence of cost savings based on estimates of cost of care
Phillips *et al.* 2004[44]	N/A	2003	Congestive heart failure; patients aged 55+ years	Discharge planning with supported discharge	Systematic review	*n* = 18 studies (3304 participants); 18 RCTs	No effect		Significantly lower readmission rates	Significantly lower mortality rates Significantly greater improvements in quality of life	Significant reduction in US setting, non-significant cost reductions in non-US settings
Teasell *et al.* 2003[45]	N/A	2002	Ischaemic or haemorrhagic cerebrovascular accident	Early supported discharge	Systematic review	*n* = 15 studies (1286 participants); 10 RCTs (reported in the 15 studies)	Significant reduction in six studies: range 2.6–15 days Increase in two studies: range 2 days (non-significant) to 12.5 days (significant)		N/R	No significant difference on functional outcomes	Trend in reduction of cost from three studies

continued

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital (*continued*)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Primary studies											
Bakerly *et al.* 2009[70]	UK	2003–4	Acute exacerbation of COPD	Acute assessment service	Before-and-after comparison	*n* = 225 (before *n* = 95; after *n* = 130)	Significant reduction: 7 days		No difference in readmission rates	N/R	Significant cost savings
Kastelik *et al.* 2012[71]	UK	2008	COPD	Supported discharge	Cross-sectional	*n* = 9716	Significant reduction: 3 days (median length of stay)		No significant difference in readmission rates Significantly better organisation and quality	N/R	
Lee and Lindstrom 2007[88]	Australia	2003–4	Community-acquired pneumonia	Early discharge guidelines	Before-and-after comparison	*n* = 225 (before *n* = 125; after *n* = 100)	Significant reduction: 0.74 days	No effect for most severe cases	Significantly higher rates of adherence to best practice	Significant reduction in mortality for most severe cases	Estimated cost savings
Postdischarge programmes											
Primary studies											
Barker *et al.* 2012[73]	Australia	Not reported	CHF; older patients	Pharmacist-directed postdischarge medication review	RCT	*n* = 120 (home medication *n* = 64; standard care *n* = 56)	Significant increase for all causes: 100 days; for heart failure: 128 days		No significant difference in CHF hospitalisation	No significant difference in mortality or health-related quality of life	N/R

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Pekmezaris *et al.* 2012[74]	USA	2007–9	Heart failure	Remote patient monitoring	RCT and matched cohort	RCT $n = 168$ (intervention $n = 83$; control $n = 85$) Matched cohort $n = 160$ (intervention n=80; control $n = 80$)	No apparent effect	Statistical significance not reported	Home care utilisation increased	N/R	Not relevant
Stewart *et al.* 2012[75]	Australia	2008–11	CHF	Outreach home-based or clinic-based management	RCT	$n = 280$ (home based $n = 143$; clinic based $n = 137$)	Significant reduction for unplanned hospitalisation: 2 days Non-significant reduction for planned hospitalisation: 4 days		No significant difference in unplanned hospitalisation	No significant difference in mortality	Cost of interventions similar Cost per day of follow-up significantly lower
Clinical care pathways *Reviews*											
Kul *et al.* 2012[46]	N/A	2010	CHF	Clinical care pathway	Systematic review	$n = 7$ studies (3690 participants); three RCTs, one interrupted time series, three controlled trials	Significant reduction: 1.89 days	(Pooled analysis of five studies)	Weak evidence for reduction in readmission rates	Weak evidence of reduction in mortality rates	Non-significant cost reduction

continued

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital (*continued*)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Lodewijckx *et al.* 2011[47]	N/A	2010	COPD	Clinical care pathway	Systematic review	*n* = 4 studies (475 participants, data missing for usual care from one study); one non-RCT, three before-and-after studies	Varied: 0.5-day increase to 4-day decrease		Decrease in 30-day readmission rates Increase in 1-year readmission rates Change in number of diagnostic tests performed (variable)	Significant decrease in mortality and number of complications	N/R
Rotter *et al.* 2010[22]	N/A	2008	Medical professionals and inpatients	Clinical care pathway	Systematic review	*n* = 27 studies (11,398 participants); 19 RCTs, two controlled clinical trials, four controlled before-and-after, studies two interrupted time series	15 single-pathway studies reported mixed results Significant reduction in three multifaceted interventions: 0.86 days	Not possible to pool results of single-pathway studies as too heterogeneous	No significant difference in readmission Significant improvement in documentation	Varied	

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Primary studies											
Corbelli *et al.* 2009[76]	USA	2002–4	Acute coronary syndrome	ACSETS	Before-and-after comparison	$n = 2949$ (before $n = 1240$; after $n = 1709$)	Significant reduction by 18%		Weak evidence for reduction in readmission rates Significantly greater adherence to guideline medication	Non-significant reduction in mortality for all conditions (significant for myocardial infarction group)	N/R
Panella *et al.* 2012[77]	Italy	2005–7	Acute ischaemic stroke patients	Clinical care pathway	Cluster RCT	$n = 448$ in 14 hospitals (clinical pathway $n = 229$ in seven hospitals; usual care $n = 219$ in seven hospitals)	Non-significant reduction: 0.9 days		Significantly higher rates of adherence to best practice	Significant reduction in 7-day mortality Significantly lower rates of adverse functional outcomes	N/R
Neuman *et al.* 2012[78]	USA	2009–11	Community-acquired pneumonia; patients aged < 18 years	Institutional clinical practice guidelines	Retrospective cohort study	$n = 19,710$ in 41 hospitals (intervention $n = 13$ hospitals; control $n = 28$ hospitals)	No effect		No difference in readmission rates Significantly higher rates of adherence to best practice	N/R	Cost of hospitalisation was non-significantly lower for intervention

continued

TABLE 1 Key characteristics and findings of studies assessing organisational interventions to reduce length of stay in hospital (*continued*)

Reference	Country (primary studies only)	Year data collected (reviews: final year searched)	Condition or population targeted	Intervention	Study design	Sample size (reviews: number of studies)	Effect on length of stay (mean length of stay, unless otherwise stated)[a]	Additional information on effect on length of stay or intervention	Other utilisation	Patient outcomes	Cost
Schouten *et al.* 2008[79]	The Netherlands	2002–4	Stroke patients	Multidisciplinary stroke team clinical care pathway	Before-and-after comparison	*n* = 4549 in 23 multidisciplinary service teams	Reduction: 5 days	Statistical significance not reported	Significant reduction in discharge delay Significantly higher rates of adherence to best practice	N/R	N/R
Verdu *et al.* 2009[80]	Spain	2002 and 2004	Deep venous thrombosis	Clinical care pathway	Before-and-after comparison	*n* = 90 (before *n* = 50; after *n* = 40)	Significant reduction: 2.06 days	Increase in the proportion of shorter hospital stays	N/R	Not relevant	Cost savings reported
Walker *et al.* 2012[81]	UK	2003–10	Infants aged up to 6 months with bronchiolitis	Clinical care pathway	Before-and-after comparison	*n* = 328	Significant reduction: 13 hours (median length of stay)	Infants prescribed antibiotics had a longer stay	No difference in readmission Reduction of bronchodilator prescription	N/R	N/R

ACSETS, Acute Coronary Syndrome Emergency Treatment Strategies; CHF, chronic heart failure; COPD, chronic obstructive pulmonary disease; GP, general practitioner; N/A, not applicable; N/R, not reported.

a Mean length of stay was the most commonly used measure of length of stay but note where other or additional measures were used. Please see *Appendix 4* for further detail on individual studies.

Interventions targeted at the patient journey during the hospital stay

We identified 11 reviews and 18 primary studies. Of the 11 reviews included, seven were classified as systematic reviews,[23,34–36,39–41] three as meta-analyses[33,37,38] and one review was not specified further.[32] Primary studies included one RCT,[63] four non-RCTs,[48,58,61,62] three controlled before-and-after studies,[50,59,65] and 10 before-and-after comparisons.[49,51–57,60,64] Of studies identified in this section, seven were set in the USA,[50–52,58,60,61,65] four in Australia,[53,54,62,63] three in the UK,[49,57,59] and one each in Belgium,[48] the Netherlands,[56] Sweden[55] and Switzerland.[64]

Eleven studies evaluated different forms of multidisciplinary care, including five reviews[32–36] and six primary studies.[48–53] Four studies assessed hospital-based or hospital-initiated case management; two were reviews[37,38] and two were primary studies.[54,55] Four studies assessed nurse-led interventions (one review[23] and three primary studies[56–58]); four reported on staffing interventions (one review,[39] three primary studies[59–61]); two studies assessed exercise interventions (one review,[40] one primary study[62]); two studies evaluated the provision of physiotherapy out of hours (one review,[41] one primary study[63]); and two primary studies examined nutritional interventions.[64,65]

This categorisation is not clear-cut and there is considerable overlap between approaches; for example, interventions may include a multidisciplinary team component but be led by nurses, in which case we would consider them as nurse-led interventions.[57] Conversely, case management approaches may involve multidisciplinary team involvement and are frequently, but not always, led by nurses; however, we consider case management as a distinct strategy.[37,38] In the following, we report on the main intervention category which we identified, separating evidence from systematic reviews and primary studies.

Multidisciplinary care approaches

Multidisciplinary care approaches evaluated in systematic reviews included organised stroke care,[33,36] multidisciplinary rehabilitation[34] or exercise,[35] and palliative care consultation services.[32] We further identified three primary studies of geriatric interdisciplinary care including geriatric consultation or assessments for older patients,[48,49,52] two studies of multidisciplinary care in an intensive care setting[50,51] and one study of a multidisciplinary approach aimed at patients with tracheostomy.[53]

Given the wide range of settings, the composition and specific functions of multidisciplinary teams varied, although common elements can be identified. These included individual patient assessment and review, which may include the development of a treatment or care plan; a co-ordinating function to optimise patient care and follow-up; and, frequently, education of other staff. Multidisciplinary teams typically included doctors and specialist nurses, and, frequently, physiotherapists and other allied health workers. The geriatric consultation intervention assessed by Deschodt *et al.*[48] also included a social worker.

Owing to the diversity of approaches employed, we report on subgroups of multidisciplinary care approaches.

Multidisciplinary care: stroke care

Reviews

Foley *et al.*[33] and the Stroke Unit Trialists' Collaboration[36] reviewed the evidence on stroke unit care compared with other forms of care. Stroke unit care is generally defined as a complex organisational intervention that comprises multidisciplinary teams providing a comprehensive package of care to stroke patients in hospital.[36] However, the term 'stroke unit' has been used to describe a wide range of service models and there is no universally accepted definition;[33] indeed, the Stroke Unit Trialists' Collaboration[36] suggested that stroke service organisation could be categorised according to a hierarchy, ranging from dedicated stroke wards involving a 'multidisciplinary team including specialist nursing staff based in a

discrete ward caring exclusively for stroke patients' to mobile stroke teams or multidisciplinary staff providing care in a variety of settings.

Length of stay The two reviews of stroke care identified in this report demonstrated a significant, if small, reduction in the length of stay of patients admitted to a stroke unit compared with usual care. The Stroke Unit Trialists' Collaboration[36] analysed 26 RCTs comparing organised stroke care with an alternative service. Within the 26 trials, mean (or median) length of stay ranged from eight to 162 days in the organised stroke care groups and from 10 to 129 days in the control groups. Pooled analysis identified a modest reduction in length of stay in the intervention group, with a SMD of –0.17 [95% confidence interval (CI) –0.32 to –0.03, $p = 0.02$], equating to a reduction of approximately 2–6 days. There was, however, substantial heterogeneity among the studies, partly due to different approaches used to calculate length of stay. The evidence that organised stroke care models reduce length of stay appeared to be strongest for dedicated stroke wards. The evidence for mixed rehabilitation wards or mobile stroke teams, which also use multidisciplinary teams but in different settings, was less robust, although the number of studies assessing these settings was small.

Foley *et al.*[33] carried out a meta-analysis of 14 randomised and quasi-RCTs which estimated the impact of different models of stroke care: acute stroke care unit ($n = 5$); combined acute and rehabilitation units ($n = 4$); and postacute rehabilitation ($n = 5$). Analyses of pooled data found an average overall reduction in length of stay of 9.9 days for all models combined compared with usual care (95% CI –16.6 to –3.1 days). For individual models, only the combined acute and rehabilitation units were associated with a significant reduction in length of stay [weighted mean difference (WMD) –14.4 days, 95% CI –27.1 to –1.7 days). Twelve of the 14 studies analysed by Foley *et al.*[33] were also included in the review by the Stroke Unit Trialists' Collaboration.[36] The latter considered a wider range of interventions such as mobile stroke units, which Foley *et al.*[33] excluded, and this might explain the differences in effect sizes between the two reviews.

Patient outcomes Given the overlap in trials reviewed, it is not surprising that both studies reported significant reduction in mortality among stroke survivors receiving care in organised stroke care service delivery models. The Stroke Unit Trialists' Collaboration[36] reported a significant reduction in the odds of death at the end of follow-up (12 months) of 0.86 (95% CI 0.73 to 0.92, $p = 0.001$) compared with patients receiving care in alternative service models, as well as in the odds of death or institutionalised care [odds ratio (OR) 0.81, $p < 0.0001$] and death or dependency (OR 0.79, $p < 0.0001$). Similarly, the analysis by Foley *et al.*[33] found a significant reduction in the odds of death and dependency among patients receiving organised stroke care compared with usual care, with the combined acute and rehabilitation units and postacute rehabilitation associated with a significant reduction in the odds of mortality (OR 0.71, 95% CI 0.54 to 0.94 and OR 0.60, 95% CI 0.44 to 0.81) after 1 year.[33]

Other outcomes and cost The two reviews considered here did not report on other outcomes or cost.

Primary studies

We did not identify primary studies in this subgroup.

Multidisciplinary rehabilitation

Reviews

Two reviews assessed multidisciplinary rehabilitation. Handoll *et al.*[34] evaluated rehabilitation programmes targeting older hip fracture patients. The programmes were delivered by a multidisciplinary team, supervised by a geriatrician, rehabilitation physician or clinician. The intervention could be delivered in the inpatient or ambulatory care settings; we focus on the findings of 11 of the 13 trials that were set in inpatient care. de Morton *et al.*[35] evaluated studies of exercise aimed at older hospitalised patients with an acute exacerbation of a medical condition. Of the nine trials analysed, six examined exercise that was

prescribed as a component of a multidisciplinary intervention and supervised by nursing or allied health staff, while three trials examined exercise-only interventions.

Length of stay The impact on length of stay of multidisciplinary rehabilitation delivered in inpatient settings to older hip fracture patients varied substantially among the 11 trials evaluated by Handoll *et al.*[34] Eight trials reported distribution data for length of stay. Within these trials, the mean difference in length of stay between intervention and control groups varied from a reduction of 19.0 days (95% CI –35.9 to –2.12 days) to an increase of 25.3 days (95% CI 17.5 to 33.1 days); owing to heterogeneity among studies as the authors did not attempt to combine data.

Pooled analysis by de Morton *et al.*[35] of data from six trials of multidisciplinary interventions including exercise targeting older hospitalised patients found a small but significant reduction in acute hospital length of stay compared with usual care, with a WMD of –1.08 days (95% CI –1.93 to –0.22 days). Conversely, pooled analysis of three exercise-only studies found no evidence of an effect, with a WMD of 0.01 days (95% CI –1.23 to 1.26 days).

Patient outcomes Neither review found evidence of adverse effects on patient outcomes such as mortality multidisciplinary rehabilitation or interventions that included exercise. There was some indication from the 11 studies that investigated multidisciplinary rehabilitation of a possible reduction in mortality at the end of scheduled follow-up in the intervention group, although the effect was not statistically significant [risk ratio (RR) 0.90, 95% CI 0.76 to 1.07].[34] Similarly, de Morton *et al.*[35] did not find that the intervention increased the risk of death, with a pooled estimate (RR) from six studies of 0.99 (95% CI 0.59 to 1.64).

There was also no clear effect of multidisciplinary interventions including exercise on functional status at discharge, with pooled data from three studies providing a RR of 1.05 (95% CI 0.97 to 1.15).[35] Two exercise-only interventions reported non-significant improvement in functional status at discharge, with a pooled effect estimate (SMD) of 0.17 (95% CI –5.75 to 0.71); however, there was high heterogeneity between studies. Overall, the review by Handoll *et al.*[34] was also unable to provide clear evidence of improvements in functional outcome among older hip fracture patients receiving multidisciplinary rehabilitation, although individual studies included in the review tended to report positive outcomes favouring the intervention; as measures of functional outcome varied substantially across studies it was not possible to pool data.

Other outcomes Handoll *et al.*[34] reported on hospital readmissions, finding no evidence of a significant effect of multidisciplinary rehabilitation (RR 0.99, 95% CI 0.82 to 1.19). Three trials with shorter lengths of stay in the intervention groups tended to have higher rates of readmissions in the intervention groups. In contrast, one trial showed fewer readmissions in the intervention group, where average length of stay was 25 days longer than in the control group.

de Morton *et al.*[35] found a significant effect of multidisciplinary interventions including exercise on discharge destination, with four out of six studies showing a significant increase in the proportion of patients discharged to home rather than geriatric rehabilitation, transfer to another acute hospital, sheltered living or nursing home care, compared with usual care, with a RR of 1.08 (95% CI 1.03 to 1.14). A similar trend was found for three exercise-only studies but this was not statistically significant (RR 1.15, 95% CI 0.80 to 1.66).

Cost Both reviews reported on cost. Handoll *et al.*[34] documented results from four trials of multidisciplinary rehabilitation in inpatient settings, but the findings varied. One trial set in Australia reported significantly reduced costs per recovered person in the intervention group, whereas one UK trial of geriatric–orthopaedic management of patients with fractured femoral necks did not observe substantial differences in the cost of care per patient; one study in Sweden and one in Finland each reported

increased cost for the intervention group. Overall, units of cost measures varied across countries, making it difficult to generalise.

de Morton *et al.*[35] were able to pool data from five multidisciplinary interventions including exercise. These indicated a significant cost saving compared with usual care, with a WMD in the cost of acute hospital stay of US$278.70 (95% CI –US$491.90 to –US$65.40).

Primary studies

We did not identify primary studies in this subgroup.

Palliative care consultation services

Reviews

We identified one systematic review evaluating palliative care consultation services compared with usual care.[32] The review did not provide a definition of the nature and scope of palliative care consultation services used to select studies; it also did not report on the definitions offered by studies included in the review.

Length of stay The review by Cassel *et al.*[32] found limited evidence of an impact of palliative care consultation services on length of stay compared with usual care. Twelve out of 16 analyses did not identify significant differences in length of stay between intervention and control groups (usual care). However, four analyses reported reduced length of stay in the intervention group, with a mean difference ranging from 2.9 to 5.1 fewer days. These interventions were set in intensive care, and the majority of patients (93%) in the analyses had died. The authors further noted that two of the four studies demonstrating reduced length of stay did not constitute palliative care consultations, with one examining ethics consultations in relation to non-beneficial life-sustaining treatment and the second concerned with improving family communication at the end of life. Therefore, overall the findings are difficult to interpret.

Patient outcomes, other outcomes, cost The review by Cassel *et al.*[32] reported on length of stay only.

Primary studies

We did not identify primary studies in this subgroup.

Geriatric interdisciplinary care

Reviews

We did not identify reviews in this subgroup.

Primary studies

Three primary studies examined forms of geriatric interdisciplinary care including geriatric consultation or assessments for older patients.[48,49,52]

Length of stay In a non-RCT of inpatient geriatric consultation for older patients with traumatic hip fracture in Belgium, Deschodt *et al.*[48] did not find evidence that the intervention significantly reduced length of stay. For patients transferred to a geriatric or rehabilitation unit, mean length of stay was 56.3 days [standard deviation (SD) 43.7 days], compared with 55.1 days (SD 25.5 days) for patients receiving usual care ($p = 0.90$). However, the authors noted that usual care at the tertiary hospital which formed the setting for the intervention was fairly comprehensive; for example, it routinely included physiotherapy. This suggests that the potential to benefit, in terms of length of stay, from added geriatric consultations in this specific setting might have been small.

Harari *et al.*[49] carried out a before-and-after study, with adjustment for baseline factors, of an Older People Assessment Liaison (OPAL) service targeted at acute medical inpatients aged 70 years and older in the UK. This found a reduction in length of stay of 4 days in the intervention group compared with before the intervention was implemented, with a mean length of stay of 10.4 days (SD 11.1 days, range 1–64 days) compared with 14.5 days (SD 12.2 days, range 1–44 days) ($p = 0.023$). Rubin *et al.*[52] in an observational study of the Hospital Elder Life Program (HELP) involving geriatric interdisciplinary care to prevent delirium among older hospitalised patients, observed a reduction in the mean length of stay among patients with and without delirium receiving HELP compared with the baseline, pre-HELP implementation. Mean length of stay among patients with delirium was 1 day shorter after 1 year and 2.8 days shorter after 7 years; for those without delirium, the respective figures were 0.1 days and 0.8 days. The authors did not report whether or not these reductions were statistically significant.

Patient outcomes Deschodt *et al.*,[48] in their analysis of inpatient geriatric consultation for older patients with traumatic hip fracture, did not find significant differences in mortality between intervention and usual groups at 6 weeks, 4 months or 12 months after surgery. However, patients in the intervention group were significantly less dependent 8 days after surgery ($p = 0.02$), although this effect was not sustained 6 weeks, 4 months or 12 months after surgery. Harari *et al.*[49] observed a significant impact of an intervention involving geriatric assessments (OPAL) on the proportion of patients in whom a problem identified by the assessment was addressed. These included falls (0% before OPAL, 92% post OPAL), functional dependency [RR for problem being addressed 0.39, 95% CI 0.01 to 0.28 (as stated by the authors)], delirium (0.16, 95% CI 0.0 to 0.94), depression (0.13, 95% CI 0.0 to 0.41) or poor nutrition (0.55, 95% CI 0.33 to 0.9). Rubin *et al.*[52] observed a 23% fall in the rate of delirium among older patients supported by HELP over the duration of the intervention, from 41% at baseline to 18% after 7 years.

Other outcomes Two studies of comprehensive geriatric assessment reported on readmissions[48,49] but these tended not to differ between intervention and control or pre-intervention period. The study by Harari *et al.*[49] observed a significant increase in the number of patients transferred to elderly care, from 30% pre OPAL to 65% post OPAL ($p < 0.001$), and the mean time from admission to transfer had decreased from 9.6 days (SD 8.3 days) to 2.5 days (SD 1.8 days) ($p < 0.001$).

Cost One study of HELP in a community teaching hospital in the USA estimated the financial return of the programme to be higher than US$7.3M per year during 2008, comprising cost savings from delirium prevention (US$2,031,440) and revenue generated from freeing up hospital beds because of a reduced length of stay for patients with and without delirium (estimated at US$5,337,109).[52] The analyses did not use a controlled design, making it difficult to draw conclusions about the extent to which savings might have accrued in the absence of the programme.

Multidisciplinary intensive care

Reviews

We did not identify reviews in this subgroup.

Primary studies

Two primary studies examined multidisciplinary care in an intensive care setting,[50,51] while one used a multidisciplinary approach aimed at patients with tracheostomy post intensive care.[53]

Length of stay Using a prospective, unblinded, stepped-wedge design, Lilly *et al.*[50] evaluated the impact of a tele-ICU intervention which involved an off-site team of clinicians reviewing the care of individual patients, care planning and auditing the care of adult ICU patients. This study found mean length of hospital stay to be significantly shorter in the intervention group, at 9.8 days (SD 10.0 days) compared with 13.3 days (SD 17.1 days) in the pre-intervention group ($p < 0.001$). Likewise, examining the impact of a multidisciplinary team in an ICU targeting patients with acute respiratory failure, Needham *et al.*[51] found mean length of hospital stay to be reduced by 3.1 days (range 0.3–5.9 days) compared with before the

implementation of the intervention, from 17.2 to 14.1 days ($p = 0.03$). In a before-and-after study of an intensivist-led multidisciplinary team tasked with reviewing and preparing care plans for patients discharged from ICU with a tracheostomy, Tobin and Santamaria[53] found median length of hospital stay to have decreased over the study period, from 42 days (range 29–73 days) in 2003 to 34.5 days (range 26–53 days) in 2006 ($p = 0.06$).

Patient outcomes None of the studies reviewed here reported negative patient outcomes associated with the intervention. Lilly *et al.*,[50] in their evaluation of a tele-ICU intervention involving an off-site team, observed a significant reduction in mortality associated with the intervention, with an adjusted OR of 0.40 (95% CI 0.31 to 0.52). There were also lower rates of preventable complications (OR for ventilator-associated pneumonia 0.15, 95% CI 0.09 to 0.23; OR for catheter-related bloodstream infection 0.50, 95% CI 0.27 to 0.93). Needham *et al.*[51] did not find significant changes in in-hospital mortality among patients with acute respiratory failure receiving care from a multidisciplinary team in ICU compared with before the implementation of the intervention (21% vs. 23.3%; $p = 0.55$). There was, however, a significant increase in the proportion of days when patients were alert (29% vs. 66% of ICU days; $p < 0.001$) and not delirious (21% vs. 53%; $p = 0.003$) compared with the pre-intervention period. A fall in mortality observed by Tobin and Santamaria,[53] in their assessment of an intensivist-led multidisciplinary team tasked with reviewing and preparing care plans for patients discharged from ICU with a tracheostomy, was not statistically significant ($p = 0.1$).

Other outcomes In their assessment of a tele-ICU intervention, Lilly *et al.*[50] found the intervention to be associated with higher rates of best clinical practice adherence for the prevention of deep-vein thrombosis (OR 15.4, 95% CI 11.3 to 21.1), stress ulcers (OR 4.57, 95% CI 3.91 to 5.77) and ventilator-associated pneumonia (OR 2.20, 95% CI 1.79 to 2.70) compared with usual care. Improvements in best practice were also observed in the before-and-after study by Needham *et al.*[51] of patients with acute respiratory failure receiving care from a multidisciplinary team in ICU. These authors reported a lower proportion of ICU patients receiving benzodiazepines (96% vs. 73%; $p = 0.03$) and narcotics (96% vs. 77%; $p = 0.05$), alongside lower median doses of benzodiazepines and morphine.

Cost The three studies considered here did not report on cost.

Case management

Reviews

Two systematic reviews evaluated case management during hospital stay.[37,38] Components of case management tend to vary with the setting within which it is delivered. Elements of hospital-based case management include assessment, education, collaboration, discharge planning, linkage and monitoring, and it involves collaborative multidisciplinary practice, frequently led by nurse case managers. Kim and Soeken[38] reviewed 12 RCTs reporting on the effect of hospital-based case management for patients with heart failure or stroke, or frail older people. The review by Huntley *et al.*[37] sought to assess the impact of case management on unplanned hospital admissions, considering a range of interventions including those initiated and delivered in the community. Among the 11 RCTs considered by Huntley *et al.*,[37] six examined a case management intervention that was initiated within the hospital or on discharge. We focus here on two RCTs reviewed by Huntley *et al.*,[37] which reported on case management initiated in hospital and provided data on length of stay.[83,84]

Length of stay

Kim and Soeken[38] did not find a statistically significant effect of hospital-based case management on length of stay. Analyses of pooled data from 10 trials showed an average weighted effect size (difference between group means) of 0.094 (95% CI –0.032 to 0.220). However, the effect varied by subgroup, and was statistically significant for patients with heart failure (effect size 0.24, 95% CI 0.012 to 0.470), with a non-significant reduction seen for frail older people (effect size 0.13, 95% CI –0.073 to 0.324). Conversely, there was a non-significant increase in length of stay for stroke patients (effect size –0.23,

95% CI –0.542 to 0.089). The authors did not offer an explanation for this last observation. However, they noted that, in general, variation in effects might be explained by differences in the case management intervention, or how usual care was defined in the control group; usual care possibly included elements of case management itself. Indeed, one of the two trials that assessed case management for stroke patients in the UK compared the intervention (an integrated clinical care pathway) with a control group of stroke patients receiving conventional multidisciplinary care; the potential for an added benefit might therefore have been small.[85]

Of the two RCTs of hospital-initiated case management reviewed by Huntley *et al.*,[37] one reported a significant reduction in length of hospital stay in the intervention group of 9.2 days at 12 months.[83] The second RCT, although also reporting a reduction, did not report whether or not the reduction was statistically significant.[84] However, the latter study was also reviewed by Kim and Soeken,[38] whose reanalysis of the data found a statistically significant SMD of 0.393 (95% CI 0.036 to 0.751).

Patient outcomes

The two reviews considered here did not report on patient outcomes.

Other outcomes

There was an overall reduction in the odds of readmission among 10 trials of hospital-based case management analysed by Kim and Soeken,[38] with an OR of 0.87 (95% CI 0.69 to 1.04); this reduction was equivalent to a 6% decrease in the readmission rate. Again the effect was stronger for the case management for patients with heart failure (OR 0.75, 95% CI 0.45 to 1.05), but small for frail older people; data for stroke were not reported. Of the two studies of hospital-initiated case management targeted at older people, reviewed by Huntley *et al.*,[37] one showed a significant decrease in hospital readmissions at 6 months compared with usual care (relative rate 0.45, 95% CI 0.29 to 0.69) whereas the other did not find a difference in hospital readmissions at 12 months. The interventions differed, however, with the former involving an intensive advanced practitioner nurse intervention while the latter used a team of specialised geriatric health professionals who provided case management.

The analyses presented by Kim and Soeken[38] further reported a strong country effect, with the seven studies conducted in the USA showing a consistent reduction in readmission rates (OR 0.79, 95% CI 0.59 to 0.99) but not the three conducted elsewhere. These findings point to the potential impact of health-system factors on the effectiveness of interventions at organisational level, indicating that interventions conducted in the USA were effective in reducing readmission rate.

Cost

Of the two reviews presented here, only Huntley *et al.*[37] commented on cost, citing evidence from two trials of hospital-initiated case management which reported cost savings associated with the intervention. One study, set in the USA, found a significant reduction in per-patient imputed reimbursement in the intervention group (US$3630 vs. US$6661);[84] one other study in Germany reported a lower total cost in the intervention group of US$4000 per person per year.[83]

Primary studies

We identified two primary studies that evaluated case management in a hospital setting.[54,55] Ekman *et al.*[55] used a controlled before-and-after design to evaluate a person-centred care and treatment programme for patients with chronic heart failure, which was developed by nurses, physicians, physiotherapists, occupational therapists and representatives of a local patient association in Sweden. Although not classified as case management by the study authors, the description of the intervention included many of the elements that Kim and Soeken[38] considered as common to hospital-based case management approaches as described above. Curtis *et al.*[54] carried out a retrospective cohort study of a trauma case management intervention in an Australian hospital. The intervention involved a case manager (a trauma nurse) to oversee the patient's entire journey, improve quality of care and conserve hospital resources.

Length of stay

Applying an intention-to-treat analysis, Ekman *et al.*[55] did not identify a significant impact of the intervention on length of hospital stay; however, when considering those receiving the intervention as planned (i.e. not withdrawing at any point during the hospital stay), the authors observed a significantly reduced length of stay, by 2.5 days compared with the control group. Conversely, Curtis *et al.*,[54] in their evaluation of trauma case management, found a non-significant increase in median length of hospital stay in the intervention group compared with the control group (5 days vs. 4 days; $p = 0.423$). However, findings differed by patient subgroup, with significant reductions observed for those aged 45–64 years (7 days in the intervention group compared with 5 days in the control group; $p = 0.353$), whereas for those aged 65 years and older there was a significant increase in length of stay (10 days vs. 9 days; $p = 0.243$).

Patient outcomes

The person-centred care and treatment programme for patients with chronic heart failure was shown to be associated with a significant improvement in activities of daily living at discharge in the intervention group compared with usual care in the intention-to-treat ($p = 0.07$) and per-protocol analysis ($p = 0.04$).[55] Health-related quality of life did not differ significantly between the two groups. Curtis *et al.*[54] investigated complications for six clinical outcomes, finding a decrease in the occurrence of deep-vein thrombosis in the intervention group ($n = 1$ vs. $n = 7$; $p < 0.038$) and a trend towards decreased patient morbidity.

Other outcomes

Ekman *et al.*,[55] in their analysis of a person-centred care and treatment programme for patients with chronic heart failure, reported a reduction in readmissions within 6 months in the intervention group compared with the control group (49% vs. 59%), but this was not statistically significant ($p = 0.16$). Time to first readmission did not differ. The study by Curtis *et al.*[54] of trauma case management reported a decline in unplanned admissions to intensive care, but this was not statistically significant in the intervention group compared with before the intervention was implemented (6 cases vs. 14 cases). There was a significant increase in the number of patients receiving allied health services, with 55% in the intervention group receiving physiotherapy compared with 45% before the intervention ($p < 0.0001$).

Cost

Ekman *et al.*[55] and Curtis *et al.*[54] did not report on cost.

Nurse-led interventions

Reviews

Griffiths *et al.*[23] presented a systematic review of evidence of the efficacy of nursing-led inpatient units in preparing patients for discharge from hospital. Nursing-led inpatient units describe an intervention that is located in settings other than the patient's home, with a nurse as the identified leader of the clinical team, or with the authority to admit or discharge patients. The intervention substitutes for an inpatient stay in an acute care facility with usual modes of care organisation. Nursing-led inpatient units are among a range of services considered to manage more effectively the transition between hospital and home for patients with extended recovery times.

Length of stay

Nine of the 10 studies reviewed by Griffiths *et al.*[23] reported on length of inpatient stay, with the majority reporting an increase compared with usual inpatient care. Pooled analyses showed that length of stay to first discharge from hospital was significantly increased for patients cared for in nursing-led inpatient units, with a WMD of 7.4 days (95% CI 2.9 to 11.9 days). Analysis of four studies considered as more robust confirmed these findings (13.4 days, 95% CI 8.5 to 18.3 days).

Patient outcomes

There was no evidence of a statistically significant effect on inpatient mortality among patients cared for in nursing-led inpatient units compared with general inpatient care in seven studies, with an OR of 1.10 (95% CI 0.56 to 2.16); however, analysis of higher-quality studies (four out of seven) pointed to a non-significant increase in inpatient mortality (OR 1.52, 95% CI 0.86 to 2.68).[23] Patients discharged from nursing-led inpatient units were more likely to have improved functional status compared with those discharged from general inpatient care (six studies), with a SMD of 0.35 (95% CI 0.16 to 0.53). There was also evidence of significantly improved quality of life or general health status in the intervention group [SMD 0.28, 95% CI 0.09 to 0.48 (five studies)], as well as improved psychological well-being [SMD 0.36, 95% CI –0.03 to 0.74 (three studies)] and patient satisfaction [SMD 0.22, 95% CI –0.11 to 0.48 (three studies)], although the last two findings did not reach statistical significance.

Other outcomes

Five of 10 studies reviewed by Griffiths *et al.*[23] reported on 30-day readmissions, with evidence of a significant reduction among patients in nursing-led inpatient units (OR 0.52, 95% CI 0.34 to 0.80); this finding became non-significant when considering stronger studies only (three out of five), although the size of the effect remained considerable (OR 0.63, 95% CI 0.36 to 1.12). The odds of being discharged to institutional care were also reduced among patients in nursing-led inpatient units [OR 0.44, 95% CI 0.22 to 0.89 (seven studies)], although pooled analysis of the three stronger studies reduced the effect (OR 0.88, 95% CI 0.54 to 1.43).

Cost

Seven of the 10 studies reviewed by Griffiths *et al.*[23] reported data on cost, with costs of care for patients in nursing-led inpatient units estimated to be higher than usual care for UK studies but lower for studies conducted in the USA. However, the review did not report numerical data.

Primary studies

Three primary studies assessed nurse-led interventions. These comprised an intervention targeted at patients with stable postmyocardial infarction admitted to a coronary care unit in a hospital in the Netherlands, involving a nurse practitioner tasked with patient education and training, care co-ordination and rehabilitation support;[56] a nurse-led inpatient diabetes management team targeting all patients diagnosed with diabetes in a large teaching hospital in the UK;[57] and a nurse-led mobility team tasked with the implementation of a mobility protocol in a medical intensive care unit in one hospital in the USA.[58] Although targeting different patient groups, the nurse-led interventions reviewed here all comprised teams of (specialist) nurses and allied health workers such as physiotherapists, with some involvement of consultants in a supervisory or supportive role.

Length of stay

In a before-and-after study of a nurse-led intervention for patients with stable, non-high-risk postmyocardial infarction, Broers *et al.*[56] found that patients in the intervention phase had a significantly shorter length of stay compared with patients in the pilot phase receiving usual care [6.2 days (SD 6 days) vs. 11.1 days (SD 10 days); $p < 0.001$]. In their observational analysis of a nurse-led diabetes team, Flanagan *et al.*[57] . . . found a significant reduction in length of stay for emergency admissions . . . and for medical admissions but not for elective admissions or surgical admissions also reported a significant, if small, reduction in length of stay of 0.6 days [pre-intervention mean 8.3 days (SD 0.18 days), postintervention mean 7.7 days (SD 0.10 days); $p = 0.002$] following the introduction of the team. This study also found a significant reduction in length of stay for emergency admissions [9.7 days (SD 0.23 days) vs. 9.2 days (SD 0.20 days); $p < 0.001$] and for medical admissions [9.2 days (SD 0.24 days) vs. 8.4 days (SD 0.20 days); $p < 0.001$] but not for elective admissions or surgical admissions. Morris *et al.*[58] conducted a prospective cohort study of intensive care patients receiving care from a nurse-led mobility team tasked with the implementation of a mobility protocol. They observed that adjusted length of hospital stay was shorter for protocol patients compared with patients receiving usual care, at 11.2 days (95% CI 9.7 to 12.8 days) versus 14.5 days (95% CI 12.7 to 16.7 days) ($p = 0.006$).

Patient outcomes

Two studies reported on mortality, finding no evidence of an adverse effect of the intervention. For example, the assessment of a nurse-led intervention for patients with stable, non-high-risk postmyocardial infarction did not observe a statistical difference between intervention and control groups in the numbers of deaths (0/500 vs. 2/101) or reinfarction events (4/500 vs. 1/101) at 30 days after discharge ($p > 0.5$).[56] Similarly, Morris *et al.*[58] did not detect a significant difference in in-hospital mortality between ICU patients receiving care according to a mobility protocol and those receiving usual care, at 12.1% (20/165) and 18.2% (30/165), respectively ($p = 0.125$). However, there was a significant improvement in that protocol patients were out of bed earlier than usual care patients, at 5.0 days (95% CI 4.3 to 5.9 days) versus 11.3 days (95% CI 9.6 to 13.4 days) ($p < 0.001$).

Other outcomes

Two studies reported on readmission rates associated with a nurse-led intervention, but did not observe statistically significant effects. For example, Flanagan *et al.*,[57] reporting on the outcomes of a nurse-led diabetes team, found an increase in diabetes admissions over time but noted that this was not associated with the intervention. Morris *et al.*[58] reported that there were no statistically significant differences in the numbers of patients readmitted to intensive care within the same hospital stay between patients receiving care according to a mobility protocol and those in the control group (8.5% vs. 9.7%; $p = 0.702$).

Cost

One analysis of a nurse-led mobility team tasked with the implementation of a mobility protocol in intensive care reported on cost.[58] Total and average per-patient costs were reported to be lower for the intervention group, with direct inpatient costs inclusive of mobility team salaries estimated at US$6,805,082, compared with the usual care group at US$7,309,871. The average cost per patient was also lower in the intervention group, at US$41,142 compared with US$44,302 for the usual care group, but this difference was not significant ($p = 0.262$).

Staffing interventions

Reviews

We identified one systematic review of staffing models. Butler *et al.*[39] reviewed 15 studies of nurse staffing interventions, considering a wide range of staffing models, staffing levels, skill mix, grade mix or qualification mix. Of the studies reviewed, eight examined the addition of a specialist nurse post to staffing, with the role typically focusing on the needs of specific groups of patients and involving care co-ordination, such as arranging tests and procedures, assessing patients and care planning, and educating patients, nurses and other staff. Two studies assessed an increase in the proportion of support staff, one evaluated new rosters or shift patterns, two studies compared the introduction of primary nursing with the usual model of nursing and one study assessed team midwifery compared with standard care.

Length of stay

Six of the 15 studies assessed by Butler *et al.*[39] evaluated the impact of adding a specialist nurse on patient length of stay. Findings varied, with three studies reporting a reduction in length of stay while three studies did not. It was only possible to pool data for two out of the six studies. This found a significant reduction in length of stay compared with standard staffing (mean difference –1.35 days, 95% CI –1.92 to –0.78 days). A significant reduction in length of stay was also reported in one study that examined introducing team midwifery compared with standard midwifery care, with a mean difference of –0.30 days (95% CI –0.54 to –0.06 days). One study of adding dietary assistants to nurse staffing did not identify an impact on length of stay in the intervention group compared with standard staffing.

Patient outcomes

There was little robust evidence of an impact on patient outcomes of adding a specialist nursing post to staffing, with reanalysis of one study finding no effect on in-hospital mortality in the intervention group (RR 0.96, 95% CI 0.59 to 1.56).[39] Among studies examining the impact of increasing the proportion of support staff, one (of two) assessed patient mortality and reported that additional support from dietetic assistants was associated with a reduction in in-hospital mortality and death at 4 months, with RRs of 0.56 (95% CI 0.29 to 1.09) and 0.57 (95% CI 0.34 to 0.95), respectively.

There was evidence from one study of the impact of a specialist nursing post on pressure ulcer rates, with a statistically significant improvement in the incidence of pressure ulcers ($p = 0.001$).

Other outcomes

Four of the 15 studies reviewed by Butler *et al.*[39] examined the impact of introducing specialist nurses on readmission rates, with a pooled analysis of three studies finding no evidence of effect (RR 1.15, 95% CI 0.88 to 1.52). Similarly, one study, which also examined the impact of adding a specialist nurse post on ED attendance within 30 days of admission, did not find evidence of a significant effect (RR 1.14, 95% CI 0.79 to 1.62).

Cost

One study of introducing specialist nurses reported savings accruing from a reduction in patient length of stay to offset the costs of employing the additional nurse specialist, but costs were not reported.[39] One other study of the introduction of advanced practice nurses did not identify significant differences between the intervention and standard staffing in terms of costs. One study of increasing nursing assistive support reported an increase in unit staff costs to be associated with patient care, but was unable to provide an explanation for the observed increase.

Primary studies

Three studies assessed different forms of staffing interventions. Ahmad *et al.*[59] evaluated the impact of increasing consultants' input through twice-daily ward rounds in two medical wards in a university teaching hospital in the UK. Mains *et al.*[60] examined different compositions of teams within a trauma centre in the USA, while Terceros *et al.*[61] assessed the impact of involving a pharmacy resident in internal medicine team ward rounds, tasked with intervening and making recommendations to prevent adverse drug events and prescribing errors in one tertiary teaching hospital in the USA.

Length of stay

Using a before-and-after design with between-group comparison, Ahmad *et al.*[59] found a significant decrease in the average length of stay of about 5 days in the intervention wards compared with before the intervention was implemented ($p < 0.01$) and compared with control wards ($p < 0.01$). This corresponded to a reduction of approximately 50% in the average length of stay in the intervention wards.

The before-and-after study by Mains *et al.*[60] found that adjusted mean and median lengths of stay were not significantly different for the group involving a trauma panel with in-house trauma surgeons, but without residents, compared with a group comprising independent general surgery attendings with partial surgical resident coverage (4.69 days vs. 4.62 days; $p = 0.59$). However, there was a significant reduction in mean length of hospital stay when comparing a third grouping, which included a core trauma panel plus physician assistants, with the trauma panel without residents (4.32 days vs. 4.69 days; $p = 0.05$); this also applied to median adjusted length of hospital stay. Overall, findings need to be interpreted with caution as the study design did not include a parallel control group. The authors further highlighted that patient populations cared for by the different trauma groupings differed, so introducing bias.

Terceros *et al.*[61] carried out a matched-pairs controlled study involving a pharmacy resident in medical team ward rounds. They found that the mean length of stay in the intervention group was significantly shorter than in the usual care group, at 7.9 days (SD 7.2 days) versus 10.9 days (SD 7.9 days) ($p = 0.008$).

Patient outcomes

Ahmad *et al.*[59] reported no significant changes in mortality rates following the implementation of twice-daily consultant rounds. The study of trauma centre teams by Mains *et al.*[60] found that overall mortality (over the study period) was significantly lower for the group involving a trauma panel without residents than for that comprising independent general surgery attendings, at 3.12% versus 3.82% ($p = 0.05$) and with an OR of 0.81 (95% CI 0.66 to 0.99). Furthermore, mortality was also significantly lower in the group of core trauma panel plus physician assistants than in the group without residents, at 2.80% versus 3.76% ($p = 0.05$), with an OR of 0.74 (95% CI 0.55 to 0.99).

Other outcomes

Ahmad *et al.*[59] found a significant increase in the number of discharges, which almost doubled ($p < 0.01$) in the intervention ward compared with before the intervention was implemented, and compared with control wards. Similarly, bed occupancy was significantly reduced in the intervention ward, compared with before the intervention was implemented [87.5% (SD 4%) vs. 95.3% (SD 2.1%); $p < 0.01$] and compared with two control wards [95.1% (SD 1.6%) vs. 91.5% (SD 4%); $p < 0.05$]. There was no significant change in the readmission rate. Mains *et al.*[60] and Terceros *et al.*[61] did not report on other outcomes.

Cost

Two studies reported on cost. Ahmad *et al.*[59] found the twice-daily consultant round intervention to be cost neutral as it did not increase the working hours or sessions of the consultants, and did not require additional resources. Terceros *et al.*[61] in their assessment of adding a pharmacy resident to medical team ward rounds, estimated that 64 (25.6%) of the 250 interventions made by the resident and acted upon by the team had resulted in direct cost savings of US$4155. The total cost of drugs initiated by the pharmacy resident was US$2068, which the authors translated into a net drug-related cost saving associated with the intervention of US$2087. It is important to note that the study was small (total number of patients = 80), with a short intervention duration (4 weeks), a patient population limited to the internal medicine unit and a setting in a tertiary care teaching hospital, which all limit the generalisability of findings to other settings.

Exercise interventions

Reviews

English and Hillier[40] reviewed the evidence on providing circuit class therapy to stroke survivors. Two of the six studies included in the review examined the provision of circuit class therapy to stroke patients receiving inpatient rehabilitation, while the remainder was targeted at stroke survivors living in the community. We focus here on the two studies of inpatient rehabilitation, one RCT and one non-randomised controlled study, both set in Australia.[86,87]

Length of stay

The provision of circuit class therapy within inpatient rehabilitation for stroke patients was found to be associated with a significant reduction in length of stay, with a mean difference of –19.7 days (95% CI –35.43 to –4.04 days).[40] This finding held when one non-randomised trial was excluded from the analysis (mean difference –33.0 days, 95% CI –64.11 to –1.89 days).

Patient outcomes

The provision of circuit class therapy within inpatient rehabilitation for stroke patients was associated with selected indicators of significantly improved mobility in one study reviewed by English and Hillier,[40] including walking capacity as measured by the 'six-minute walk test' (mean difference 116.0 m, 95% CI 35.07 to 196.93 m), and balance as measured by the 'Timed Up and Go test' (mean difference –7.6 seconds, 95% CI –15.14 to –0.06 seconds). The second study also reported on improved balance measures in the intervention group but these were not significant.

Other outcomes and cost

English and Hillier[40] did not report on other outcomes or on cost.

Primary studies

Nolan and Thomas[62] carried out an observational study of an exercise intervention, targeted at older people aged 70 years and over. Implemented in one metropolitan acute hospital in Australia, it involved an individually tailored functional maintenance programme, prescribed and progressed by a physiotherapist and supervised by an allied health assistant.

Length of stay

Analyses found that the mean length of stay for patients receiving the intervention [10.01 days (SD 7.88 days)] was 1.93 days shorter than for those receiving usual care [mean 11.94 days (SD 8.36 days)], equating to a 15.7% reduction in average length of stay.[62] Adjusted for age and sex, the odds of a shorter length of stay in the intervention group was 0.412 (95% CI 0.122 to 1.389).

Patient outcomes

The study reported evidence of improvements in scores on the Elderly Mobility Scale in both groups during hospitalisation, with a greater average score improvement for the intervention group compared with the control group; the authors did not comment on whether or not this difference was statistically significant.[62]

Other outcomes

There were 8% fewer readmissions within 28 days in the intervention group ($p = 0.153$), as well as a significant decrease in the likelihood of referral for nursing home admission (OR 0.228, 95% CI 0.088 to 0.587; $p = 0.002$) and approval for admission to residential care (OR 0.307, 95% CI 0.115 to 0.822; $p = 0.019$).[62]

Cost

Nolan and Thomas[62] did not report on cost.

Provision of additional physiotherapy

Reviews

Brusco and Paratz[41] conducted a systematic review of nine studies to evaluate the impact of the provision of physiotherapy to hospital inpatients out of business hours as a potential means to influence patient and hospital outcomes. Business hours were defined as Monday to Friday, 09.00 to 17.00. Seven of the nine studies reviewed by Brusco and Paratz[41] examined the effect of weekend physiotherapy; one study examined the effectiveness of overnight physiotherapy compared with day provision only and one assessed the effectiveness of additional evening provision of physiotherapy.

Length of stay

Four of the nine studies reviewed by Brusco and Paratz[41] reported a significant reduction in length of stay, while five studies did not detect an effect for the provision of out-of-hours physiotherapy. Effect sizes ranged from –6.16 (95% CI –6.93 to –5.32) to 0.19 (95% CI –0.53 to 0.91), and the largest effect was observed for a 7-days-versus-5-days of physiotherapy treatment following total hip and knee arthroplasty.

Analysis of pooled data from three studies suggested a non-significant reduction in length of stay in the intervention group, with a WMD of –0.15 days (95% CI –0.37 to 0.07 days).

Patient outcomes

Three studies reviewed by Brusco and Paratz[41] reported on discharge mobility status in relation to the provision of out-of-hours physiotherapy; there were no significant effects observed for the intervention group and the authors were unable to calculate effect sizes because the reporting of results in individual studies was considered insufficient. Two studies documented patient preferences, with one reporting that the majority (82%) of patients preferred 6 days of physiotherapy over 7 days. One study reported that preference for weekend treatment varied according to the frequency of treatments received, with 61% of high-frequency patients (two sessions, Monday to Sunday) preferring fewer treatments at the weekend, whereas 79% of patients in the low-frequency group (one session, Monday to Friday) would have preferred weekend treatment.

Other outcomes

Brusco and Paratz[41] did not report on other outcomes.

Cost

The review by Brusco and Paratz[41] of the provision of out-of-hours physiotherapy documented evidence of cost from three studies. One study set in Australia reported a saving in per-patient and day costs of overnight physiotherapy in intensive care or the acute spinal injury unit, and overall saving to the hospital, of AUS$59,990 for seven patients. One study set in Canada found weekend physiotherapy to be associated with a cost saving to the health fund of CA$47,700 for 84 patients. Conversely, the provision of a weekend rheumatology service in the UK was associated with an increase in hospital costs of £3860 for 136 patients.

Primary studies

Subsequent to their 2006 systematic review[41] of the impact of providing additional physiotherapy out of hours described above, Brusco *et al.*[63] using a RCT design, examined the impact of offering an additional Saturday session of physiotherapy for adult inpatients undergoing rehabilitation in one hospital in Australia.

Length of stay

The study identified the mean total length of stay to be 3.2 days lower in the intervention group than in the control group, at 21.2 days compared with 24.4 days ($p = 0.09$).[63]

Patient outcomes

Brusco *et al.*[63] did not find evidence of a statistically significant difference in flexibility and strength at discharge between intervention and control groups.

Other outcomes

Brusco *et al.*[63] did not report on other outcomes.

Cost

When applying the observed reduction in length of stay of 3 days to an average 30-bed rehabilitation unit that accommodates 448 rehabilitation patients over 12 months, the authors estimated an annual cost saving to the hospital of AUS$626,304, or an additional 68 rehabilitation inpatient admissions per year.[63]

Nutritional interventions

Two primary studies examined nutritional interventions. These comprised the implementation of a nutrition protocol in intensive care, complemented with a dietitian, in one hospital in Switzerland,[64] and a nutrition intervention including daily assessment of nutrition status using a newly introduced assessment tool targeted at adult hospitalised patients in a US university teaching hospital.[65]

Length of stay

Soguel *et al.*,[64] in their before-and-after assessment of the implementation of a nutrition protocol in intensive care, found large variations in lengths of stay. After exclusion of outliers there was no statistically significant difference in length of stay between baseline and the intervention (2.2 days, from 25.4 at baseline to 23.2 during protocol implementation supported by a dietitian; *p*-value not stated). Somanchi *et al.*[65] carried out a controlled before-and-after study of nutritional screening and regular assessment among adult medical inpatients. This found a decline in length of stay in the malnourished group to 6.11 days (SD 5.4 days) following the nutrition intervention, compared with 8.71 days (SD 11.7 days) in a historical comparison ($p < 0.05$). The effect was stronger for the severely malnourished group, where length of stay fell by almost 5 days ($p < 0.05$). Controlling for age, sex and case mix, the nutrition intervention decreased length of stay by an average of 1.93 days (95% CI –3.19 to –0.661 days).

Patient outcomes

Studies reviewed here reported on a small set of patient outcomes only. Soguel *et al.*,[64] in their assessment of implementing a nutrition protocol in intensive care, observed that hospital mortality had increased over the study period, with the proportion of patients having died by day 180 at 10.1% at baseline and 21.5% during protocol implementation supported by a dietitian ($p = 0.004$). The authors noted that this increase was associated not with the intervention but rather with a rise in the severity of conditions among patients admitted to the ICU, as standardised ICU mortality had remained relatively stable over the study period, at 37.7% at baseline and 37.5% during protocol implementation supported by a dietitian.

Other outcomes

Two studies reported improvements in selected process measures that were attributed to the intervention under study. Soguel *et al.*[64] reported that the feeding technique had changed significantly with progressive increase of days with nutrition therapy in intensive care. Somanchi *et al.*[65] observed an increase in the proportion of malnourished patients in the intervention group receiving nutrition consultation, from 20% at baseline to 44% during the intervention; the consultation time from the date of admission (in days) fell by 47% but this was not significant [4.9 days (SD 7.34 days) vs. 2.63 days (SD 1.82 days)].

Cost

Somanchi *et al.*[65] estimated savings for patients with severe malnutrition of $1514 in hospital costs, to be associated with the implementation of nutritional screening and regular assessment. This saving was estimated to have been accrued from the observed reduction in length of stay in this patient population.

Summary

We identified 11 reviews[23,32–41] and 18 primary studies[48–65] of organisational interventions targeting the in-hospital stay of the patient journey. Ten studies were disease- or condition-specific (myocardial infarction, stroke, chronic heart failure, diabetes, hip fracture, tracheostomy),[33,34,36,38,40,48,53,55–57] seven targeted specific inpatient populations (older people, inpatients at risk of developing pressure ulcers),[34,35,37,38,49,52,62] six examined specific areas of inpatient care (intensive care, trauma care, palliative care)[32,50,51,54,58,64] and the remainder were aimed at the general inpatient population.[23,39,41,59–61,65]

Of systematic reviews, three had based their analyses solely on RCTs,[36–38] five included RCTs and quasi-controlled trials[23,33–35,40] and three included data from observational studies, in addition to RCTs and quasi-experimental studies.[32,39,41] Nine reviews were able to combine data from individual studies for pooled analyses,[23,32,33,35,36,38–41] although the number of studies and patients included varied, ranging from 26 RCTs of organised stroke care including 5592 patients[36] to two studies of stroke inpatient rehabilitation plus circuit classes capturing 92 participants.[40] There was also wide variation in the design of primary studies considered here, with the majority using some form of controlled before-and-after design ($n = 3$)[50,59,65] or before-and-after only ($n = 10$).[49,51–57,60,64] We identified only one RCT[63] and four non-RCTs,[48,58,61,62] all with relatively small sample sizes. It is against this background of varied study designs that the evidence presented in this section has to be interpreted.

Keeping these limitations in mind, there was evidence of the potential for a range of interventions involving multidisciplinary teams or care models to reduce length of stay. These included some forms of organised stroke care delivered in dedicated units when assessed against alternative service provision,[33,36] multidisciplinary rehabilitation that included exercise for older patients with acute exacerbations of a medical condition[35] and multidisciplinary approaches in intensive care.[50] There was also, albeit somewhat weaker, evidence from two systematic reviews[37,38] and one primary study[55] pointing to a beneficial impact of multidisciplinary, hospital-initiated nurse-led case management for older people[37] and, possibly, heart failure patients[38,55] on length of stay. Selected multidisciplinary interventions involving some form of geriatric assessment may also be promising in their potential to reduce length of stay; however, relevant evidence was based on small or uncontrolled studies only and needs to be interpreted with caution.[49,52] Similarly, there may be potential of selected nurse-led interventions to reduce length of stay, including those aimed at patients with stable postmyocardial infarction[56] and diabetes,[39] although the impact of interventions is difficult to interpret in the absence of a controlled study design. In several instances, observed improvements were attributed to changes in best practice adherence.[49,50,58]

There was evidence of the potential of selected staffing models to reduce length of stay, such as the addition of a specialist nurse or the use of midwifery teams,[39] changing the frequency of consultant ward rounds[59] or adding a pharmacist to the clinical team,[61] providing exercise for long-term stroke survivors[40] and older patients,[62] and selected nutritional support interventions.[65]

The evidence remained inconclusive for the provision of additional physiotherapy out of hours,[41,63] palliative care consultation services[32] and multidisciplinary rehabilitation for hip fracture patients.[34] In all cases, the authors cautioned about the robustness of the available evidence and highlighted the need to interpret findings against the background of other outcomes, such as clinical outcomes, potentially benefited by the intervention.[32]

One review of nursing-led inpatient units found a significant increase in length of stay in the intervention group, while outcomes such as functional status were significantly improved.[23] It was not clear to what extent longer length of stay contributed to patients being better prepared for discharge as indicated by improved functional status, and there was concern about a potential adverse effect in the intervention group, with an elevated risk of early mortality.

A small number of studies reported cost savings which were attributed to the intervention, although frequently cost savings were inferred from reduced lengths of stay rather than measured directly,[41] with estimates from a small set of controlled studies included here also pointing to cost savings.[58,61,65] Where cost savings were reported, these tended to occur in interventions implemented in the USA,[23,41,58,61,65] whereas interventions set in a UK context tended to report an increase in costs.[23,41] However, data are difficult to interpret and compare.

Interventions at the discharge stage of the patient journey

We identified five systematic reviews[31,42–45] and 10 primary studies[66–70,73–75,88] that focused on interventions at the discharge stage of the patient journey; the latter category included five RCTs,[66,69,73–75] one reanalysis of RCT data,[67] three before-and-after comparisons[68,70,88] and one cross-sectional study.[71] The RCT by Pekmezaris *et al.*[74] also included a matched cohort study. Of primary studies, three were carried out in the UK,[19,20,67] four in Australia[69,73,75,88] and three in the USA.[66,68,74]

Discharge planning

Discharge planning is typically described as the development of an individualised discharge plan for a patient to ensure that patients leave hospital at an appropriate time and that, with adequate notice, the provision of other necessary services post discharge will be organised.[31]

Reviews

We identified one review that focused entirely on discharge planning, although the authors noted that it was likely to become increasingly uncommon for discharge planning to be implemented as an isolated intervention.[31] The review included 21 RCTs, of which 14 focused on patients with medical conditions, four on both medical and surgical patients, two on psychiatric patients and one on patients admitted to hospital following a fall.

Length of stay

Shepperd *et al.*[31] carried out a comprehensive review of discharge planning, targeted at any acute inpatient stay irrespective of condition. They reported a significant, although small reduction in length of stay associated with discharge planning (mean difference –0.91 days, 95% CI –1.55 to –0.27 days).

Patient outcomes

Mortality was measured in five of the included studies. Overall there was no significant difference in the risk of mortality between discharge planning and comparison groups; four studies, three on elderly patients and one on mixed surgical patients, found no difference between groups while one final trial of patients admitted following a fall reported a non-significant increase in mortality (RR 1.33, 95% CI 0.33 to 5.45).[31] Around half of the trials considered measured functional status as an outcome. In eight out of 10 studies considered in the review there was a lack of follow-up data or insufficient evidence to show a difference. Only two trials reported a significant functional improvement. Three out of five studies reporting on patient satisfaction reported an increase.

Other outcomes

Shepperd *et al.*,[31] were able to pool the results of 11 trials to assess the effect of discharge planning on unscheduled readmission to hospital for patients receiving discharge planning compared with usual care. A relatively small, but significant, reduction in readmission rates was reported, with a RR of 0.85 (95% CI 0.74 to 0.97).

Cost

Limited evidence was available to assess the effects of discharge planning on hospital costs, with three studies reporting on hospital cost.[31] Data from a 1994 trial set in the USA suggested a significant reduction in costs at 2 weeks' follow-up for medical patients receiving discharge planning but not for patients with surgical conditions. A 2009 study, also in the USA, found the total costs for discharge planning compared with usual care at 6 months to be associated with an average saving of US$412 per person.

Primary studies

We identified four primary studies evaluating discharge planning.[66–69] Distinguishing interventions as being related to discharge planning rather than discharge support is not clear cut. Here we interpreted 'discharge planning' as relating to those interventions concerned with preparedness for discharge or the discharge process itself, but where there was no, or very limited, follow-up post discharge. Harris *et al.*[67] evaluated a nursing-led inpatient unit, with a senior nurse responsible for care, co-ordinating with medical providers and deciding when a patient was ready for discharge. This model of 'intermediate care' had a primary purpose to facilitate the transition from hospital to home. Three other studies[66,68,69] focused on interventions in which nurses had responsibility for discharge planning in the role of facilitator or co-ordinator. Ornstein *et al.*[68] evaluated a nurse practitioner-led transitional care programme targeted specifically at hospitalised homebound people in the USA. In this programme, a nurse practitioner was responsible for discharge planning and preparedness, communicating with primary care where necessary upon discharge and conducting one postdischarge home visit, which included a physical examination. Preen *et al.*[69] evaluated a hospital co-ordinated discharge plan, with a research nurse individually tailoring patient discharge plans prior to discharge. Based in Western Australia, the target patient population for the programme was patients with chronic cardiorespiratory diagnoses, recruited from respiratory, cardiovascular and general medical wards. Finn *et al.*[66] assessed an intervention involving a discharge facilitator (nurse practitioner) who was embedded in a resident team and was tasked with identifying

patients to be discharged, scheduling follow-up appointments and tests, undertaking medication reconciliation, communicating with pharmacists and primary care physicians and meeting with patients to discuss discharge.

Length of stay

Three of the four studies[66,68,69] did not find a significant difference in length of index admission. Focused on cardiorespiratory disease, the mean length of hospital stay in the study by Preen *et al.*[69] was 11.6 days for patients receiving discharge planning and 12.4 days for those receiving standard discharge processes. The median length of stay in the evaluation of an embedded discharge facilitator was 4 days.[66] Ornstein *et al.*[68] found no difference in mean length of stay for patients receiving the transitional care programme (6.6 days) compared with patients before implementation of the programme (6.23 days). Conversely, Harris *et al.*[67] reported a significant increase in length of stay for patients admitted to the nursing-led inpatient unit compared with a control group (at 33.4 days vs. 28.7 days; $p = 0.003$).

Patient outcomes

There was limited reporting on patient outcomes. None of the four studies reported mortality, two reported on quality of life or functionality[67,69] and three on satisfaction.[66,67,69] Preen *et al.*[69] assessed quality of life among patients with cardiorespiratory diagnoses and showed that mental quality of life was significantly improved within the intervention group from pre discharge to 7 days post discharge (13.4% improvement; $p = 0.003$) whereas no statistical difference was shown for control patients (2.8%). The improvement observed, compared with controls, approached statistical significance ($p = 0.055$).

Harris *et al.*[67] reported that the intervention group, those admitted to a nursing-led inpatient unit, were more functionally independent than controls, showed greater psychological well-being and had lower health-related distress. These findings were statistically significant. There was some indication of improved satisfaction with the discharge planning interventions. Preen *et al.*[69] also showed increased satisfaction among patients with regard to their own contribution to discharge care planning (36% greater among the intervention group; $p = 0.02$), although no significant difference was seen for any other aspect of satisfaction with the discharge procedure at 7 days post discharge. In the evaluation by Finn *et al.*[66] of the embedded facilitator, more intervention patients were satisfied with the discharge process [153 (97%) vs. 124 (76%); $p < 0.0001$] and a significantly higher proportion reported better understanding of their follow-up plans [150 (95%) vs. 138 (85%); $p = 0.003$].

Other outcomes

Finn *et al.*[66] did not find an effect of a discharge facilitator on 30-day readmission (20% vs. 18%; $p = 0.55$) or 30-day emergency readmission (36% vs. 23%; $p = 1.0$). The other three studies did not report on readmission rates. Harris *et al.*[67] did show that patients admitted to the nursing-led inpatient unit were more likely to be discharged to live independently in the community than controls (OR 0.42; $p = 0.001$). There was some evidence of improved processes and communication with the interventions. Finn *et al.*[66] showed that a higher proportion of discharge summaries were completed in wards with a discharge facilitator (67% vs. 48%; $p < 0.0001$) and that the median time to completion was significantly shorter (18.9 hours vs. 73.1 hours; $p < 0.0001$). Patients on wards with a discharge facilitator had more follow-up appointments booked at the time of discharge (16.2% vs. 36%; $p < 0.0001$). Preen *et al.*[69] reported that the time taken for discharging hospitals to contact general practitioners (GPs) was significantly reduced with the intervention ($p = 0.002$). In the intervention arm, all GPs were notified before discharge, whereas the average contact time for GPs receiving patients in the control arm was 4.4 days post discharge and no hospital communication was made in around one-tenth of these cases.

Cost

There was limited reporting on costs among the four studies. Ornstein *et al.*[68] considered net revenue, direct care costs, indirect costs and contribution to margin for the transitional care programme for hospitalised homebound patients. They reported a significant increase in net revenue with the intervention but also increased direct and indirect costs. The contribution to the margin, or profit, was also greater in

comparison with the period before the programme was implemented by £282 per admission, but the result was not significant. Finn *et al.*[66] did not present cost data relating to the discharge facilitators, but noted that the intervention was not cost neutral and that paying for the discharge facilitator was not compensated for by reduced length of stay, ED visits or readmissions. Details about cost were not presented in the evaluation of discharge planning in cardiorespiratory care or the nursing-led inpatient unit.[67,69]

(Early) supported discharge

Discharge planning typically involves a greater degree of care provision and support following discharge in comparison with discharge planning interventions. Early supported discharge (ESD), or early home-supported discharge (EHSD), may include discharge planning but aims specifically to accelerate discharge from hospital with the provision of continued support in a community setting,[42] typically at the same intensity that would have been provided had the patient remained in hospital. These interventions are usually provided by multidisciplinary teams including doctors, nurses and therapists but the degree of co-ordination and whether they are driven from hospital outreach or community teams can vary.

Reviews

We identified three reviews that examined ESD or EHSD, all in the context of stroke care,[42,43,45] and one review that assessed the effectiveness of discharge planning with supported discharge (without the explicit aim of accelerating discharge).[44]

Length of stay

The three reviews consistently showed a significant reduction in length of stay for stroke patients receiving ESD. These included two meta-analyses suggesting that ESD may lead to a reduction in length of stay of between 7 and 10 days.[42,43] For example, Fearon and Langhorne[42] pooled the results of 13 RCTs and showed that ESD led to a significant reduction in length of stay of about 7 days (mean difference –7.10 days, 95% CI –10.03 to –4.17 days). The size of the potential reduction varied by severity, with a mean reduction of 28 days (95% CI 17 to 44 days) among those with severe stroke compared with 3 days (95% CI 1 to 7 days) for moderate stroke. Fearon and Langhorne[42] further demonstrated that hospital outreach teams appeared to have a more marked effect on length of stay than community in-reach teams, but that this interaction was not significant. Teasell *et al.*[45] did not undertake meta-analyses but the majority of trials included in the review reported a potentially large reduction in length of stay, varying from 2 to 15 days. In the review of discharge planning with postdischarge support, 10 out of 18 studies considered by Phillips *et al.*[44] reported length of hospital stay. Pooling the data from these studies showed that there was a small but non-significant reduction in length of stay for those receiving discharge planning with postdischarge follow-up [difference in length of stay –0.37 days, 95% CI –0.15 to 0.60 days (as stated by the authors)].[44]

Patient outcomes

Two meta-analyses reported on the effect of ESD or EHSD on death or institutionalisation.[42,43] Death was reported as an outcome in all 14 of the trials included in the meta-analysis by Fearon and Langhorne[42] but showed no significant difference with ESD compared with usual care. A combined outcome for 'death or requiring institutional care' showed a just-significant reduction in both studies. Fearon and Langhorne[42] also reported a 20% reduction with ESD (OR 0.78, 95% CI 0.67 to 0.97) and Larsen *et al.*[43] found a reduction of 25% (OR 0.75, 95% CI 0.46 to 0.95). Fearon and Langhorne[42] further showed a significant reduction in a combined outcome of death or dependency (OR 0.80, 95% CI 0.67 to 0.97).

Self-reported patient satisfaction was found to be statistically higher among patients receiving ESD services (OR 1.60, 95% CI 1.08 to 2.38).[42] Teasell *et al.*[45] reported mixed evidence on improvements in functional status across 10 trials, with four giving evidence for improvement and six showing no difference. Other patient outcomes such as satisfaction were not reported. In the review of postdischarge support with discharge planning, Phillips *et al.*[44] identified a greater percentage improvement in quality of life scores compared with baseline scores for the intervention groups (25.7%, 95% CI 11.0% to 40.4% vs.

13.5%, 95% CI 5.1% to 22.0%). The study also reported a trend towards lower all-cause mortality for patients receiving the intervention compared with usual care (RR 0.87, 95% CI 0.73 to 1.03), although this was not statistically significant.

Other outcomes

Limited evidence was available on other outcomes. Two reviews reported on readmission rates.[42,44] Phillips *et al.*[44] found that, over a mean observation period of 8 months post discharge, fewer intervention patients were readmitted compared with controls (RR 0.75, 95% CI 0.64 to 0.88). Fearon and Langhorne[42] reported on readmissions to hospital for early discharge support interventions and found rates to be very similar among the two groups, with a non-significant increase in readmissions among patients receiving the ESD service (OR 1.26, 95% CI 0.94 to 1.67).

Cost

There was limited and inconclusive evidence regarding costs across the three studies examining ESD. Fearon and Langhorne[42] synthesised evidence from seven trials to show that estimated costs may range from a 23% reduction for ESD to a 15% increase. Similarly mixed results were reported by Teasell *et al.*[45] Larsen *et al.*[43] estimated that the intervention represented a cost saving (calculated as saved nursing home and hospital bed-days) of US$140 compared with usual care. Based on existing evidence, the authors considered that this cost saving would be likely to increase with time, beyond 1 year. For discharge planning with postdischarge support, pooling cost data across eight trials, Phillips *et al.*[44] found that the cost difference favoured the intervention over usual care. The study disaggregated results for non-US and US trials, showing a reduction of US$359 (95% CI –US$763 to US$45) for non US-trials and $536 (95% CI –US$956 to US$115) for US trials.

Primary studies

Three primary studies were focused on (early) supported discharge.[70,71,88] Two focused on chronic obstructive pulmonary disease (COPD).[70,71] Kastelik *et al.*[71] reviewed supported discharge programmes as part of the 2008 UK COPD audit. Details of the individual programmes were not provided, but from what we could infer from a list of quality indicators, supported discharge was expected to deliver a pulmonary rehabilitation programme, care plans and smoking cessation support. Bakerly *et al.*[70] evaluated an acute COPD assessment services team comprising specialist respiratory nurses and one physician, who regularly reviewed acute-episode COPD admissions to assess suitability for discharge with home nurse support, also involving patient education and a comprehensive management plan. Lee and Lindstrom[88] sought to assess the benefit and safety of early discharge guidelines in the management of community-acquired pneumonia, including an early switch to oral antibiotics. Both the early discharge and early switch to oral antibiotic guidelines were adapted locally from national-level guidelines.

Length of stay

All three studies reported a statistically significant reduction in length of stay associated with the intervention. Kastelik *et al.*[71] reported that for patients treated at a unit with one or more audit patients within a standard discharge programme, the median length of stay was significantly shorter than for those not accepted [3 days (range 1–6 days) vs. 6 days (range 3–11 days); $p < 0.001$]. Bakerly *et al.*[70] found a larger effect with an integrated care model in the management of acute COPD exacerbations, where the treatment group had a length of stay 7 days shorter on average than the control group [3.3 days (SD 3.9 days) vs. 10.4 days (SD 7.7 days); $p < 0.001$]. Lee and Lindstrom[88] reported a mean reduction of 0.74 days [7.62 days (SD 0.60 days) vs. 8.36 days (SD 0.55 days); $p = 0.04$]. A subgroup analysis based on severity of pneumonia found that the significant reduction in length of stay held for all groups except for the most severe.

Patient outcomes

There was some evidence of reduced mortality with the programmes. Kastelik *et al.*[71] reported the mortality rate at 90 days after admission to be significantly lower in patients treated within standard discharge programmes than in those not accepted for discharge programmes, at 4.3% versus 6.7% ($p < 0.001$). Lee and Lindstrom[88] examined inpatient mortality rates and found a significant reduction in inpatient mortality following the implementation of the guidelines.

Other outcomes

Bakerly *et al.*[70] and Kastelik *et al.*[71] reported that there were no differences in readmission rates between patients receiving COPD-focused interventions and control groups. Kastelik *et al.*[71] identified improvements in quality and process measures in units providing supported discharge programmes compared with those that did not, for example the implementation of local COPD guidelines (75% vs. 33%; $p < 0.005$), provision of access for all patients with COPD to respiratory nursing (89% vs. 67%; $p < 0.001$) and access to formal pulmonary rehabilitation (94% vs. 84%; $p < 0.02$). Lee and Lindstrom (2007)[88] reported that of a random sample of 82 patients from the prospective group selected for follow-up, seven had presented for a further course of antibiotics, but no statistical analysis was undertaken. Considering the impact of guidelines on mean duration of intravenous antibiotic treatment, they reported a reduction in the group following the implementation of guidelines [3.38 days (SD 0.22 days) vs. 3.99 days (SD 0.28 days); $p = 0.03$], which became non-significant after excluding deceased patients from the analysis. The authors also considered delayed discharge; only a small proportion (7.2%) of patients were discharged on the same day as being switched from intravenous to oral antibiotics. The most common reason for delay was unstable comorbid conditions. It was not possible in the study to compare this against delay in the retrospective cohort.

Cost

Two of the three studies reported some element of cost or cost savings. Taking a health service perspective, Bakerly *et al.*[70] found a statistically significant cost saving of £600 per patient ($p < 0.001$) for the acute multidisciplinary COPD assessment service, and concluded that additional costs such as community specialist home visits were more than offset by the reduction in hospital length of stay that was observed. Assuming no cost for the intervention, Lee and Lindstrom[88] undertook a basic calculation of costs saved, estimating for a sample of 125 patients a cost saving of AUS$27,750.

Postdischarge programmes

Postdischarge programmes include programmes concerned with review, monitoring or management after a patient has been discharged from the hospital.

Reviews

We did not identify any systematic reviews in this category.

Primary studies

We identified three eligible primary studies.[73–75] All three focused on heart failure patients. Pekmezaris *et al.*[74] evaluated remote monitoring, or telehealth, for patients who had recently been discharged from hospital. They reported on a RCT and a matched control study to compare remote patient monitoring, incorporating live nursing visits and video-based nursing visits, with live nursing visits only. Stewart *et al.*[75] sought to compare a clinic-based programme of management for chronic heart failure patients with a nurse-led, postdischarge, multidisciplinary management programme, which involved a structured and detailed home visit within 7–14 days after discharge, after which a report was sent to the patient's family and cardiologist and ongoing management was planned. Barker *et al.*[73] sought to assess pharmacist-directed home medication reviews, involving patient education about medication use and follow up.

Length of stay

Pekmezaris *et al.*[74] reported that there was no significant difference in length of stay for index admission between patients who received remote patient monitoring and those receiving live nursing visits only. Similarly, there was no difference for the index admission in the comparison of clinic- and home-based interventions[75] or the pharmacist-directed medication review.[73]

Patient outcomes

There were limited data reporting patient outcomes. Stewart *et al.*[75] did not find a significant difference in mortality or quality of life between patient groups receiving clinic- and home-based interventions. However, there was a significant difference between groups for actual days out of hospital alive (from unplanned hospitalisation) [452 days (SD 158 days) vs. 418 days (SD 173 days); $p = 0.019$] and all days out of hospital alive [451 days (SD 158 days) vs. 414 days (SD 172 days); $p = 0.009$], in favour of the home-based intervention. Barker *et al.*[73] did not report significant differences in mortality and health-related quality of life between patients receiving the medication review and control groups. Pekmezaris *et al.*[74] did not report on patient outcomes.

Other outcomes

Pekmezaris *et al.*[74] did not find a difference in hospitalisation rates for remote patient monitoring compared with controls. Numbers of home-care visits, including live nurse visits and remote patient monitoring visits, were reported to be higher in the intervention group, but they did not report whether or not this was statistically significant. Stewart *et al.*[75] did not find differences in the number or rate of unplanned or total hospitalisations between the clinic- and home-based interventions, although average length of hospital stay for all-cause, unplanned hospitalisation was significantly lower in the home-based intervention group (median 4.0 vs. 6.0 days; $p = 0.004$). A similar trend in relation to elective hospitalisation was not statistically significant. Age and allocation to the community-based intervention were the only two statistically significant predictors of prolonged hospital stay. Barker *et al.*[73] found no difference in chronic heart failure hospitalisations following medication review [incidence rate ratio (IRR) 1.74, 95% CI 0.85 to 3.60; $p = 0.131$]. However, there was a significant increase in all-cause inpatient bed-days (IRR 1.25, 95% CI 1.06 to 1.48) and heart failure inpatient bed-days (IRR 2.34, 95% CI 1.80 to 3.05) in the intervention group compared with controls. There were significantly fewer hospital inpatient days for conditions other than heart failure.

Cost

Stewart *et al.*[75] provided a detailed breakdown of components of cost for home-based intervention and heart failure clinic. The majority of costs in both groups were hospital costs. The costs of implementing the programmes were very similar: AUS$1813 ± AUS$220 for the home-based intervention and AUS$1829 ± AUS$174 for the clinic-based intervention. Overall, total health-care costs per patient were found to be around 30% lower in the home-based intervention group. Pekmezaris *et al.*[74] compared the home-care costs and found the mean per-patient home-care cost to be greater for the remote patient monitoring group than for usual care. This was explained by a higher number of visits on average for this group. The size of the cost difference varied between the RCT (US$153 greater) and the matched controlled studies (US$55 greater), again accounted for by a difference in number of visits. Barker *et al.*[73] did not report data relating to cost.

Summary

We considered five systematic reviews[31,42–45] and 10 primary studies[66–71,73–75,88] that focused on the discharge stage of the patient journey. We further categorised interventions as those relating to (1) discharge planning; (2) (early) supported discharge; and (3) postdischarge support. In a pooled analysis, Shepperd *et al.* (2010)[31] showed a small (less than 1 day) but significant reduction in length of stay associated with discharge planning. More recent primary studies showed no difference or, in the case of a nursing-led inpatient unit in the USA, a significant increase in length of stay.[67] A similar finding was also documented in a systematic review by Griffiths *et al.*[23] which we reported above (see *Nurse-led interventions*). It should be noted that a greater proportion of patients discharged from the nursing-led inpatient unit were able to live independently,

and therefore the appropriateness of length of stay should also be considered. There was little evidence to suggest a difference in mortality or health-related outcomes between patients receiving discharge planning and controls, but there was some evidence of greater patient satisfaction with discharge planning. Pooled analysis showed a relatively small but significant reduction in readmission rates with discharge planning, although this was not supported by more recent primary studies. Although reported data on cost were limited, there was some evidence of cost savings with discharge planning interventions.

Turning to (early) supported discharge, there was consistent evidence across systematic reviews that this was associated with a reduction in length of stay. In the case of discharge planning with postdischarge follow-up, this was modest, at around 8 hours, but with ESD, meta-analyses showed a reduction of between 7 and 10 days.[42,43] This difference in effect may be expected, as early discharge schemes have an explicit aim to accelerate discharge and seek to continue care at the same intensity as would have been provided in hospital. There was some evidence of a positive effect of ESD interventions on patient outcomes, notably with improvements in a composite measure of death and disability.[42,43] Although ESD did not appear to be associated with changes in readmission rates, there was some evidence of a decrease in rates associated with discharge planning and postdischarge support.[44] There was also some, albeit limited, evidence that interventions could be associated with savings for ESD and discharge planning with postdischarge support. The nature of the interventions was, however, very broad and the intensity of support varied considerably. This makes it difficult to draw robust conclusions from the evidence reviewed here.

Considering postdischarge programmes, we identified three primary studies[73–75] relating to patients with heart failure and these did not find an effect of the intervention on length of index hospital admission. Patient outcomes were poorly reported in this group of studies. Evidence on other measures of utilisation was mixed, although there was some evidence of reduced hospitalisation following a home-based intervention. A pharmacist-directed medication review was associated with no change in hospitalisation, although there was an increase in bed-days in the intervention group.[73] Similar to studies of discharge planning and (early) supported discharge, those assessing postdischarge support presented limited evidence with regards to cost savings.

In summary, and at the risk of simplification of what is inherently a complex issue, our findings seem to suggest that individual or discrete interventions such as discharge planning or postdischarge medication review on their own may convey little beneficial effect in relation to length of stay or readmissions. While acknowledging the varied nature and quality of studies reviewed in this section, it appears reasonable to conclude that a combination of interventions or sets of interventions are more likely to be effective with regard to impact on length of stay, as suggested by findings for the provision of postdischarge support in relation to discharge planning.[73]

Clinical care pathways

We identified three systematic reviews[22,46,47] and six primary studies[76–80,89] examining clinical care pathways; of the latter category, one was a cluster RCT,[77] four were before-and-after comparisons[76,79,80,89] and one was a retrospective cohort study.[78] Primary studies were set in Italy,[77] the Netherlands,[79] Spain,[80] the UK[81] and the USA (two studies).[76,78]

Clinical care pathways

Reviews

Three systematic reviews assessed clinical care pathways for inpatients.[22,46,47] Two systematic reviews were disease specific, evaluating the impact of clinical care pathways on in-hospital treatment for heart failure[46] or COPD,[47] while one study examined the impact of care pathways on patients generally.[22]

Kul *et al.*[46] conducted a systematic review to investigate the impact of clinical care pathways on patients admitted to hospital with a primary diagnosis of chronic heart failure, defining a clinical care pathway according to the European Care Pathway Association definition. Lodewijckx *et al.*[47] explored characteristics of existing clinical care pathways for the management of inpatients with COPD exacerbations. Rotter *et al.*[22] assessed the effect of a clinical pathway more generally, considering 27 studies, of which 20 assessed the clinical pathway as a single-pathway intervention and seven classified it as an element of a multifaceted intervention.

Length of stay

Five of the seven included studies in the systematic review by Kul *et al.*[46] reported on length of stay. Meta-analyses of all five studies suggested that the implementation of a clinical care pathway significantly reduced hospital length of stay by 1.8 days ($p < 0.001$). Lodewijckx *et al.*[47] also found the mean length of hospital stay to be reduced for those patients who received care according to a pathway compared with usual care, ranging from less than 1 day to 4 days, but the results were only significant in one study (10.2 days vs. 13.2 days; $p = 0.04$) out of three studies which assessed this outcome. One study considered by Lodewijckx *et al.* reported that the introduction of a clinical care pathway resulted in an increase in length of stay by half a day.

Of the 20 single-pathway interventions reviewed by Rotter *et al.*,[22] 15 reported on length of hospital stay and, of these, 11 showed a significant reduction and 2 found a non-significant increase. Of seven studies classified as multifaceted interventions that included a clinical care pathway element, three reported on length of stay; the pooled analysis found a reduction compared with usual care, with a WMD of –0.86 days (95% CI –2.52 to 0.81 days), but this was not statistically significant.

Patient outcomes

All three reviews reported mortality as an outcome. Pooled analysis of five studies by Kul *et al.*[46] suggested that the introduction of a clinical care pathway reduced the risk of mortality by over 50% (OR 0.45; $p = 0.03$), although there was evidence of significant heterogeneity between studies. Lodewijckx *et al.*[47] reported a decrease in mortality to be associated with the implementation of a clinical care pathway in two studies. However, the size of the impact varied considerably, from a decrease in mortality of 1% in one study to 57% in the second study, although data for the latter were difficult to interpret. Rotter *et al.*[22] did not find evidence of a difference in mortality rates for single clinical care pathways or multifaceted interventions compared with usual care.

Lodewijckx *et al.*[47] and Rotter *et al.*[22] reported a decrease in the number of in-hospital complications in the clinical care pathway group. For example, pooled analysis of five studies reviewed by Rotter *et al.*[22] found the risk of complications to be significantly lower in the intervention group, with an OR of 0.58 (95% CI 0.46 to 0.94).

Other outcomes

Three reviews reported on readmission rates. Kul *et al.*,[46] in a meta-analysis of five studies, showed a significant reduction in readmission rates among patients who had been treated according to a clinical care pathway, with a RR of 0.95 ($p = 0.04$). However, length of follow-up to readmission varied between studies, from 31 days to 6 months.

Readmission was also reported in three studies reviewed by Lodewijckx *et al.*,[47] with two out of the three showing a decline in readmission rates 30 days after discharge, although this was not significantly confirmed in one study. The third study measured readmission rates after 1 year and found rates to be non-significantly higher in the pathway group, although time to first readmission was longer.

Six of 15 single clinical care pathway studies reviewed by Rotter *et al.*[22] reported readmission up to 6 months, and although rates appeared to be reduced, with an OR of 0.6, this decline was not significant (95% CI 0.32 to 1.13). Only one out of three of the multifaceted interventions that reported on

readmission rates found a significant reduction; the study was specific to hypoglycaemia in patients with diabetes.

All reviews reported on a number of process measures. For example, Lodewijckx *et al.*[47] presented evidence from two studies that stated an overall improvement in the performance of care processes, although no numerical data were reported. Rotter *et al.*[22] found a substantial improvement in documentation for the clinical care pathway group in two studies, with an OR of 11.95 in favour of the intervention (95% CI 4.72 to 30.30). In this context it may be important to note that Kul *et al.*[46] commented on the significant influence that team performance is likely to have on the effectiveness of a clinical care pathway. They suggested that the greatest benefit in outcomes would be seen for those teams that are poorly organised before the implementation of a clinical care pathway. None of the included studies reported on team performance, however, so this potential confounder could not be controlled for.

Cost

Cost data were reported in two reviews.[22,46] Kul *et al.*[46] presented findings from a meta-analysis of three studies which suggests that the introduction of a clinical care pathway did not increase hospitalisation costs compared with standard care, with a WMD of –0.11 (95% CI –0.25 to 0.03). Rotter *et al.*[22] reported a decrease in hospital costs or charges, which ranged from a WMD of US$261 in favour of usual care to –US$4919 favouring clinical care pathways. Pooled analysis of three studies reporting on cost found non-significant evidence for cost savings in the clinical care pathway, with a WMD of –1.57 (95% CI –3.66 to 0.52).

Primary studies

The six primary studies examining care pathways were disease specific, concerning patients with stroke,[77,79] deep-vein thrombosis,[80] acute coronary syndrome,[76] and infants with bronchiolitis[89] and community-acquired pneumonia.[78]

Corbelli *et al.*[76] carried out a before-and-after study that evaluated the impact of the introduction of a critical clinical care pathway (acute coronary syndrome emergency treatment strategies) in four US hospitals on patients who were discharged with a clinical diagnosis of acute coronary syndrome. The pathway, which was initiated in the ED and continued beyond discharge, embedded a guideline-based treatment in order to encourage adherence to evidence-based treatment. The clustered RCT conducted by Panella *et al.*[77] investigated the appropriateness of a clinical care pathway in providing organised care to patients within 24 hours of stroke onset. Staff were provided with training, including information on evidence-based key interventions. Schouten *et al.*[79] evaluated the effectiveness of a service improvement programme in the Netherlands which involved 23 multidisciplinary stroke service teams implemented in two sequential phases, using a before-and-after design. One before-and-after study evaluated the impact of a clinical care pathway, designed by the study team, on length of stay in 88 patients with deep-vein thrombosis admitted to the internal medicine department in one hospital in Spain.[80] Walker *et al.*[89] evaluated the impact of a bronchiolitis clinical care pathway, which introduced joint medical and nursing records and greater nurse autonomy, on treatment and hospital stay in 328 infants over the course of 7 years in the UK. Finally, Neuman *et al.*[78] assessed the extent to which the presence of institutional clinical practice guidelines for children with community-acquired pneumonia was associated with the clinical management of patients. They surveyed 41 hospitals in the USA, of which 13 had a clinical practice guideline in place.

Length of stay

Length of stay was reported to have been reduced in four out of the six primary studies. Corbelli *et al.*[76] found that the introduction of a critical clinical care pathway (acute coronary syndrome emergency treatment strategies) resulted in an 18% relative reduction in length of hospital stay when compared with pre-intervention length of stay [hazard ratio (HR) 0.82, 95% CI 0.72 to 0.9]. Schouten *et al.*,[79] in their study of stroke service teams, observed a reduction in mean length of hospital stay of 27%, from 18.3 days before the intervention to 13.3 days after the intervention (SDs not reported).

The authors noted, however, that the mean length of hospital stay varied between teams, and that those with higher team-functioning scores had lower length of hospital stay and higher scores for the indicators of well-organised stroke services.

A reduction in mean length of stay of more than 2 days was also observed by Verdu *et al.*[80] in their analysis of a clinical care pathway for patients with deep-vein thrombosis (6.8 days before vs. 4.7 days after implementation of the pathway; $p = 0.012$). Likewise, Walker *et al.*[89] reported the median duration of stay to be reduced for children admitted with bronchiolitis, from 79 hours pre-intervention to 66 hours following implementation of the clinical care pathway ($p = 0.010$).

Conversely, the cluster RCT by Panella *et al.*,[77] of a clinical care pathway to provide organised care to patients within 24 hours of stroke onset, reported an increase in length of stay. It found that, on average, patients in the clinical care pathway remained in hospital 1 day longer than those in usual care, although the difference was not significant (11.8 days vs. 10.8 days; $p = 0.19$). Neuman *et al.*[78] were unable to detect a difference in the length of hospital stay of children with pneumonia between institutions with and without a related clinical practice guideline; median length of stay was 2 days (interquartile range 1–3 days in both groups; $p = 0.269$).

Patient outcomes

Mortality was reported in two studies.[76,77] Corbelli *et al.*[76] reported a non-significant reduction in mortality rates from 5.5% to 4.1%, 1 year after the introduction of the clinical care pathway. Subgroup analysis revealed that mortality among patients with a diagnosis of myocardial infarction was significantly reduced by 19% (HR 0.81, 95% CI 0.66 to 0.99). Panella *et al.*[77] reported that the patients who attended hospitals randomised to clinical care pathways had a significantly lower risk of mortality after 7 days (OR 0.10, 95% CI 0.01 to 0.95), but not after 30 days.

Panella *et al.*[77] found a significantly lower rate of adverse functional outcomes, measured as the odds of not returning to pre-stroke functioning in a patient's daily life, in patients treated according to the clinical care pathway (OR 0.42, 95% CI 0.18 to 0.98). One study reported a patient satisfaction rate of 67% among those in a clinical care pathway.[80] No comparative group data were presented.

Other outcomes

Three studies reported on readmission.[76,78,89] Corbelli *et al.*[76] found weak evidence of a decrease in readmission rates, from 53% before the implementation of a clinical care pathway to 49% after ($p = 0.062$). Walker *et al.*[89] did not find a change in readmission rates. There were also no differences reported by Neuman *et al.*[78] in the proportion of children readmitted within 14 days, in hospitals with and without a clinical practice guideline for children with community-acquired pneumonia (2.3% in hospitals with a guideline vs. 1% in hospitals without a guideline; $p = 0.4$). Discharge delay was reported to have significantly decreased by 71%, from 5.9 to 1.7 days, after the introduction of a multidisciplinary stroke service team.[79]

Three studies examined team-related attributes and service function.[77–79] Panella *et al.*[77] reported that organised care and evidence-based interventions were used more frequently in the clinical care pathway group compared with usual care. Schouten *et al.*[79] found that the number of stroke service key features included in the treatment increased by 27% following introduction of the clinical care pathway. Neuman *et al.*[78] noted that institutions with a practice guideline recommending the use of penicillin or aminopenicillins as first-line agents in children were more likely to use these compared with institutions without such a practice guideline (adjusted OR 2.7, 95% CI 1.4 to 5.5).

Cost

Two studies estimated the cost of the intervention.[78,80] Verdu *et al.*[80] estimated an overall saving of between €17,093 and €21,393 following the implementation of a clinical care pathway for patients with deep-vein thrombosis. Neuman *et al.*[78] were unable to find an association between the presence of a

clinical practice guideline for children with community-acquired pneumonia and the cost of hospitalisation for the index visit, or the total cost per episode of illness. The latter was reported as US$13,265 (without practice guideline) versus US$9478 (with practice guideline); the mean difference was US$1843 (95% CI –US$1861 to US$5547; $p = 0.329$).

Summary

We identified three systematic reviews[22,46,47] and six primary studies[76–80,89] evaluating clinical care pathways. Eight studies were disease specific and one examined clinical care pathways for all inpatients.

Three systematic reviews evaluated clinical care pathways. Two were disease specific (chronic heart failure and COPD), and one was not. The number of studies and patients included in the reviews varied, as did the type of studies that were included in the reviews. None of the systematic reviews were restricted to RCTs, and all included non-RCT data. Meta-analyses were conducted in two of the reviews, both of which were considered to have been well conducted.[22,46] One review concluded that clinical care pathways for the treatment of heart failure led to decreased mortality rates and length of hospital stay,[46] and Rotter *et al.*[22] found that clinical care pathways were associated with reduced in-hospital complications and improved documentation without having a negative impact on length of stay or hospital costs. Kul *et al.*[46] were, however, cautious about their overall conclusions, and stated that what works for one organisation may not work for another owing to differences in processes and bottlenecks.

Primary studies were conducted in patients with stroke, deep-vein thrombosis, acute coronary syndrome, bronchiolitis and community-acquired pneumonia. There was variability in studies with regard to whether or not a clinical care pathway had a significant impact on length of stay. Those employing before-and-after designs tended to report a significant reduction in mean length of stay, whereas the cluster RCT by Panella *et al.*[77] found an increase in length of stay in a group of stroke patients treated according to a clinical care pathway for stroke, although this finding was not statistically significant.

Most studies reported positive impacts on patient outcomes, such as a reduction in mortality or complication rates. Several mentioned improvements in processes or teamwork due to the implementation of clinical care pathways, although such improvements were not systematically measured. Improved outcomes included shorter delays and better collaboration within the care team.

Overall, although there was evidence on the potential effectiveness of clinical care pathways in reducing length of hospital stay and enhancing patient and care utilisation outcomes, further research using rigorous study methodology is needed to assess the effectiveness of different types of clinical care pathways in different settings.

Implementing interventions seeking to reduce length of stay in hospital: an exploratory analysis of experiences in the NHS

The implementation of complex interventions depends on a range of system and contextual factors which are not easily identifiable or documented in the published literature. This section provides insights into the experiences of a select group of managers in the NHS representing a small sample of NHS trusts, who are observers of or are directly involved in the planning, implementation and delivery of interventions seeking to reduce length of hospital stay. This component of the research was designed to be exploratory only, to help place the findings of the evidence review in the NHS context and so inform how our findings might best be used to meet the needs of the NHS. The interviews were not restricted in the same way as the evidence review, and, therefore, also allowed us to explore the manager's experiences of interventions that would not have been included in the review, particularly around admissions and maternity care.

Description of participants

Of 13 potential participants, eight agreed to be interviewed for our study. These represented four acute NHS trusts in the West Midlands and south-east of England, with sites located in a range of settings (as defined by level of deprivation and population density) (*Table 2*). Trusts and interviewees were anonymised (as trusts A to D and interviewees 1 to 8).

We report here interviewees' views as they relate to, first, the drivers of interventions that seek to directly or indirectly reduce length of stay in hospital, and second, examples of interventions that are being or have been implemented in the four sites under study. We explore these along the stages of the patient journey through hospital, in line with our reporting on findings from the literature in the preceding sections.

Drivers to reduce length of stay

In the introduction to this report we highlighted the challenges faced by the NHS as a consequence of demographic changes in the context of a testing economic climate. Study participants confirmed the pressures arising from an increase in the demand for services faced by an acute trust (interviewee 2) vis-à-vis financial constraints (interviewee 5). Strategies seeking to reduce length of hospital stay were considered as ways to simultaneously increase bed capacity, save costs, respond to patient preferences and improve patient outcomes:

> *So we're trying to deliver our savings target which is anything from £30–40M per year and we're trying to look at how we do that through efficiency and productivity whilst absolutely maintaining the quality for which we're known; so we're very interested in length of stay . . . It's mainly around improvement initiatives that improve efficiency and productivity.*
>
> *Interviewee 5*

TABLE 2 Participant characteristics

NHS trust	Characteristics of the local area[a]		Number of and role of participants	Type of intervention discussed
	Level of deprivation	Percentage of the population living in urban area		
Trust A	Very low	26	*n* = 5 • Clinical lead for patient flow • Consultant lead for ambulatory care initiative • Lead of Hospital-at-Home intervention • Lead case manager • Lead for clinical care pathway redesign	Trust-wide initiatives including: • Clinical care pathways • Ambulatory care • Hospital care at home • Case management
Trust B	Mixed	100	*n* = 1 Deputy director of transformation	Trust-wide initiatives including: • Hospital care at home • Clinical care pathways • Nurse-led discharge
Trust C	Very low	56	*n* = 1 Surgical director	Breast cancer pathway • Induction of labour in outpatient settings • Antibiotics at home
Trust D	High	100	*n* = 1 Director of midwifery and divisional nurse director, women's and children's services	

a Adapted from Public Health England, Health Protection Assessment.[90]

Bed capacity was identified as one of the main bottlenecks (interviewees 2 and 4) affecting the delivery of care:

> *The results of that [bed capacity issue] have been failure to meet the 4-hour trolley wait because obviously there's nowhere for patients to go because the hospital's full; and a failure to meet waiting time targets because operations get cancelled because there's no beds for people to come into.*
>
> *Interviewee 2*

As well as optimising the use of existing capacity through more efficient patient management, interviewees also emphasised the benefits of shorter length of stay in its own right, to respond to patient preferences and safeguard patient outcomes as important drivers (interviewees 1, 4, 6 and 7):

> *You don't want to be just kicking people out just for the sake of reducing length of stay. It has to be part of a whole policy and normally it's driven by the patients, 'cause the patients are the ones who want to go home all the time. And so that's where . . . and if you can give them good . . . a very good initial experience, you get less complications, you get less complaints, you get less returns to hospital, and that is where the hospital gains the most from that, and so that's what we aim for here.*
>
> *Interviewee 6*

The combination of drivers and motivations as illustrated here has in many cases prompted the development and implementation of a range of interventions targeting different stages of the patient journey through hospital. The selection and design of initiatives described by the interviewees were typically informed by existing data gathered through audit (interviewees 2 and 3) or by guidelines (interviewees 4 and 8), alongside continuous improvement efforts that monitor progress through the collection of administrative and patient data. We report here on selected examples of interventions offered by study participants, and their perceived effectiveness.

Admissions

Examples of interventions acting at the admissions stage of the patient journey included the establishment of an ambulatory care unit to prevent short-stay admission using a pathway-led approach (trust A). It introduced a protocol to identify patients presenting to A&E with a select set of symptoms, who would otherwise have been admitted for a short period (1–2 days), for referral to the ambulatory care unit. Examples of conditions considered for ambulatory care by the time of this study included suspected or confirmed pulmonary embolism and subacute diabetic emergencies.

One study participant involved in the delivery of the ambulatory care unit in trust A (interviewee 1) noted that the costs of treating a patient in the ambulatory care setting were higher than those incurred in the outpatient setting, but lower than those in inpatient care. At the same time, although costs incurred might be higher, it was suggested that this needed to be set against the wider benefits to the patient, including patient safety:

> *The reason patients like [it] is they want things to happen quickly but they don't want to be in a hospital bed and there's lots of good reasons to keep people out of a hospital bed. They get a better night's sleep. If they're at home, they're more active, you're reducing the risk of infection. So from a patient perspective, if you can give them, if you can deliver exactly the same investigations and treatments that you would in the inpatient setting, but at the same time say well you can go home and come back the next day, that ticks all their boxes.*
>
> *Interviewee 1*

However, the interviewee also highlighted the challenges involved in implementing the ambulatory care unit, particularly in relation to the commissioning of the new service and the staffing of the unit, which had to draw on the existing workforce by means of moving staff from other services, including the acute medicine department (interviewee 1).

A further example of an intervention seeking to reduce avoidable admissions for people presenting to the A&E department was established in trust A. This included a staffing intervention, in which the trust has 'put increased senior resource in the emergency department' (interviewee 2). Greater consultant presence in the evenings and at weekends is anticipated to lead to better decision-making on patient admission by virtue of senior experience: 'The rationale behind that being that senior decision-makers will be more likely to not admit people who don't need admitting. If you're less experienced, you're probably less likely to take a calculated risk' (interviewee 2).

In trust D, where bed availability posed a particular challenge in the maternity ward, one of the main initiatives to reduce length of stay consisted of delaying the admission of low-risk pregnant women. The goal of the intervention was to reduce length of stay, release bed capacity and improve the women's experience (interviewee 4). Low-risk women overdue by 10 days were induced in outpatient settings (an obstetric day unit), and sent back home until labour started. The interviewee noted that such a procedure would save 1–2 inpatient-days per person, and decrease the risk of infection. Given the large catchment area of this particular trust, this intervention could potentially lead to large bed-day savings while also offering benefits for the women affected:

> *Obviously, the benefits for the woman is that she is going home to be in her own environment, she is not in a hospital environment, she is probably less anxious, therefore, it is more likely things will happen naturally and we won't have to then do further intervention.*
>
> *Interviewee 4*

Hospital stay

Two interviewees discussed the perceived benefits of case management (interviewees 2 and 3). For example, in trust A, case management has been under development for about 5 years and is reportedly associated with reduced length of stay and saving bed-days. Among inpatients with hip fracture, for example, average length of stay has reduced by about half. The intervention involves a dedicated lead case manager who co-ordinates a team of case managers across the trust, including senior case managers who supervise more junior staff within the team (interviewee 3). Their overarching role is to ensure that patients progress through the different steps of the clinical care pathway and to reduce delays to that progression (interviewee 3). The implementation of the programme has been met by a (perceived) resistance from nursing staff, highlighting the need to use 'good leadership' skills and to strengthen communication efforts and clarity on functions and roles (interviewee 3). The programme initially saw a temporary worsening of average length of stay, although this is being attributed to measurement rather than an actual increase:

> *Funnily enough, what we've found is every time we go into a new area with case managers, the length of stay goes up and everybody goes, '[Name], the length of stay is going up, why is that?' You're putting case managers. I say no, that's because we've gone in and we've sorted out some of the complex patients on there with a long length of stay and they've now gone home and our length of stay is measured on the month that the patient is discharged in.*
>
> *Interviewee 3*

Measurement issues were also reported by another interviewee:

> *So one of the challenges has been around measurement, actually, the . . . you know, the quality of data hasn't entirely helped . . . Once a patient is ready to go but for external reasons, is delayed, you know, that is a bit of the patient journey that a case manager cannot really impact on. What we want to measure is, compared to last year, the time from admission to N2, which is a form that's filled in when patients are ready to go, or discharge them. But actually to . . . you think that would be quite easy but it's been incredibly difficult.*
>
> *Interviewee 1*

Discharge

Two of the trusts under study, trusts A and B, have been designing and piloting transition care programmes, with hospital care being delivered at home before formal hospital discharge. In trust A, the intervention involved a private sector contractor providing care at home. Its role is to identify eligible (older) patients in the medicine and surgery departments and to deliver care in their homes once their clinical status is stabilised. In trust B, care in the home setting is delivered by hospital staff. Services provided in the home setting include physiotherapy and wound dressing. The patient will remain under supervision by the consultant and is not formally discharged. Interviewees noted that these initiatives were developed based on the 'evidence' (interviewees 5 and 7) or the 'belief' (interviewee 7) that patients recover faster in the home environment, and that they would therefore be discharged faster. Interviewees also mentioned that such schemes correspond to the preferences of patients and carers who feel more comfortable in their home environment. Additionally, there is an expectation that hospital at home may release inpatient bed capacity through reduced length of stay:

> *I think it's certainly released the pressure as far as the throughput of patients, do you know what I mean; they're able to get more patients in and particularly within surgery we're hoping that it will mean that they can get the patients in as planned.*
>
> *Interviewee 7*

There was also a perception that such interventions would be less costly than a regular inpatient stay (interviewee 7). At the same time, the potential for such a programme to lead to substantial savings was seen to be limited, mainly because the intervention would only be suitable for a select group of patients. This last point was also identified as one of the main challenges in implementing the programme (interviewee 7), as the capacity to identify eligible patients before discharge requires strong collaboration with clinicians in charge of patient care. Co-ordination and communication, alongside clarification of roles and functions, was thus identified as one of the key features necessary for the intervention to be successful (interviewees 5 and 7).

Clinical care pathways

Clinical care pathways were reported to be commonly used, frequently originating from pathways in surgery which then informed the development of clinical care pathways elsewhere. One of the challenges of designing pathways, identified by interviewees, was the availability and engagement of clinicians to help develop the different stages in the clinical care pathway (interviewees 8 and 5). Clinician engagement was also seen as key for the actual implementation, with 'ownership' perceived to be central to successful implementation (interviewee 8). The multidisciplinary character of pathway teams was considered as an enabler in the design and implementation of clinical care pathways (interviewee 5). It was suggested that adoption of new information systems could help streamline clinical care pathways by automating tasks and centralising data (interviewee 8):

> *One of the problems for pathways is if people don't buy into it, if they don't see how useful they are, it won't work unless it's an electronic system where you literally go through and you can't go anywhere unless you use it . . . If you're working in a factory and you decide to change your production line, you probably change a piece of machinery or something like that, so actually people can't any longer do it the old way, they have to do it the new way.*
>
> *Interviewee 8*

Summary

In summary, interviews with a small number of senior staff involved in the implementation and delivery of interventions seeking (directly or indirectly) to reduce length of stay highlighted a range of perceived and actually observed benefits of such interventions, both financial and with regard to patient outcomes. Given the very small sample interviewed for this study, it is not possible to generalise across and to other organisations in the NHS, and we were only able to shed light on a few select examples of approaches taken by NHS trusts. There appears to be some commonality across trusts, with an emphasis on streamlining processes and optimising efficiency of the patient journey from admission to discharge. Factors required to successfully implement interventions as perceived by study participants included leadership, clinician engagement, definition of roles and responsibilities, clear lines of communication and cross-team collaboration.

Chapter 4 Discussion, conclusions and research recommendations

This report presents the findings of a rapid assessment of the available evidence of organisational initiatives and interventions having an impact on length of stay in acute care hospitals. By means of a review of the published literature, we sought to describe the nature of strategies that have been tested, identify modifiable factors known to influence length of stay, and assess the impact of interventions to reduce length of stay on patient outcomes, service outcomes and costs.

In this chapter we discuss the main observations of the evidence review and provide recommendations for future research. Before doing so, it is necessary to highlight some of the limitations of the work presented here.

Limitations of the study

We highlighted earlier that the range of interventions that have an impact on length of hospital stay is very diverse in nature and scope. Thus, strategies and initiatives range from the introduction of innovative surgical techniques, which would allow procedures that previously required admission to hospital care to be carried out as day surgery, to complex interventions involving multidisciplinary hospital teams working closely with primary care and community services to support early discharge or, indeed, the delivery of inpatient services in alternative settings, such as virtual wards[91] or hospital at home.[92,93]

In this study we focused on organisational interventions with a particular emphasis on patient management in the non-elective, in-hospital setting, including those initiated by the hospital but implemented in the community. We only considered assessments of interventions which provided a quantitative estimate of the impact of the given organisational intervention on length of hospital stay. We recognise the limitation of this approach, as it did not capture interventions that by virtue of reducing or avoiding admission to hospital would have an impact on length of stay, such as the provision of services in alternative care settings. Although such interventions might affect length of stay, and could indeed provide a viable alternative to inpatient care, they were outside the scope of this review. Interviews with a small sample of NHS clinicians involved in the delivery of interventions seeking, directly or indirectly, to reduce length of stay, as presented in *Chapter 3* of this report, provided limited insight into examples of initiatives that are being implemented in acute care settings. There is scope to assess the nature and type of interventions that are being implemented across NHS organisations more systematically.

We restricted our analyses to reviews published between 2003 and 2013 and primary studies reporting on data collected from 2003 onwards. We accept that by imposing such limits we may have missed the potential for important lessons to be drawn from earlier work. However, the NHS has undergone considerable change during the last decade, including a move to activity-based financing of acute hospital services from 2003 onwards. This was intended to encourage hospitals to reduce length of stay among other things, thus freeing up capacity to treat a greater number of patients more quickly and improve access to health care.[94] We believe that we have captured those types of interventions most pertinent in terms of informing current practice in the NHS.

We included only studies that met a minimum threshold of quality, with the research question, methods and results clearly stated and reported. However, we did not formally assess the quality of the studies by means of a detailed evaluation and included a range of evidence levels, from systematic reviews and RCTs to before-and-after studies without a control. We chose to do so in order to capture evidence of potentially promising practice which, though it would benefit from the application of more rigorous designs, could be relevant to the NHS. We note that we identified a relatively larger number of RCT

designs among interventions targeted at the discharge stage than among those aiming at the in-hospital stay more generally. We acknowledge that some interventions are more amenable to robust experimental and quasi-experimental evaluation designs than others, in particular complex organisational interventions that involve a range of actors and settings. We should, however, note that in our searches we did consider evaluations of interventions that used less robust designs, such as before-and-after studies, which tend to be more common among complex organisational interventions. We sought to capture these by also considering the grey literature as made available through SIGLE, and as long as the study description met our minimum quality criteria (i.e. the research question, methods and results were clearly stated and reported), we would have included such evaluations in our review. However, by definition we did not include interventions that were not subject to some form of evaluation, and in this sense we will have missed innovative approaches that are currently being implemented.

Against this background, it is also important to highlight that studies included here tended to be characterised by heterogeneity in the definition and description of the intervention and components of care under study. This made systematic categorisation and comparison challenging. In several instances, particularly for systematic reviews which considered interventions set in hospital and in the community, it was difficult to determine the degree to which the original studies considered would have met our working definition of organisational intervention initiated in hospital. We clustered reviews and primary studies according to the stages of the patient's passage through the hospital, distinguishing interventions targeted at the patient journey during the hospital stay from those targeting discharge; we also considered clinical care pathways as a separate category, in line with our conceptual framework. However, in several instances the categorisation of interventions was not clear-cut and there was considerable overlap across categories and subcategories, and these could potentially have been presented differently. We recognise this challenge and we have attempted to be explicit in our process of categorisation throughout.

Summary overview of key observations

Organisational interventions that have the potential to have an impact on length of stay in hospital

We have highlighted the limitations of the evidence base from which to draw conclusions. However, evidence that is available points to selected types of interventions that may have the potential to reduce length of hospital stay. Acknowledging that the context within which interventions identified in our review were implemented and the populations targeted will have an impact on the size of any observed effect. We identified the following potentially effective interventions: multidisciplinary team care; improved discharge planning; ESD programmes; and clinical care pathways. We discuss the key observations for each in turn.

Multidisciplinary team care

There was evidence that a range of interventions which involve multidisciplinary teams or care models may reduce length of stay. These included some forms of organised stroke care delivered in dedicated units,[33,36] multidisciplinary interventions including rehabilitation[35] and some forms of geriatric assessment.[49,52] The composition and specific functions of multidisciplinary teams will vary with the setting within which related interventions are being implemented, but common elements include individual patient assessment and review, which may include the development of a treatment or care plan; a co-ordinating function to optimise patient care and follow-up; and education of other staff. Multidisciplinary teams typically include doctors and specialist nurses and, frequently, physiotherapists and other allied health workers.

The strength of evidence varied across interventions using multidisciplinary teams or care models. For example, evidence supporting multidisciplinary stroke care was able to draw on a comparatively large number of RCTs (e.g. the Stroke Unit Trialists' Collaboration[36] analysed 26 RCTs comparing organised stroke care with an alternative service), whereas evidence supporting multidisciplinary interventions

involving some form of geriatric assessment was based on small or uncontrolled studies only and should be interpreted with caution.[49,52]

Given the wide range of interventions and populations considered, it is difficult to arrive at overarching conclusions regarding the impact of interventions involving multidisciplinary teams or care models on average length of hospital stay. For example, pooled analyses of multidisciplinary stroke care trials found that reductions in length of hospital stay in the intervention groups ranged from 2–6 days to just under 10 days.[36] These differences in effect size reflect the range in the nature of individual interventions considered in each of the reviews of multidisciplinary stroke care,[33,36] although it is important to note that both reviews found the evidence for dedicated stroke wards that bring together acute and rehabilitation care to be strongest.

Improved discharge planning

Improved discharge planning may lead to a range of benefits, including more efficient and rapid processes in completing paper work, greater communication between primary and secondary care, and increased satisfaction among patients. Impact on length of stay of interventions targeted at this stage appear to be modest, however, with pooled analysis showing a reduction in average length of stay of less than 1 day.[31] We note that the systematic review by Shepperd *et al.*[31] has been updated since we carried out our search.[21] This updated review considers three additional studies but the overall conclusion and size of pooled effect remain the same.

Early supported discharge

Conversely, studies of ESD indicated that there may be potential for reductions of between 7 and 10 days in length of stay, without an increase in subsequent admissions.[42,43] ESD programmes are perhaps the category of intervention where the aim to reduce length of stay is most explicit and it appears that this aim has been a core driver of the effect. Supported discharge, without the emphasis on accelerated discharge, did not show the same effect on length of stay. This may seem an obvious finding, but understanding the relative effect of different intervention types on length of stay may be an important consideration in prioritising different courses of action. Fewer studies evaluated postdischarge programmes, which may be an effect of the inclusion and exclusion criteria which we applied. As might be expected, these interventions did not appear to have an impact on length of stay for the index admission. In such cases, evidence of subsequent utilisation of services is particularly important to understand, but the evidence in this regard was mixed.

Clinical care pathways

Evidence that evaluated clinical care pathways points to positive impacts on length of hospital stay and patient outcomes such as mortality; this appeared to be more common in specific contexts where the pathway can address locally important problems or bottlenecks.[46] Recognising the small number of studies identified in this category, the available evidence highlights that the implementation of clinical care pathways led to improvements in processes or teamwork, reduced delays in discharge and better collaboration within the care team.[22,77,79]

Further observations

When considering the evidence base reviewed in this report, it is important to highlight that we identified nursing-led inpatient units as one intervention where available studies suggested potential to improve some patient outcomes, such as functional status and independent living post discharge, but also indicated that the intervention may increase length of stay.[23,67] This suggests that if the primary aim is to reduce length of stay, nursing-led inpatient units as they have been implemented are unlikely to achieve this. It further highlights that focusing the evidence of effect on singular indicators such as length of stay might miss the potential of some interventions to positively affect other outcomes, and the need to interpret the evidence in the context within which specific interventions are implemented.

Considering the available evidence on nursing-led inpatient units in particular, which included one systematic review of 10 studies[23] and one primary study,[75] it was not clear to what extent longer length of stay contributed to patients being better prepared for discharge as indicated by selected patient outcomes. At the same time, the systematic review also found evidence of a potential adverse effect, with indications of an elevated risk of early mortality (which was not statistically significant).[23] This highlights the need for close monitoring of such interventions when considered for implementation in practice.

Implementing organisational interventions seeking to reduce length of stay: what we know and what we do not know

A number of studies reviewed in this report noted that the success of an intervention is heavily dependent on local context and that transferability to other settings may be limited. Only a small number of studies provided detail on intervention rationale and selection, or described the process of implementation that would help in understanding the key factors required for effective translation of evidence presented here into practice. Those that did, highlighted the need to use an iterative process involving adapting and refining the intervention protocol to best address the needs of the patients, fit the resources of the organisation or maximise the efficiency of the intervention.[60,64,80]

The degree to which a given intervention was implemented successfully was rarely assessed explicitly, although a small number of studies provided indirect measures such as level of adherence to a guideline, protocol or best practice.[49,50,58] Verdu *et al.*[80] reported an 'implementation indicator', which was measured as the number of patients who followed a clinical care pathway for lower-extremity deep-vein thrombosis and the number of patients who 'should' have followed it.

The ultimate measure of success of a given intervention is the degree to which the primary outcome, for example reducing length of stay, is being achieved. However, a number of studies, particularly systematic reviews, failed to establish a (statistically significant) effect or found effect sizes to vary across interventions. This was frequently attributed to variation in the nature and scope of the interventions themselves, although several studies also highlighted that the nature of the effect may vary by population subgroup. For example, Fearon and Langhorne,[42] in their meta-analysis of 13 RCTs of ESD for stroke care, found that there was potential for greater reduction in length of stay among patients with more severe stroke. In guidelines for early discharge and switch from intravenous to oral antibiotics in the management of community-acquired pneumonia, Lee and Lindstrom[88] reported a significant reduction in length of stay for all groups except patients with the most severe pneumonia. A systematic review of hospital-based case management found the intervention to be effective (as measured by reduced length of stay) for patients with heart failure and frail older people, but not for stroke patients.[38] Curtis *et al.*,[54] assessing trauma case management, found the intervention to significantly reduce length of stay for those aged 45–64 years but not those aged 65 years and over, although differences were small. Although it is difficult to generalise from these findings, they highlight that interventions might need to be (re)designed to target those who are likely to benefit most.

This last observation also points to a more general need for those designing and implementing interventions to better understand the likely impacts of the intervention in question from the very start, particularly regarding its potential to improve processes and outcomes beyond what is already being achieved at organisational level. For example, one primary study which evaluated inpatient geriatric consultation for older patients with traumatic hip fracture did not find evidence of a reduction in length of stay for the intervention group compared with a control group receiving usual care.[48] The authors attributed this lack of effect to the observation that 'usual care' was already fairly comprehensive, suggesting that the potential to benefit, in terms of length of stay, from added geriatric consultations might have been small. Similarly, Kim and Soeken,[38] in their systematic review of hospital-based case management, noted that the absence of a (significant) effect in a group of stroke patients in the UK was most likely because the comparator group of stroke patients already received multidisciplinary care and the added benefit of a case manager would have been small.

This suggests that when designing a new intervention, it will be important to first understand the precise nature of the underlying problem that the intervention seeks to address. Epstein and Sherwood[95] referred to this process (albeit in a different context) as the need to assess the inefficiencies in the existing structures (such as at hospital or ward level) which would then inform the design and implementation of effective interventions suitable to achieve intended outcomes. This requires good theoretical understanding of the links within the causal chain and how the intervention is expected to cause change of ('theory of change').[96] We suggest that by improving the theoretical underpinning of the design, selection, implementation and reporting of an intervention, a more systematic and informed approach could be taken to determine the appropriateness of an intervention to a particular setting, or the degree to which it could be successfully implemented.

However, although good understanding of how a given intervention is expected to lead to improved outcomes (however defined) is an important prerequisite, successful implementation will crucially depend on those expected to deliver the intervention. This issue was not explicitly discussed in studies reviewed for this report, and here we can only draw on our arguably limited evidence from interviews with a small group of NHS managers and clinicians involved in the implementation and delivery of interventions seeking to reduce length of stay. This highlighted a number of factors perceived as key in order to achieve 'buy-in' and adoption of change, such as clinician engagement, well-defined roles and responsibilities, clear lines of communication, staff commitment and cross-team collaboration. These observations are supported by the wider literature around change management in health care and the role of clinical leadership.[97,98] For example, a recent exploratory study into models of medical leadership and levels of clinical engagement in NHS organisations found that trusts with high levels of engagement tended to perform better on available measures of organisational performance than trusts with low levels of engagement.[99]

Key informant interviews also highlighted the need to take account of patient preferences when designing models of care suited to reducing length of stay. It was, however, not always clear to what extent hospitals routinely evaluated patient experience to monitor the intervention success and, in particular, whether or not, or how, they used such information to modify and adapt interventions to meet the needs of the patients. Patient experience was reported in some studies, but this was frequently conceptualised as satisfaction measure only. Satisfaction is a limited concept, particularly in health care where reported satisfaction is likely to be high,[100] and the correlation between length of hospital stay and satisfaction has recently been questioned.[101]

Reducing length of hospital stay may also have important implications for family or carers, but this is not well reported in the literature. Our review identified only limited evidence that patients or carers had been actively involved in the design of the interventions or resulting evaluations. There were some examples of patient engagement, for example the involvement of representatives of a local patient association in Sweden in the development of a patient-centred care protocol.[55] Taken together, this calls for a more sophisticated understanding of patient experience and preferences in this context.[102]

Interventions seeking to reduce length of stay may reduce costs but the evidence is difficult to generalise

We have noted in the introduction to this report that average length of stay in hospital is frequently used as an indicator of efficiency.[10] Reducing the duration of hospital stay reduces the cost per discharge; there is also an expectation that shorter stay may shift care to (less expensive) alternative settings. At the same time, shorter hospital stays can be associated with a higher intensity of services provided, and can also be more costly on a day basis. Against this background, it may not be surprising that the evidence reviewed here has tended to be mixed with regard to the extent to which interventions seeking to reduce length of stay were associated with cost savings. Additionally, much of the evidence was from countries outside the UK and it is difficult to transfer insights to the UK context.

Information on cost and cost savings was typically inferred from reduced utilisation rather than measured directly. Indeed, most of the available evidence on cost was derived from bed-days saved, which

constitutes a proxy for cost savings rather than a full economic costing. Evidence on discharge showed that ESD programmes may be associated with greater declines in length of stay, but that cost savings may be moderate given the intensity of the intervention required pre and post discharge.[70] Some studies did make an attempt to assess whether or not the costs saved from fewer days in hospital compensated for the costs associated with delivering the intervention and subsequent health-care utilisation.[70,74] Overall, however, such analyses were not undertaken in the majority of studies reviewed here. Furthermore, where costs were assessed, these frequently used a health service perspective only, and it remains unknown to what extent observed savings occurred at the expense of services provided elsewhere or affected patients and families themselves. Thus, costs saved or incurred in one part of the health system economy were not generally understood in relation to their impact on costs or savings elsewhere. Therefore, although we found several studies reporting a cost saving for different interventions, we cannot draw firm conclusions.

Our inclusion and exclusion criteria meant that studies that modelled the potential (economic) impacts of a given intervention, and might thus have provided further insights, may not have been captured. This can be illustrated by a study by Gray *et al.*,[103] who conducted an economic modelling study of the potential costs and savings associated with an antibiotic and infection management intervention and its effects on early discharge. The study considered costs associated with the implementation of the intervention and hospital utilisation, alongside community support costs and costs of outpatient parenteral therapy. It found that the intervention had potential to reduce the use and cost of antibiotics, and the length of stay, and that only a small proportion of these potential savings would be offset by other costs. Further sensitivity analyses also highlighted the impact on costs of patients with very long inpatient stays. Although findings such as these need to be confirmed by an assessment of the actual costs incurred (and potentially saved) by the intervention, an economic assessment at this level can provide important additional insight into the (likely) effectiveness of a given intervention.

There is scope for wider use of economic modelling studies such as that conducted by Gray *et al.*[103] Such approaches can help in understanding the cost implications of scaling up promising interventions within varying parameters to a wider range of providers, or at regional or national level.[104]

It was outside the scope of this review to assess how the success of interventions seeking to reduce length of stay in hospital is influenced by the financing arrangements within which hospitals operate; and it is conceivable that organisational and system features will influence the transferability of a given intervention from one setting to another.[23,58,63,65] We highlighted earlier (see *Limitations of the study*) that our review only included reviews published from 2003–13; and primary studies reporting on data collected from 2003 onwards, coinciding with the move to activity-based financing ['payment by results' (PbR)] of (initially, acute) hospital services in the NHS. The introduction of PbR has been associated with an accelerated decline in average length of stay in acute care hospitals in England,[12] which was also interpreted as a reinforcement of an already existing trend of falling length of stay.[105] We also noted earlier that a considerable proportion of the evidence reviewed here originated from the USA and Australia, and a small number of European countries. All these countries operate some form of activity-based financing of (acute) hospital care, although the precise details of how the financing mechanism is used varies between countries.[11] It was not possible, in the context of our study, to assess the possibly differential impact of approaches to hospital financing on the likely success of a given organisational intervention to reduce length of hospital stay in different health-system contexts.

It is also conceivable that a changing macro-economic climate will exert pressures at the organisational level that may have an impact on the success of a given intervention in reducing length of hospital stay, and the sustainability of potentially promising programmes. For example, our review included one observational study[52] of an intervention (HELP) that involved geriatric interdisciplinary care implemented in one hospital in the USA. A recent qualitative study of the HELP intervention, implemented across a larger number of sites across the USA, found that several operational sites had been closed over recent years. This was in part because of challenges created by the financial crisis of the late 2000s, which led to the removal of 'programme champions', and a new focus on revenue-generating programmes, among other

factors.[106] This suggests that a financially constrained environment may make certain programmes vulnerable. Some of the findings are difficult to generalise from the USA, but they highlight the importance of sustainability of programmes and the need for buy-in among senior health-care professionals, a concern echoed in our interviews with NHS managers and clinicians.

Reducing length of hospital stay: generating evidence to inform practice

We highlighted earlier how a lack of observed effect of a given intervention that seeks to reduce length of stay may be due to a range of factors related to its design, such as its suitability to a given patient population group or its (limited) potential to improve above and beyond service structures already in place.

The conceptual framework guiding our work (see *Figure 2*) served to identify those stages in the patient journey where interventions may have an impact on length of hospital stay and the elements of the health system involved, but it does not describe how a given intervention might cause a desired change at each of these stages. As we have noted above (see *Implementing organisational interventions seeking to reduce length of stay: what we know and what we do not know*), such an understanding will be of key importance to ensure that an intervention achieves its desired outcomes, or where it does not, to help in understanding the components that have influenced a possible lack of observed effect.[107] Although studies included in our review did not generally provide insights into the precise mechanisms by which a given intervention was expected to 'work', the majority will include elements of professional behaviour change, whether it be adoption of new guidelines, changed models of teamworking or change in routine practice. More specific theory-informed frameworks have recently been used in implementation research that would help in the development, evaluation and testing of such interventions.[108] A growing body of work is also available on clinical care pathways as complex interventions and the implications for design and evaluation.[109,110] It will be important for future studies to take such factors into account and, at a minimum, improving reporting of organisational interventions designed to reduce length of stay will increase the opportunity for learning.[111]

Although our review has provided useful insights into the types of interventions that have potential to reduce length of hospital stay, lesson learning was limited by the evidence available, and the degree to which studies included provided sufficient detail to allow assessment of the specific contextual factors that have helped or hindered the success of a given intervention and its potential for transferability across settings and populations. Furthermore, by its very nature, the methodological approach of the REA used in this study will always be limited, as it has to draw on the published studies of interventions that have been evaluated in some form, and our inclusion and exclusion criteria may have excluded literature that may have provided further valuable insight. There has been debate over whether systematic reviews or derivations such as REA are best suited to synthesising evidence on complex interventions such as those considered in this review.[112]

In order to achieve a more nuanced understanding, a realist synthesis approach which focuses on the contextual influences of whether, why and how interventions might work could usefully complement our review.[113,114] A theory-driven approach, realist syntheses draws on a range of sources in order to test specific theories, using iterative search processes with an element of flexibility to allow for reflection and back-tracking. Such an approach would, for example, likely consider documents which we would have excluded from our review, involving a much greater reliance on grey literature in addition to the peer-reviewed empirical literature, while maintaining the same level of rigour and transparency applied to traditional forms of evidence review. Importantly, realist review takes explicit account of stakeholder views, with the focus of the synthesis derived from negotiation between stakeholders and reviewers. Such an approach could explicitly consider the health-system context within which organisations operate, something which was not possible in the context of the rapid evidence synthesis presented in this report. Undertaking realist synthesis is resource intensive,[115] although more rapid forms of realist review have been developed recently in order to provide more timely evidence to inform decision-making,[116] and any such work could usefully draw on the evidence synthesised in the present review to inform theory development and search strategies.

However, although a realist synthesis would contribute greatly to our understanding of why and how a given intervention might work (or not), and the factors that may enable or hinder implementation, it will still be limited in that it might not capture potentially innovative interventions which are being implemented across organisations at present, and which might provide useful learning for organisations. Interviews with a small number of NHS managers and clinicians for this study identified the range of interventions that have been or are being implemented by NHS acute trusts, and highlighted factors seen to be key for the success of a given intervention, including learning that was not explicitly articulated in the published literature reviewed for this report. Given that we were only able to capture a very small sample of hospital trusts and the managers and clinicians within these, a potentially useful follow-up on the present review could involve a larger study using a case study approach capturing a broader set of NHS hospital trusts. This would draw on document review as well as interviews with staff at the different tiers of a given trust to understand the strategic vision, as well as challenges for front-line staff to deliver interventions. Such a study would, however, have to take account of the additional demands it would place on individuals and the challenges of recruiting a sufficient number of participants to commit to the study.

Implications for practice

In this study we sought, by means of a review of the published literature, to (a) describe the nature of strategies that have been implemented to reduce length of stay, (b) identify modifiable factors known to influence length of stay and (c) assess the impact of these interventions on patient outcomes, service outcomes and costs. Evidence reviewed in this report points to selected types of interventions that have the potential to reduce length of hospital stay. These were:

- Multidisciplinary team care, for example some forms of organised stroke care. This may include care from specialist geriatricians and rehabilitation specialists.
- Improved discharge planning. This may lead to a range of benefits including more efficient and rapid processes in completing paper work, better communication between primary and secondary care, and increased satisfaction among patients.
- ESD programmes. These show potential for significant reductions in length of stay without an increase in subsequent readmissions. Postdischarge programmes without a focus on early discharge did not appear to reduce length of stay.
- Clinical care pathways. These include an explicit statement of goals and key elements of care and the co-ordination of the care process by co-ordinating and sequencing the activities of the care team. This needs to include good communication among team members and with patients and families. The approach requires structured care plans detailing essential steps in the care of the patient.

We also found that nursing-led inpatient units were associated with some improved outcomes but, if anything, increased length of stay. However, there was also some evidence of potential adverse effects, suggesting the need for close monitoring if implemented as a strategy.

The context within which interventions identified in our review were implemented and the types of populations targeted will have an impact on the size of any observed effect. Studies frequently lacked detail on the implementation process that would allow for systematic assessment of modifiable factors known to influence length of stay. There was evidence of a differential impact of some interventions on population subgroups, with reductions in length of stay varying by age, the nature and severity of the condition and other patient characteristics, suggesting that interventions might need to be designed to target those who are likely to benefit most.

Where studies failed to establish evidence of measurable reductions in length of stay following an intervention, this was frequently, although not always, because the potential to improve above and beyond what was already being delivered as ‘usual care’ tended to be small. For example, adding an

additional specialist to an existing multidisciplinary team might only convey a small added benefit, although any such conclusion would need to be based on a sound assessment of the existing delivery structure in a given organisational setting. The evidence on nursing-led inpatient units described above also suggests that a focus on length of stay as a singular key outcome measure might miss other potential beneficial effects of a given intervention on patient outcomes.

The design and implementation of an intervention seeking (directly or indirectly) to reduce length of stay should be informed by local context and needs. This involves understanding how the intervention is seeking to change processes and behaviours that are anticipated, based on the available evidence, to achieve desired outcomes ('theory of change'). It will also involve assessing the organisational structures and processes that will need to be put in place to ensure that staff who are expected to deliver the intervention are appropriately prepared and supported.

We found that patient views on a given intervention were rarely reported. Although this does not mean that patient views were not taken into account, it suggests that there is potential for greater patient involvement in the design and monitoring of interventions seeking to reduce length of hospital stay. Systematic assessment of patient feedback during the implementation process could usefully inform further adaption to the needs of patients. Service design needs to take account of the range of priorities, expectations and needs of patients, particularly where it concerns transition from hospital to home.

There is an expectation that interventions aimed at reducing length of stay will lead to cost savings. Studies reviewed in this report provided some tentative evidence to support this assumption, although costs were generally poorly reported and findings were not easily transferable across settings, particularly those from studies carried out in different health systems. In order to more fully understand the implications of a given intervention for costs, commissioners and practitioners should consider, as part of the implementation of the intervention, systematic collection of related data, informed by the theoretical model underlying the intervention. From a commissioner's perspective, it will be important to consider the cost implications for the wider local health economy, including the direct or indirect impacts of the interventions that succeed (or even fail) in reducing length of hospital stay on service utilisation within and outside hospital, including outpatient services, primary care and community services.

Recommendations for further research

Reviewing the evidence presented in this report, we have identified a number of gaps in the evidence that would benefit from further research to usefully inform practice. We offer a small set of recommendations for further research, relating to the design, implementation and evaluation of organisational interventions seeking to reduce length of hospital stay. We note that these areas are not necessarily indicative of distinct fields of research; indeed, they can be thought of as stages on a continuum of implementation and evaluation research. Furthermore, the recommendations are not necessarily specific to interventions seeking to reduce length of stay in hospital; instead they cover the same ground as many other recent debates in the literature on the implementation and evaluation of complex interventions in health care.[96,117,118]

1. *Greater attention should be given to the theoretical underpinning of the design, implementation and evaluation of interventions or programmes.* Only a small number of studies reviewed in this report provided detail on the design of the intervention(s) under study, and the extent to which this was informed by a 'theory of change' also guiding implementation and evaluation. Although this apparent shortcoming may not necessarily indicate the absence of a theory, and may, at least in part, be attributable to the nature of the review we have undertaken, we argue that explicit definition and reporting would help to advance the literature in the field and improve learning from one context to another. Guidance such as that issued by Craig *et al.*[96] on behalf of the Medical Research Council, and other guidance in the field of implementation research, offers specific frameworks, for example relating

to behaviour change programmes.[119] Such guidelines can be helpful for researchers and implementers in taking systematic steps and making the theory of change underlying a given programme explicit. They also help in defining measures of success and understanding the extent to which desired outcomes are likely to be achieved, in the context of the organisational and wider health system setting within which the intervention is set.

2. *There is a need for further research using appropriate methodology to assess the effectiveness of different types of interventions in different settings.* Our review highlighted methodological shortcomings that prevented us from being able to confidently interpret some of the results. Future research should not focus only on the impact of such interventions on length of stay as the sole indicator of success, but should set this in relation to other impacts such as patient outcomes, service utilisation and costs more broadly. Careful consideration should be given to study design including treatment allocation and choice of comparator.
3. *Different evaluation approaches may be useful, and closer relationships between researchers and NHS organisations would enable more formative evaluation.* One approach to address design and reporting shortcomings of current research mentioned above lies in the capacity of stakeholders to embed evaluation into the design of an intervention, or at the early stages of the implementation phase. Benefits of such research practice would include the possibility of adapting the intervention protocol to the needs and resources of the organisation at different points in time. Other approaches, such as realist reviews, have the potential to address the questions of what works, where, why and for whom, questions which were repeatedly raised through our review. Such an approach would aim to identify the drivers of and barriers to change, disentangling the influence of the local and organisational contexts from the impact of the interventions themselves, and therefore contributing to the production of practical guidelines for health-care managers.
4. *Full economic costing should be undertaken where possible.* Studies reviewed in this report provided some tentative evidence to support the assumption that interventions aimed at reducing length of stay may be associated with cost savings. However, costs were generally poorly reported, and findings are not easily transferable across settings, particularly those from studies carried out in different health systems. Further research is needed that considers the cost implications for different stakeholders in the system, and takes a societal perspective to capture costs that affect the wider local health economy.

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Céline Miani (Analyst, Health and Healthcare) was involved in data collection and analysis, and in the preparation of the report.

Dr Sarah Ball (Analyst, Health and Healthcare) was involved in data collection and analysis, and in the preparation of the report.

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Dr Sarah King (Senior Analyst, Health and Healthcare) was involved in the preparation of the report.

Professor Martin Roland (Health Services Research) was involved in data collection and analysis, and in the preparation of the report.

Dr Jonathan Fuld (Consultant Physician) was involved in the framing of the study, the interpretation of the results and the finalisation of the report.

Dr Ellen Nolte (Research Director, Health and Healthcare) was principal investigator of the project. She led the study and was involved in data collection and analysis, and in the preparation of the report.

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Appendix 1 Original review protocol

Aims and objectives

The overarching aim of the project is to:

- describe the nature of initiatives and interventions that have been used to reduce length of stay in acute care hospitals;
- identify the factors that are known to influence length of stay; and
- assess the impact of interventions to reduce length of stay on patient outcomes, service outcomes, and costs.

The evidence synthesis will be undertaken in two stages: (i) a review of published literature relating to length of hospital stay, drawing on evidence from systematic reviews and primary research of high quality (experimental and quasi-experimental design; high quality observational studies), and (ii) key informant interviews with NHS stakeholders to explore experiences of initiatives for reducing length of stay.

We identify four tasks that we will undertake: (a) review of the published and grey literature on initiatives to reduce length of stay; (b) assess the experience from NHS key informants of initiatives to reduce length of hospital stay; (c) derive recommendations based on the strength of the evidence reviewed and how it may best be used to meet the needs of the NHS; and (d) reporting strategy.

Our approach

The principal approach to be used is a review of the published and grey literature based on Rapid Evidence Assessment (REA). We will complement this review by a series of interviews with a small set of NHS managers and clinical leads, representing key stakeholder views, including review of selected initiatives to reduce length of hospital stay in England. This second component of the work will provide important additional insights that will usefully complement the scientific evidence reviewed. Based on our previous work we expect that while a select set of interventions may appear to be promising, implementing such approaches in practice will depend on a range of system factors which are not easily identifiable and/or documented in the published literature. Such factors are frequently not easily identifiable and/or documented in the published literature and we will therefore carry out interviews with key informants in a select set of settings in order to better understand the most salient issues that facilitate or hinder the implementation of new interventions designed to reduce length of stay. This will help placing the findings of the evidence review in the NHS context and so inform how our findings might best be used to meet the needs of the NHS.

Below we describe the principle tasks we propose undertaking.

Task 1: Rapid evidence assessment

Rapid Evidence Assessment (REA) is a comprehensive, systematic and critical assessment of the scope and quality of available evidence. RAND Europe has developed a tried and tested approach to conducting REAs on a range of topics (Nolte et al. 2010; Nolte et al. 2012). The review will be carried out following the general principles of undertaking reviews in healthcare, and builds on the collective experience of the expert team assembled for this project including Cambridge Centre for Health Services Research directed by Professor Martin Roland, who previously led the SDO review on outpatient services (Sibbald et al. 2007).

The REA principally comprises the following steps:

i. Defining the question
ii. Preparing the review protocol

   (a) Defining inclusion and exclusion criteria for studies
   (b) Determining search terms
   (c) Identifying sources to be searched
   (d) Setting up information management processes

iii. Performing the study search and assessing study relevance (including reviewing existing systematic reviews):

   (a) Pilot testing of search terms and inclusion criteria
   (b) Conducting the full search
   (c) Reviewing titles and abstracts
   (d) Finalising inclusion/exclusion criteria

iv. Extracting data and synthesising the evidence:

   (a) Reviewing and characterising included studies
   (b) Assessing the qualities of the studies
   (c) Synthesising findings

As the question for this review is already defined (step (i)), the next sections detail steps (ii), (iii) and (iv).

Preparing the review protocol

The development of the review protocol involves first defining the criteria for inclusion of publications into the review, as well as exclusion criteria. Principal criteria relate to (i) the topic and scope of studies to be included; (ii) study design (eg randomised trial, observational study, systematic review); (iii) publication period and language.

Second, we will develop a systematic search strategy, including establishing a rationale for search methods as well as drafting, testing and reporting a search strategy. Reviewers also must consider the number of studies that will be feasible to screen, the accessibility of studies, and the types of sources to include in the search. We will identify key search terms based on the central concepts in the review questions and also use the assistance of support staff at the RAND library experienced in conducting complex searches of the academic and wider literature.

This stage will also include a pre-search analysis of the outcomes measures that will be assessed for review. Based on an initial assessment of existing evidence, we propose considering three principal forms of outcomes:

- Patient outcomes
  - Satisfaction, quality of life, acceptability, preferences
  - Health status

- Service outcomes
  - Quality of care (including patient safety measures)
  - Emergency readmissions
  - Hospital: waiting times, outpatient attendance, acceptability to clinicians
  - Primary care: waiting times, workload, acceptability to clinicians
- Costs
  - Secondary care costs (including readmissions), general practitioner costs, costs of community services, costs born by local authorities, patient costs

Outcome categories will be refined following an initial screening of studies potentially eligible for review. Information management software programmes will be used where appropriate.

Performing the study search and assessing study relevance

We will pilot test the terms to ensure that terms are broad enough to include a range of relevant studies, but also narrow enough that the search is manageable. We will also pilot test the inclusion/exclusion criteria on a sample of studies identified as potentially eligible for inclusion. Two researchers will review the same titles and abstracts in order to refine and clarify search terms and inclusion criteria and ensure criteria are consistently applied. Search terms will be identified and tested by using the National Library of Medicine's Medical Subject Heading Terms (MeSH) key word nomenclature developed for Medline. Where appropriate and relevant, we will further scan reference lists of eligible studies identified in the pilot search to identify additional studies that may be of relevance.

Studies identified by searches described above will be assessed for inclusion through scanning of titles and abstracts against inclusion criteria. Where judgment on the basis of title/abstract cannot be made, full reports will be retrieved to assess eligibility for inclusion. Initial assessments will be undertaken by two reviewers independently to reduce the risk of errors. The study selection process will be documented.

We anticipate the number of records of potential relevance to be comparatively large, given the range of existing systematic reviews already identified in a preliminary search guiding the development of this proposal. We will therefore principally consider evidence from systematic reviews, complemented by primary research studies of high quality (experimental and quasi-experimental design; high quality observational studies), principally drawing on quality criteria set out for example by the Cochrane Collaboration, and the GRADE (Grades of Recommendation, Assessment, Development and Evaluation) system for evaluating the quality of evidence for reported outcomes. However, we recognise that the GRADE approach, which generally gives the highest quality rating for evidence from randomised trials, may not always be applicable to studies assessing sometimes complex interventions aimed, directly or indirectly, at reducing length of stay. Restrictive application of GRADE thus might lead to exclusion of studies that would otherwise provide important insights, in particular where contextual factors enabling or hindering implementation of potentially promising interventions are concerned. Thus, use of a set of hierarchical criteria on the basis of criteria recommended by the Centre for Reviews and Dissemination will be more appropriate. We have previously used this approach for the quality assessment of systematic reviews (Conklin et al. 2012). We will be prioritising articles published in English, but will include publications in Spanish, Dutch, German and French language if considered relevant.

It is at this stage that we will continue to populate the outcomes measures drawn from the different articles and reviews, in order to create a typology of outcomes measures specific to reducing length of stay.

Extracting data and synthesising the evidence

We will obtain full texts of studies and documents considered eligible for review and findings will be extracted using a data extraction template. As a minimum, data to be extracted will include the publication type; stated study objective/s; study design; methodological approach (e.g. for systematic review narrative review, meta-analysis); main outcome measures; findings for each of the outcome measures (where relevant); study limitations; and assessment of the quality of the study using standard criteria as identified above. Included studies will be uploaded to standard information management software, which will assist in managing the quality appraisal process between researchers and in organising and synthesising findings. Consistency of data extraction across reviewers will be checked through duplicate extraction of a random sample of studies by two reviewers independently. Disagreements will be discussed and resolved by consensus.

The methods employed for synthesis of findings will depend on the nature and comprehensiveness of the evidence. For this review, we anticipate including both quantitative and qualitative studies as each type of study will inform different parts of the research question. *Figure 1* outlines a series of questions to consider when synthesising the evidence. The method of synthesis will be informed by the number and scope of the studies included and we anticipate selecting the method of synthesis after the search has been completed.

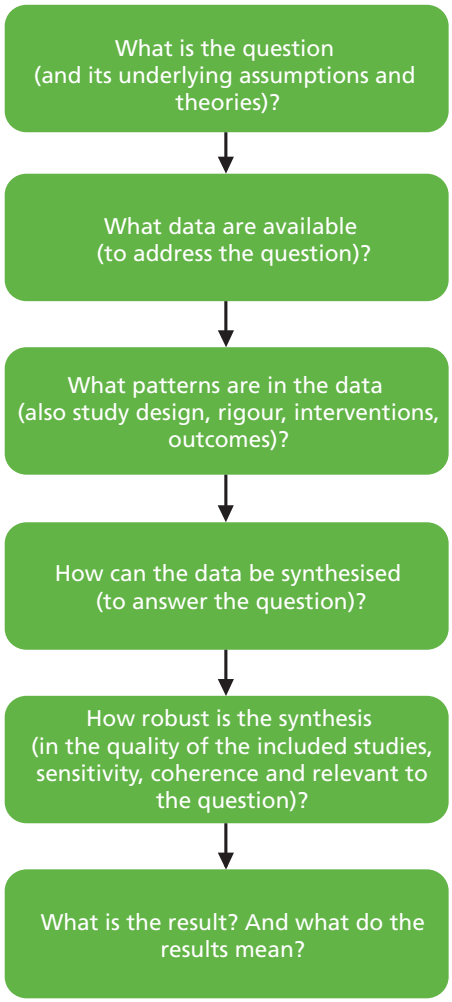

FIGURE 1 Series of questions to consider when synthesising the evidence.

Task 2: Placing the evidence in context: Key informant interviews

We will seek to place findings emerging from the evidence review in the health system context within the NHS and propose to carry out a series of interviews with a small set of NHS managers and clinical leads, representing key stakeholder views. We will initially interview informants from national organisations (such as the NHS Confederation, British Medical Association, King's Fund, and NHS Institute for Innovation and Improvement) with a view to identify local and regional initiatives that are not easily identifiable even in the grey literature. We will then interview managers of a select set of initiatives to further examine experiences. While at this stage it will be difficult to be precise about the number of initiatives to be considered, we expect exploring up to five initiatives which would be selected to present different localities (urban, rural, level of deprivation) and, where applicable, both positive and negative experiences so as to enable understanding of contextual enablers and barriers towards implementing approaches seeking to reducing length of stay.

Key informant interviews provide a means of gaining information on issues that are poorly documented and/or require a level of expertise and insight that is not easily accessible through information extracted from the published and/or grey literature. Interviews with key informants are particularly relevant to advance our understanding of salient issues relating to the health policy context and to help identify and categorise the often 'messy' elements of policy development. Expert judgement assessed through key informant interviews can be used to delineate the 'knowns' and 'unknowns' about the future of policy on a particular key health issue, and can help examine issues and factors that may be difficult to measure or quantify. Key informant interviews can also provide a valuable source of information for additional sources of data including journal articles in preparation, grey literature which can then be followed up. Key informant interviews will be carried out as semi-structured interviews to gain their views on the types of change to services which could lead to reducing length of hospital stay and the expected (or experienced) feasibility of implementation of such change. Interviews will follow a common interview guide and carried out by telephone or face to face. Interviews will follow ethical principles of conducting research involving human subjects. This means key informants will be approached in their professional function only and no sensitive personal information will be collected. Data protection measures will be put in place to maintain confidentiality of interview participants of whom written consent for participation in the interview will be sought.

Task 3: Synthesis of findings

Task 3 will synthesise the evidence compiled in tasks 1 and 2, and derive recommendations based on the strength of the evidence reviewed and how it may best be used to meet the needs of the NHS. Specifically, we will aim to identify priority areas for developing further current approaches to reducing length of stay in acute care hospitals; derive options for the use of this information in the NHS, in particular as it relates to identified gaps in current work in the NHS on the implementation of related initiatives; and comment on the appropriateness and feasibility of adapting and advancing, or possibly refocusing, existing approaches to reducing length of stay in acute care hospitals in the NHS.

Task 4: Reporting and dissemination

We believe that the proposed research is fully aligned with our mission is to support better decision making in the public interest through research and analysis. The work outlined in this document aims to synthesise the existing evidence to inform decision-makers in the NHS to realise efficiencies in the healthcare system. We will produce a research report, which will draw together findings of the major strands of work undertaken. In addition, we anticipate disseminating the work through targeting (i) the research community through publication in peer-reviewed journals and through presentation of the findings at national and international conferences and workshops in which members of the research team routinely participate; and (ii) NHS providers and decision-makers at the various tiers of the system through research notes; these are short publications aimed at busy policy makers. These would be distributed in print and/or electronically.

References

Conklin A, Yaqub O, Celia C, Nolte E. Postmenopausal osteoporosis management. A review of the evidence to inform the development of quality indicators. Santa Monica: RAND Corporation, 2012.

Nolte E, Newbould J, Conklin A. *International variation in the usage of medicines: A review of the literature*. Santa Monica/London: RAND Corporation & London School of Hygiene & Tropical Medicine, 2010.

Nolte E, Roland M, Guthrie S, Brereton L. *Preventing emergency readmissions to hospital. A scoping review*. Santa Monica: RAND Corporation, 2012.

Sibbald B, McDonald R, Roland M. Shifting care from hospitals to the community: a review of the evidence on quality and efficiency. *J Health Serv Res Pol* 2007;**12**(2):110–17.

Appendix 2 Search strategy

Language limitations: English, French, German, Spanish and Dutch.

Date limitations: 1995–present.

Document limitations: include only RCTs, controlled clinical trials, controlled before-and-after studies and interrupted time series, systematic reviews, meta-analyses, observational studies.

Country limitations: high-income countries only.

Search terms

1. Length of stay	Length of stay OR length of hospital stay OR length of hospitalisation OR length of hospitalization OR bed days OR hospital stay
2. Interventions	Day surgery OR comprehensive geriatric assessment OR enhanced recovery OR short-acting anaesthetics OR discharge planning OR patient discharge OR case management OR care management OR early discharge OR hospital at home OR post-discharge care OR clinical pathway OR service (re)design OR home ward OR virtual ward OR staffing OR staff OR organisation OR organisational OR admissions OR follow-up OR discharged OR discharge OR model of care OR payment(s) OR contract(s) OR contracting OR commission(ing) OR procure(ment) OR fees OR incentive OR management OR managerial
3. Settings	Hospital OR Primary care OR community care OR care home OR nurse care OR nursing care OR nursing home OR home care OR home OR outpatient OR secondary care OR clinic OR telecare OR tele care OR telemedicine OR telehealth OR intermediate care OR family practice OR general practitioner OR GP OR specialist physician OR specialist care OR social care OR local authority care OR long-term care
4. Outcomes: general	Outcome OR impact OR efficiency OR effectiveness OR efficacy
a. Patient outcomes	OR Patient satisfaction OR patient experience OR patient preference OR quality of life OR patient health OR health status OR acceptability
b. Service outcomes	Quality of care OR safety OR emergency re(-)admissions OR re-admissions OR readmissions OR service utilisation OR service utilization OR waiting times OR waiting list OR outpatient attendance OR acceptability to clinicians OR bed occupancy OR utilisation rate OR utilization rate OR referral
c. Costs	Costs OR spending OR saving(s) OR expense OR economy OR cost-effectiveness OR spend OR cut OR expenditure

The logic links between the different categories should be the following:

1 AND 2 AND 3 AND 4 AND 5 (general OR a OR b OR c)

Search terms should be found in the *title or the abstract*.

Appendix 3 Interview protocol

Interview topic guide: Initiatives to reduce length of stay in hospital – a rapid evidence synthesis

1. Please describe your role in the trust.
2. Intervention design: Please describe the intervention(s) your trust has or is implementing that seek to achieve a reduction in hospital length of stay. *[Probe on the following]*

    - What issue is it aiming to address?
    - When was it introduced and did everything go to plan?
    - How is it financed?
    - Who initiated it?
    - Who is leading the intervention?
    - Who is involved in running it? Which services are involved?
    - What does it consist of?

3. Challenges and enablers

    - What do you consider were the main enablers in implementing the intervention? *[Probe on available resources, staffing, commitment, work culture, ring-fenced time . . .]*
    - What do you consider were the main challenges to implementing the intervention and what were the consequences of this? *[Probe on resources and time constraints, resistance to change, logistics . . .]*

4. Outcomes

    - What were the expected outcomes? *[Probe on patient outcomes, financial outcomes, service utilisation, staff outcomes, etc.]*
    - What are the actual outcomes so far?
    - How do you know that you have achieved the (desired) outcomes?
    - How have patients responded to these changes?
    - How have staff responded to the intervention?
    - What has the wider impact been on the trust and beyond?

5. Please provide any related document that would help us understand the intervention.

Appendix 4 Studies included in the review

TABLE 3 Key characteristics of systematic reviews of interventions targeted at the patient journey during the hospital stay

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Brusco and Paratz 2006[41]	Systematic review (May 2005) Nine studies: three RCTs, two quasi-RCTs, three historical cohort, one case–control	To evaluate published literature that considered the provision of additional physiotherapy services out of regular business hours compared with the provision of physiotherapy within regular business hours, such as additional weekend, evening and 24-hour physiotherapy services	Hospital inpatients requiring physiotherapy including ICU (spinal injury), rheumatology, orthopaedics, neurology and postcardiac surgery departments	Provision of physiotherapy to hospital inpatients out of business hours (business hours defined as Monday to Friday, 09.00 to 17.00) Seven out of nine studies examined the effect of weekend physiotherapy, five studies compared 7- vs. 5-day provision, while two studies compared 6- vs. 7-day provision One study examined the effectiveness of overnight physiotherapy vs. day only and one examined the effectiveness of additional evening provision	Four out of nine studies reported significant reduction in length of stay and five reported no significant effect Effect sizes (Cohen's *d*) ranged from *d* = –6.16 (95% CI –6.93 to –5.32) to *d* = 0.19 (95% CI –0.53 to 0.91) The largest effect was associated with 7 days vs. 5 days of physical therapy treatment following total hip and knee arthroplasty Analysis of pooled data from three studies suggested a non-significant reduction in length of stay associated with the intervention (WMD –0.15, 95% CI –0.37 to 0.07 days)	Two out of nine studies reported on pulmonary complications, both reporting a significant reduction for two different patient groups in an ICU with additional physiotherapy out of regular business hours Three out of nine studies accounted for discharge destination and/or discharge mobility status with no significant difference reported Two out of nine studies reported on patient preferences. One reported that 82% of patients preferred 6 days vs. 7 days physiotherapy. One reported that preference for weekend treatment varied according to the frequency of treatments received. 61% of high-frequency patients (two sessions, Monday to Sunday) would have preferred to have fewer treatments at the weekend, whereas 79% of patients in the low-frequency group (one session, Monday to Friday) would have preferred weekend treatment Quality of life, adverse events and mortality were not reported	N/R	Three out of nine studies reported on costs: Overnight physiotherapy in ICU/acute spinal injury resulted in a saving of AUS$1270 per patient per day and overall saving to the hospital of AUS$59,990 for seven patients Weekend physiotherapy was associated with cost saving to health fund of CA$47,700 for 84 patients Provision of weekend rheumatology service in the UK was associated with increase in hospital costs of £3860 for 136 patients and no decrease in length of stay	Variation in the definition of length of stay between studies Included studies were all of low to medium quality

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures: Impact on length of stay	Outcome measures: Patient outcomes	Outcome measures: Other outcomes	Outcome measures: Cost measures	Comment
Butler *et al.* 2011[39]	Systematic review, Cochrane (May 2009) 15 studies: eight RCTs, two controlled clinical trials, five controlled before-and-after studies	To assess the effect of hospital nurse staffing models on patient and staff-related outcomes	Hospital nursing staff and hospital patients, including acute and non-acute, small, medium and large, teaching and non-teaching, public and private hospitals	Hospital nurse staffing model interventions including staffing models, staffing levels, skill mix, grade mix or qualification mix 8/15 studies: addition of a specialist nurse post to staffing 2/15 studies: increase the proportion of support staff vs. usual nurse staffing 1/15 studies: new rosters or shift patterns 2/15 studies: primary vs. usual model of nursing 1/15 studies: team midwifery vs. standard care	8/15 studies assessed length of stay, findings varied by study and type of intervention Specialist nurse post: six out of eight studies reported on length of stay. Three studies (two RCTs) identified potential for introduction of a specialist nursing position to reduce patient length of stay, whereas three studies (two RCTs) did not Analysis of pooled data from two RCTs found reduction in length of stay: RR –1.35 (95% CI –1.92 to –0.78, $p < 0.00001$). Of the four studies not included in the pooled analysis three provided only median length of stay and one provided no SD for the mean	3/15 studies reported on other patient outcomes Specialist nurse post: one out of eight studies examined the impact of adding specialist nurse post on in-hospital mortality; reanalysis found RR of 0.96 (95% CI 0.59 to 1.56, $p = 0.86$) One out of eight studies examined the impact of adding a specialist nurse post on pressure ulcer rates and found statistically significant improvement in the incidence of pressure ulcers ($p = 0.001$) Increase proportion of support staff: one out of two studies found that additional support from dietetic assistants led to a reduction in hospital mortality (RR 0.56, 95% CI 0.29 to 1.09) and death at 4 months (RR 0.57, 95% CI 0.34 to 0.95)	Other outcomes were reported in relation to addition of specialist nurse post Four out of eight studies examined impact of adding specialist nurse post on readmission rates, with pooled analysis of three studies showing no effect (RR 1.15, 95% CI 0.88 to 1.52; $p = 0.31$) One of these studies examined, the impact of adding a specialist nurse post on ED attendance within 30 days of admission but found no effect (RR 1.14, 95% CI 0.79 to 1.62)	3/15 studies reported on costs Specialist nurse post (two out of eight): one study of introducing specialist nurses found savings accruing from reduction in patient length of stay to offset the costs of employing the additional nurse specialist. One study found no significant differences between intervention and control Support staff proportion increase: one out of two studies reported on costs, and found increase in staff costs	Results reported by intervention type; reporting unclear and difficult to follow Time period for readmission rates was not provided within the review; therefore, the primary studies were consulted directly For studies included in pooled analysis of readmission data: one study reported on 30-day readmission, one on 12-month readmission and for one study the period was not provided in the primary study

continued

TABLE 3 Key characteristics of systematic reviews of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
					Increase proportion of support staff: one out of two studies reported on length of stay and found no significant effect Team midwifery: one out of one study reported on length of stay and found a significant reduction (mean difference –0.30, 95% CI –0.54 to –0.06)				
Cassel *et al.* 2010[32]	Review (date not provided) 12 studies: two RCTs, four quasi-experimental studies, six observational studies with retrospective control	To evaluate the efficacy of a PCCS compared with usual care, and analyse the reason for reported variability in length of stay associated with intervention	Not stated	Intervention as such not defined, only the aims of the intervention	12/16 analyses found no significant difference in length of stay between intervention and usual care. Mean length of stay in PCCS group varied from 4.7 days to 35.8 days For 4/16 studies, length of stay was reduced in the PCCS group, with a mean difference ranging from 2.9 to 5.1 fewer days. These four studies were set in ICU	N/R	N/R	N/R	The intervention was poorly defined There was high heterogeneity between included studies in terms of methods

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures: Impact on length of stay	Outcome measures: Patient outcomes	Outcome measures: Other outcomes	Outcome measures: Cost measures	Comment
de Morton *et al.* 2007[35]	Systematic review, Cochrane (February 2006) Nine studies: seven RCTs, two controlled clinical trials	To determine the effect of an exercise intervention on functional status, adverse events and hospital outcomes	Hospitalised older inpatients (aged > 65 years) with an acute exacerbation of a medical condition	In six out of nine studies, exercise was prescribed as a component of a multidisciplinary intervention, prescribed and/or supervised by nursing staff ($n = 2$), a physiotherapist ($n = 1$), physiotherapist and occupational therapist ($n = 1$), families and/or ward staff ($n = 4$) Intervention reported to commence 'early' at hospital admission or within 3 days of admission Content not generally well described Three out of nine were exercise-only interventions; included a walking programme and exercises that were individually tailored by a physiotherapist and administered by a physiotherapy assistant, commenced within 2 to 3 days of hospital admission	Nine out of nine studies reported on length of stay. Effects varied between intervention types Pooled analysis of six out of six multidisciplinary interventions including exercise showed significant reduction in acute hospital length of stay compared with usual care (WMD –1.08 days, 95% CI –1.93 to –0.22 days). There was weak evidence of heterogeneity ($p = 0.08$) Pooled analysis of three out of three exercise-only studies found no evidence of an effect (WMD 0.01 days, 95% CI –1.23 to 1.26 days). There was significant heterogeneity between studies ($p = 0.02$)	Five out of nine studies reported on functional status at discharge: Three out of six multidisciplinary intervention studies reported on activities of daily living between hospital admission and discharge (pooled effect RR 1.05, 95% CI 0.97 to 1.15) Two out of three exercise-only studies reported on functional outcomes at discharge based on Barthel Index. Pooled analysis was inconclusive (SMD 0.17, 95% CI –5.75 to 0.71). Heterogeneity between studies was high Nine out of nine studies reported on mortality at discharge: Pooled analysis of six out of six multidisciplinary intervention studies ($n = 3552$) found no effect (RR 0.99, 95% CI 0.59 to 1.64) Pooled analysis of three out of three exercise-only trials ($n = 696$) found no effect (RR 1.98, 95% CI 0.64 to 6.18)	Seven out of nine studies reported on discharge destination: Pooled analysis of four out of six studies of multidisciplinary interventions showed a significant increase in the proportion of patients discharged to home rather than geriatric rehabilitation, transfer to another acute hospital, sheltered living or nursing home care, compared with usual care (RR 1.08, 95% CI 1.03 to 1.14) Pooled analysis of three out of three exercise-only studies indicated no significant effect (RR 1.15, 95% CI 0.80 to 1.66)	Five out of nine studies reported on costs of hospital stay: Pooled analysis of five out of six multidisciplinary interventions indicated significant cost saving compared with usual care, mean difference US$278.7 (95% CI –$491.9 to –$65.4) No costs reported for studies of exercise-only interventions	Exercise programmes were not clearly defined; programme differences might explain some of the observed heterogeneity Three of the studies included exercise only and there was considerable heterogeneity between them

continued

TABLE 3 Key characteristics of systematic reviews of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
English and Hillier 2010[40]	Systematic review, Cochrane (November 2009) Six studies: five RCTs, one non-RCT $n=292$ patients	To examine the effectiveness and safety of CCT for mobility in adults with stroke	Long-term stroke survivors (aged >18 years) living in the community or receiving inpatient rehabilitation The majority of patients were able to walk at least 10 m without requiring assistance	CCT defined as an intervention involving participants being treated in a group environment, with a staff-to-client ratio of no greater than 1 : 3 Includes minimum of once-weekly CCT session for a minimum of 4 weeks Intervention delivered in inpatient rehabilitation setting ($n=2$) or in a community, outpatient setting ($n=4$)	Two out of two studies set in inpatient rehabilitation assessed length of stay: Meta-analysis found a significant effect in favour of intervention (mean difference –19.73 days, 95% CI –35.43 to –4.04 days; $p=0.01$) This finding held when one non-randomised trial was excluded from the analysis (mean difference –33.0 days, 95% CI –64.11 to –1.89 days)	Two out of two studies set in inpatient rehabilitation assessed mobility and balance: One study found significantly improved walking capacity as measured by the Six Minute Walk Test (mean difference 116.0 m, 95% CI 35.07 to 196.93 m), and balance as measured by the Timed Up and Go test (mean difference –7.6 seconds, 95% CI –15.14 to –0.06 seconds) The second study reported non-significant effect of intervention on mobility as measured by gait speed (mean difference 0.05 m/s; 95% CI –0.17 to 0.27 m/s) and balance as measured by the Berg Balance Scale (mean difference 3.70, 95% CI –3.37 to 10.77)	N/R	N/R	Intervention not directly targeted at reducing length of stay; only two studies reviewed assessed effectiveness of CCT in stroke survivors receiving inpatient rehabilitation. However, studies were small and had methodological problems

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures: Impact on length of stay	Outcome measures: Patient outcomes	Outcome measures: Other outcomes	Outcome measures: Cost measures	Comment
Foley *et al.* 2007[33]	Meta-analysis (2005) 14 studies: 11 RCTs and 3 quasi-RCTs *n* = 780 patients	To examine clinically important outcomes associated with three forms of organised inpatient stroke care: (1) acute stroke care unit; (2) units with combined acute and rehabilitative care; (3) rehabilitation units with transfer from another service or facility after delay	Patients recovering from stroke on a physically discrete ward or unit	Three models of stroke care were evaluated 1. Acute stroke care unit: characterised by interdisciplinary teams; patients were admitted within 36 hours and remained for a period of 2 weeks or fewer (*n* = 5) 2. Combined acute and rehabilitation unit: acute and rehabilitative care combined in a seamless fashion on the same unit (*n* = 4) 3. Postacute rehabilitation: units with transfer from another service or facility after a delay, usually within 2 weeks of stroke onset (*n* = 5)	11/14 studies measured length of stay. Pooled analyses were conducted by intervention types 1. Acute stroke care, pooled analysis of three out of five studies: non-significant reduction (WMD –2.9 days, 95% CI –10.0 to 4.3 days). The study with the largest effect compared stroke unit with monitoring against conventional stroke unit care (WMD –9.00 days, 95% CI –12.24 to –5.76 days) 2. Combined acute and stroke rehabilitation, pooled analysis of four out of four studies: significant reduction (WMD –14.4 days, 95% CI –27.1 to –1.7 days)	14/14 interventions reported a reduction in the odds of mortality 1. Acute stroke care: not significant (OR 0.80, 95% CI 0.61 to 1.03) 2. Combined acute and rehabilitation unit: OR 0.71 (95% CI 0.54 to 0.94) 3. Postacute rehabilitation: OR 0.60 (95% CI 0.44 to 0.81)	N/R	N/R	Based on earlier systematic review published in 2005 but unable to access to confirm methodology Acute stroke care unit comparisons were heterogeneous, included studies comparing acute stroke units with general medical wards and those comparing acute stroke units with continuous monitoring with acute stroke units without monitoring

continued

TABLE 3 Key characteristics of systematic reviews of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
					3. Postacute rehabilitation, pooled analysis of four out of five studies: non-significant reduction [WMD –13.2 days, 95% CI –8.3 to 21.9 days (as stated by the authors)] All interventions combined: non-significant reduction (–9.9 days, 95% CI –16.6 to –3.1 days)				
Griffiths *et al.* 2007[23]	Systematic review, Cochrane (January 2007) 10 studies: eight RCTs and two quasi-RCTs *n* = 1896 patients	To determine whether or not NLUs are effective in preparing patients for discharge from hospital compared with usual inpatient care	Adult patients (aged > 18 years) assessed as eligible for nurse-managed care in a NLU where acute hospital (medically led) care is the alternative	Defined as intervention located in setting other than the patient's home, where a nurse was identified as the leader of the clinical team or with the authority to admit or discharge patients. Has substituted for a period of inpatient care in an acute care facility where usual modes of care organisation were utilised	9/10 studies reported on length of inpatient stay: Pooled analysis of length of stay to first discharge from hospital was significantly increased for patients cared for in NLUs compared with general inpatient care (WMD 7.37 days, 95% CI 2.86 to 11.88 days) (1669 patients)	7/10 studies found no statistically significant effect on inpatient mortality between the NLU and general inpatient care (OR 1.10, 95% CI 0.56 to 2.16) Analysis of higher-quality studies (four out of seven) showed a larger non-significant increase in inpatient mortality (OR 1.52, 95% CI 0.86 to 2.68)	5/10 studies reported on 30-day readmission. Rates were reduced for patients in the NLU group (OR 0.52, 95% CI 0.34 to 0.80). Analysis of the stronger studies (three out of five) found similar but non-significant effect (OR 0.63, 95% CI 0.36 to 1.12)	7/10 studies reported data on cost; costs of care on the NLU were higher than usual care for UK studies but lower for US-based studies. No numerical data reported The major determinant of cost was reported to be length of stay	NLU appears to substitute for other transitional facilities and a period of home care Authors suggested that the benefit in health status achieved in NLU patients was not due solely to increased length of stay, as additional time was relatively small

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
					There was significant heterogeneity among the weaker studies. Analysis of four strongest studies confirmed longer length of stay in the NLU group (WMD 13.41 days, 95% CI 8.54 to 18.29 days) (697 patients)	6/10 patients discharged from NLU had better functional status at point of discharge than controls (SMD 0.35, 95% CI 0.16 to 0.53) 5/10 reported a measure of quality of life/general health status. The NLU showed better outcomes in all but one study; pooled analysis SMD 0.28 (95% CI 0.09 to 0.48) 3/10 reported on psychological well-being, measured by change in 12-item General Health Questionnaire; pooled analysis found NLU to have greater impact on well-being (SMD 0.36, 95% CI –0.03 to 0.74); excluding the one weaker study gave similar results (SMD 0.25, 95% CI 0.03 to 0.52) 3/10 reported on patient satisfaction; pooled analysis found patients in NLU to be more satisfied with care (SMD 0.22, 95% CI –0.11 to 0.48)	7/10 studies reported on discharge to institutional care and 3/10 on institutionalisation at follow-up beyond the index admissions Odds of being discharged to institutional care were reduced in NLU group (OR 0.44, 95% CI 0.22 to 0.89). Pooled analysis of the three strongest studies did not find clear benefit for NLU (OR 0.88, 95% CI 0.54 to 1.43)		Generalisation from this evidence can only be to adequately resourced units

continued

TABLE 3 Key characteristics of systematic reviews of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Handoll *et al.* 2009[34]	Cochrane systematic review (April 2009) 13 trials: 12 RCTs, 1 quasi-RCT $n = 2498$ patients	To examine the effects of multidisciplinary rehabilitation for older patients with hip fracture	Older people (aged > 65 years) with hip fracture	Multidisciplinary rehabilitation programme where rehabilitation is delivered by a multidisciplinary team, supervised by a geriatrician or rehabilitation physician/clinician Delivered in inpatient or ambulatory care settings (home, outpatient department and day hospital locations) 11/13 trials set in inpatient rehabilitation settings	11 trials that evaluated length of stay in inpatient rehabilitation settings measured length of stay. Results varied substantially There was considerable heterogeneity between studies so it was not possible to pool the data 8/11 studies provided sufficient data to understand distribution of length of stay Five out of eight reported a decrease in length of stay in intervention (four out of five significant) Two out of eight reported a significant increase One out of eight reported no significant difference The difference in length of stay between intervention and control ranged from a mean reduction of 19.0 days (95% CI –35.9 to –2.12 days) to an increase of 25.30 days (95% CI 17.5 to 33.1 days)	Pooled results from 8/11 studies showed no significant difference between treatment and control groups for poor outcome (a combined outcome of death or deterioration in residential status) (RR 0.89, 95% CI 0.78 to 1.01) or mortality risk, pooled analysis of 11/11 studies (RR 0.90, 95% CI 0.76 to 1.07). Morbidity in terms of hospital complications (two studies) or complications during 12 months follow-up (one study) was reported narratively; the results were variable 2/11 studies reported no significant difference in carer burden between intervention and control. One out of two reported that the strongest predictor of care burden was level of burden prior to the fracture. A third study reported no difference in carer burden, but provided no supporting data	6/11 evaluated hospital readmissions. Pooled analysis showed there was no significant difference between intervention and controls (RR 0.99, 95% CI 0.82 to 1.19). However, there was some evidence of heterogeneity between trials ($I^2 = 28\%$) Three trials with shorter length of stay in the intervention groups tended to have more readmissions in this group. In contrast, one trial showed fewer readmissions in the intervention group, where average length of stay was 25 days more than in the control group	Cost data reported in four studies of inpatient rehabilitation settings One trial in Australia found significantly reduced costs per recovered person in the intervention group, whereas one trial of geriatric orthopaedic management of patients with fractured neck of femur in the UK did not observe substantial differences in the cost of care per patient; one study in Sweden and one in Finland both reported increased cost for the intervention group	Authors noted that while most trials appeared to have been well designed, there was evidence of risk of bias for some. These included imbalances in key patient characteristics (e.g. sex, mental health) that could have influenced results of five trials even though trials had used seemingly adequate randomisation methods; small sample sizes might have influenced these findings

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Huntley *et al.* 2013[37]	Systematic review and meta-analysis (June 2010) 11 RCTs	To systematically review the effectiveness of case management in reducing the risk of unplanned hospital admissions in older people	Older people aged > 65 years	Case management defined as 'collaborative process of assessment, planning, facilitation, care co-ordination, evaluation, and advocacy for options and services to meet an individual's and family's comprehensive health needs through communication and available resources to promote quality cost-effective outcomes' Case management was initiated in hospital ($n = 2$), on discharge from acute care ($n = 4$) or in the community ($n = 5$)	Two out of two case management studies initiated in hospital showed a reduced length of stay: 1. 33.5 days (95% CI 30.4 to 36.5 days) vs. 42.7 days (95% CI 39.8 to 45.6 days) ($p < 0.05$) at 12 months (Nikolaus *et al.* 1999,[83] Germany) 2. 1.53 (SD 3.69) days vs. 4.09 (SD 8.35) days at 6 months (Naylor *et al.* 1999,[120] USA)	N/R	Of the two hospital-initiated case management trials, one found a significant reduction in hospital readmissions at 6 months (RR 0.45, 95% CI 0.29 to 0.69), whereas the other did not at 12 months (RR 0.99, 95% CI 0.66 to 1.49)	Two out of two trials of hospital-initiated case management reported cost savings associated with the intervention: 1. Total cost lower in intervention group at US$4000 per person per year (Nikolaus *et al.* 1999[83]) 2. Significantly reduced cost: per-patient imputed reimbursement US$3630 vs. US$6661; total reimbursement cost: US$642,595 vs. US$1,238,928 (Naylor *et al.* 1999[120])	The review focused on unplanned admissions and readmissions Data on length of stay were provided by two studies of hospital-initiated case management Definitions of case management varied between trials

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TABLE 3 Key characteristics of systematic reviews of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Kim and Soeken 2005[38]	Meta-analysis (1966–2003) 12 RCTs	To measure the effect of hospital-based case management compared with usual care	Heart failure, stroke and frail elderly	Intervention not specifically defined but described common elements of hospital-based case management, including assessment, education, collaboration, discharge planning, linkage and monitoring, involving collaborative multidisciplinary practice, frequently led by nurse case managers 11/12 case management interventions were nurse led, 1/12 was physician led	10/12 reported length of stay. There was heterogeneity between studies so pooled analysis (2666 participants) used a random effects model to estimate an average weighted effect size on length of stay of 0.094 (95% CI –0.032 to 0.220, $p = 0.07$) Stratifying by major diagnosis: heart failure and frail elderly suggest a decrease in length of stay: 1. heart failure ($n = 4$; 817 participants) effect size = 0.24 (95% CI 0.012 to 0.47) 2. frail older people ($n = 3$; 1458 participants) effect size = 0.13 (95% CI –0.073 to 0.324) While pooled analysis of stroke studies suggested case management results in an increase in length of stay:	N/R	10/12 reported readmission rates. Pooled analysis ($n = 2666$) OR = 0.87 (95% CI 0.69 to 1.04); reduction equivalent to 6% decrease in admission rate for patients receiving hospital-based case management interventions Effect did not differ by diagnosis: 1. heart failure OR = 0.75 (95% CI 0.45 to 1.05) 2. frail older people OR = 0.97 (95% CI 0.75 to 1.19) 3. stroke not reported There was a strong country-of-study effect, with studies conducted in the USA ($n = 7$) showing a consistent reduction in readmission rates (OR 0.79, 95% CI 0.59 to 0.99) but not those conducted elsewhere ($n = 3$) (OR 1.12, 95% CI 0.77 to 1.48)	N/R	Small number of studies, although all considered moderate-to-high to high quality Descriptions of interventions and usual care often imprecise Includes one of the studies reviewed by Huntley *et al.* 2013[37] (Naylor 1999[84]) but not others 'Frail older people' will have included patients with a range of diagnoses and disease severity, which could explain the non-significant effect of case management on length of stay in this group There was discussion of the observed increase in length of stay among stroke patients

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
					3. stroke ($n = 2$; 273 participants) effect size = –0.23 (95% CI –0.54 to 0.089) Studies conducted in a number of countries. No significant difference was observed between those conducted in and outside the USA ($p > 0.1$)				
Stroke Unit Trialists' Collaboration 2007[36]	Cochrane systematic review (April 2006) 31 RCTs $n = 6936$ patients	To assess the effect of stroke unit care compared with alternative forms of care. Randomised and prospective controlled clinical trials comparing organised inpatient stroke unit care with an alternative service	Patients admitted to hospital with a clinical diagnosis of stroke	Organised inpatient (stroke unit) care considered as a complex organisational intervention comprising multidisciplinary staffing and providing a complex package of care to stroke patients in hospital	26/31 studies reported on length of stay Pooled analyses of data from 26 RCTs comparing stroke unit with an alternative (less organised) service showed a modest reduction in length of stay in the stroke unit group (SMD –0.17, 95% CI –0.32 to –0.03; $p = 0.02$), approximately equivalent to a reduction of 4 days (2–6 days) The authors stated that there was no indication that organised stroke unit care resulted in a longer hospital stay	31/31 studies reported on death by the end of scheduled follow-up: There was a significant reduction in the odds of death recorded at final (median 1-year) follow-up for stroke unit compared with alternative service (OR 0.82, 95% CI 0.73 to 0.92; $p = 0.001$), odds of death or institutionalised care at the end of scheduled follow-up (OR 0.81, 95% CI 0.74 to 0.90; $p < 0.0001$) and death or dependency by the end of scheduled follow-up (OR 0.79, 95% CI 0.71 to 0.88; $p < 0.0001$)	N/R	N/R	Studies reviewed used different methods of reporting results Length of stay reporting used different baselines with statistically significant heterogeneity between trials Subgroup analyses were limited by low statistical power

continued

TABLE 3 Key characteristics of systematic reviews of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
						Three trials measured outcomes 5 years post stroke, with ORs for adverse outcomes continuing to favour stroke unit care for death (OR 0.74, 95% CI 0.59 to 0.94; $p=0.01$), death or institutional care (OR 0.62, 95% CI 0.43 to 0.89; $p=0.01$) and death or dependency (OR 0.59, 95% CI 0.38 to 0.92; $p=0.02$) Two trials measured outcomes 10 years post stroke, with ORs for adverse outcomes continuing to favour stroke unit care for death (OR 0.53, 95% CI 0.36 to 0.80), death or institutional care (OR 0.57, 95% CI 0.37 to 0.88) and death or dependency (OR 0.77, 95% CI 0.45 to 1.31) Quality of life was reported in three trials, with two finding significant improvements among stroke survivors in the intervention group in two sites (Nottingham and Trondheim) but not the third (Manchester)			

CCT, circuit class therapy; NLU, nursing-led inpatient unit; N/R, not reported; PCCS, palliative care consultation service.

TABLE 4 Key characteristics of primary studies of interventions targeted at the patient journey during the hospital stay

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Ahmad *et al.* 2011[59]	Before-and-after comparison Comparison between treatment (two medical wards) and control group (two medical wards), and comparison before and after Data collected in 2008–9 and 2009–10 (1 year before and 1 year after the intervention)	To evaluate the impact of a change in the frequency of ward rounds	Inpatients in four medical wards	Twice-daily ward rounds by consultant, replacing usual twice-weekly rounds Consultant-led discharge planning, provided continuity of care and assessed newly admitted patients	Average length of stay halved in the treatment wards compared with treatment wards before the intervention and control wards after the intervention ($p < 0.01$), corresponding to a reduction of approximately 5 days	No significant change in mortality rate	No significant change in readmission rate at 28 days after discharge; number of discharges almost doubled ($p < 0.01$) compared with before the intervention, and compared with control Bed occupancy decreased (87.5% ± 4% vs. 95.3% ± 2.1%, $p < 0.01$ compared with before; and 87.5% ± 4% vs. 95.1% ± 1.6% and 91.5% ± 4%, $p < 0.05$ compared with other medical wards)	Intervention was cost neutral as it did not require additional resources	UK	
Broers *et al.* 2009[56]	Before-and-after study $n = 645$ patients Intervention: $n = 500$; benchmark: $n = 145$ Data collected 2001–6	To confirm the feasibility of a nurse practitioner intervention (embedded in a critical care pathway) to provide clinical and outpatient treatment to a stable population	Patients admitted to the coronary care unit with stable, non-high-risk post-MI	Nurse-led intervention involving nurse practitioner tasked with patient education and training (knowledge, self-monitoring and management), care co-ordination with other health care staff and physiotherapists, and rehabilitation support with limited supervision by cardiologist on clinical decisions such as discharge Comparison group formed by 101/145 patients in pilot phase of intervention receiving usual care	Patients in the intervention group had a significantly shorter length of stay compared with patients in the pilot phase receiving usual care [6.2 days (SD 6 days) vs. 11.1 days (SD 10 days); $p < 0.001$] Reduction in length of stay in intervention group was achieved over time from 8.1 days (SD 4 days) in the first quarter to 5.1 days in the fourth quarter	There was no statistical difference in the number of deaths between intervention (0/500) and control group (2/101) or in reinfarction events between groups (4/500 vs. 1/101) at 30 days after discharge ($p > 0.5$)	N/R	N/R	Netherlands	Study was designed as feasibility study and a 'control' group created from the pilot phase that tested identification of non-high-risk post-MI patients There was no independent, parallel control group

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TABLE 4 Key characteristics of primary studies of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Brusco *et al.* 2007[63]	RCT *n* = 262 patients Intervention: *n* = 130; control (usual care): *n* = 132 Data collected 2004–5	To investigate whether or not extending physiotherapy to include Saturdays would be beneficial for inpatients undergoing rehabilitation	Inpatients (aged > 18 years) undergoing rehabilitation (Patients with cognitive impairment or admitted for geriatric evaluation excluded)	Provision of additional physiotherapy (1-hour session) out of hours (on a Saturday)	The mean total length of stay was reduced by 3.2 days from 24.4 days to 21.2 days in the experimental group ($p = 0.09$) Mean physiotherapy length of stay was 2.5 days shorter in the experimental group, difference was not significant ($p = 0.15$)	There was no statistical difference in flexibility and strength at discharge between groups	N/R	Estimated cost savings: Applying observed reduction in length of stay of 3 days to an average 30-bed rehabilitation unit that accommodates 448 rehabilitation patients over 12 months would equate to annual cost saving to the hospital of AUS$626,304, or an additional 68 rehabilitation inpatient admissions per year	Australia	Excluded groups with reduced cognition although they form a large part of the inpatient rehabilitation group and are at a greater risk of falls Physiotherapists were not blinded to intervention; they determined physiotherapy length of stay
Curtis *et al.* 2006[54]	Retrospective cohort study *n* = 1541 Intervention: *n* = 786; control: *n* = 755 Data collected in 2002 and 2003	To determine the effect of TCM on patient outcomes, services outcomes and length of stay	Patients aged ≥ 15 years, admitted to the trauma centre in one hospital	TCM by trauma nurse involved (a) attending initial patient resuscitation and assisting clinically in the ED, (b) communicating patient plan to clinicians, patient and family, (c) ensuring documentation of the patient management plan and (d) identifying barriers to discharge	Total number of bed-days was 483 fewer in the TCM group than predicted from controls ($p = 0.50$); reductions were most evident in the moderately and severely injured patient groups but no numerical data provided Mean length of stay higher in TCM group (5 days vs. 4 days, $p = 0.432$); length of stay varied by age group: significantly shorter length of stay in children aged 15 years ($p < 0.05$), and those aged 44–64 years (5 vs. 7 days) ($p = 0.35$), but increased in patients aged ≥ 65 years by 25% (from 4 to 5 days). There was no significant difference in the 15- to 44-year age group	Complications: Significant decrease in the incidence of coagulopathy ($p < 0.05$) and deep-vein thrombosis ($p < 0.04$)	ICU unplanned admissions were lower in TCM (6 vs. 14 cases; not significant) Significantly higher proportion of patients receiving allied health services: physiotherapy 55% vs. 45% ($p < 0.0001$), occupational therapy 33% vs. 27% ($p = 0.008$) There was a 19% ($p < 0.879$) reduction in the number of pathology tests, ($p = 0.88$). This may be partially due to a decrease in complications	N/R	Australia	No parallel control group Care pathway enabled trauma case manager to identify patients in need of allied health services and to ensure rapid transfer. Authors concluded that this had provided time for allied health staff to prepare and plan for discharge of patient; although there was a 36% increase in allied health staff interventions, there was no increase in levels of allied health staff employment

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Deschodt *et al.* 2011[48]	Non-RCT *n* = 171 patients Multidisciplinary geriatric intervention: *n* = 94; control (usual care): *n* = 77 Data collected 2007	To evaluate the effect of an IGCT	Older patients (aged > 65 years) admitted to hospital with a traumatic hip fracture	Inpatient geriatric consultation involving geriatrician, three nurses, a social worker, two occupational therapists and a physiotherapist tasked with comprehensive geriatric assessment, devising and co-ordinating treatment plan and long-term follow-up post discharge	Length of stay during acute phase defined as number of postoperative days on the trauma ward until discharge or death There was no statistically significant difference between the intervention and control groups in mean length of stay on the trauma ward, at 11.1 days (SD 5.1 days) vs. 12.4 days (SD 8.5 days) ($p = 0.24$) Mean total length of stay for participants transferred to geriatric or rehabilitation unit was not significantly different ($p = 0.90$) between intervention [56.3 days (SD 43.7 days)] and control [55.1 days (SD 25.5 days)]	Patients in the intervention group were significantly less dependent 8 days after surgery ($p = 0.02$), but there was no difference at 6 weeks, 4 months or 12 months after surgery There was no significant difference in mortality between groups at 6 weeks, 4 months or 12 months after surgery	There was no statistically significant difference between the intervention and control for the number of participants transferred to a geriatric or rehabilitation unit (*n* = 30, 31.9% vs. *n* = 26, 33.8%; $p = 0.80$) Number of participants with unplanned readmission did not differ significantly between the groups at 6 weeks, 4 months or 12 months after surgery; the mean total number of readmission days did not differ significantly [intervention: 20.9 days (SD 17.6 days) vs. control: 18.8 days (SD 13.1 days)] ($p = 0.64$) There was no statistically significant difference in new nursing home admissions after 6 weeks, 4 months or 12 months	N/R	Belgium	Adherence to recommendations made by the IGCT was low (56.8%) so likely to reduce the potential effects of the intervention Study used 'usual care' as comparator, but noted that usual care may have been quite effective already as set in a tertiary university hospital with considerable expertise in caring for frail older adults with hip fracture. In addition, physical therapy formed part of standard care to all participants, which may have reduced any effect of the intervention on functioning

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TABLE 4 Key characteristics of primary studies of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Ekman *et al.* 2012[55]	Controlled before-and-after study *n* = 248 patients Person-centred care: *n* = 125; control (usual care): *n* = 123 Data collected 2008–10	To evaluate the impact of a person-centred care programme on patients with CHF	Patients with a prior diagnosis of CHF admitted to hospital for symptoms (mainly dyspnoea and/or fatigue) of worsening CHF	Person-centred care developed by nurses, physicians, physiotherapists, occupational therapists and representatives of local patient association, who regularly (10 times during 2-month period) review usual care practices and discuss and propose measures to align the care to patient-centred care	There was no significant difference in mean length of stay between intervention and control group, at 8.22 days (SD 4.4 days) vs. 9.22 days (SD 7.4 days) ($p = 0.16$) (intention-to-treat analysis) When including only those patients receiving the actual intervention (per-protocol analysis), length of stay was significantly shorter by 2.5 days [mean length of stay 6.77 days (SD 3.2 days); $p = 0.01$]	At discharge, activities of daily living was improved in the intervention group compared with usual care in intention-to-treat ($p = 0.07$) and per-protocol analysis, ($p = 0.04$) Health-related quality of life (measured using Kansas City Cardiomyopathy Questionnaire) did not differ significantly between groups	Readmission within 6 months did not differ significantly between groups, with 49% of patients in the intervention group being readmitted within 6 months after discharge compared with 59% in the usual care group ($p = 0.16$) Time to first readmission did not differ significantly between groups	N/R	Sweden	Study designed as proof-of-concept study Usual care group first recruited to map usual care of patients with CHF and to assess outcomes of that care. Mapping used as basis for designing the intervention and outcomes subsequently assessed in intervention group. Control ward at the same hospital monitored for changes in treatment strategies or organisational changes that could have an impact on care process (length of stay did not change) Low participation rate with only 125 of 732 eligible patients participating

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Flanagan *et al.* 2008[57]	Retrospective before-and-after comparison Unit of analysis: hospital admissions with a coded diagnosis of diabetes mellitus Data collected from January 2001 to December 2006	Not stated explicitly To assess the impact of a newly introduced team of five diabetes specialist nurses on diabetes care in hospital	All patients diagnosed with diabetes admitted to a large teaching hospital	Inpatient diabetes management team comprising five diabetes specialist nurses and supported by a consultant and specialist registrar diabetologist Tasks included (1) to provide diabetes-related education for other health professionals in the hospital; (2) to identify patients with diabetes early and provide advice and handover to community diabetes team at discharge; and (3) to co-ordinate other health professionals involved in the care of diabetic patients	There was a small but significant reduction in length of stay of 0.6 days [2002: mean 8.3 days (SD 0.18 days), 2006: 7.7 days (SD 0.10 days); $p = 0.002$] following introduction of diabetes team; length of stay was significantly longer in those admitted with diabetes; length of stay for all patients during the same period was 4.9 days (SD 0.03 days) and 4.6 days (SD 0.04 days) ($p < 0.001$) There was a significant reduction in length of stay for emergency admissions [2002: 9.7 days (SD 0.23 days), 2006: 9.2 days (SD 0.20 days); $p < 0.001$] but not for elective admissions There was a significant reduction in length of stay for medical admissions [2002: 9.2 days (SD 0.24 days), 2006: 8.4 days (SD 0.20 days); $p < 0.001$] but not for surgical admissions [2002: 7.0 days (SD 0.27 days), 2006: 6.6 days (SD 0.21 days); $p = 0.331$]	N/R	There was an increase in diabetes admissions over time but this was not associated with intervention; mean number of admissions/month in 2001 was significantly lower than the mean number/month in 2005 or 2006 [326 (SD 26) vs. 431 (SD 24) and 467 (SD 17); $p = 0.002$]	N/R	UK	Study reported a year-on-year increase in the proportion of admissions coded as having diabetes, from 6.3% of total hospital admissions in 2001 to 7.9% in 2006; this increase was not statistically significant. The authors noted that the intervention might have raised awareness of diabetes and so increased coding of the condition

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TABLE 4 Key characteristics of primary studies of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Harari *et al.* 2007[49]	Prospective before-and-after study with statistical adjustment for baseline factors, and use of national benchmarking length of stay data $n=95$ patients Intervention (post OPAL): $n=49$; 'control' (pre OPAL): 46 patients identified as high risk as per CGA but not receiving OPAL Data collected in 2004 and 2005	To evaluate a novel service model for CGA screening of older acute medical inpatients linked to geriatric intervention	Acute medical inpatients aged 70 years and over	OPAL team comprising a care nurse specialist, elderly care specialist physiotherapist and half-time geriatrician; process involved CGA assessment by nurse and physiotherapist, followed by review of OPAL patients by geriatrician for (i) rapid transfer to geriatric wards, (ii) case management by OPAL on general medicine wards or (iii) facilitated discharge with referrals to appropriate geriatric clinics (e.g. CGA, falls, continence) and intermediate care schemes	There was a reduction in length of stay of 4 days in the post-OPAL group compared with pre-OPAL, with mean length of stay of 10.4 (SD 11.1 days, range 1–64 days) vs. 14.5 days (SD 12.2 days, range 1–44 days) ($p=0.023$) At the hospital level, mean length of stay for all medical admissions among those aged ≥ 70 years fell from 12.8 days to 10.4 and then 9.1 days the first and second years after OPAL (statistical significance not reported) Benchmark comparison: 2003–4, + 9000 bed-days above NHS norms; 2004–5, 10,000 bed-days below NHS norms; 2005–6, 17,000 bed-days below NHS norms (equivalent to a reduction of 50 beds compared with average NHS practice)	There were improvements in the proportion of patients in whom a problem identified by OPAL screening was addressed for a number of problems, e.g. falls: 0% pre OPAL, 92% post OPAL; functional dependency: RR 0.39 (95% CI 0.01 to 0.28) (as stated by authors); delirium: RR 0.16 (95% CI 0.0 to 0.94); depression: RR 0.13 (95% CI 0.0 to 0.41); poor nutrition: RR 0.55 (95% CI 0.33 to 0.9)	There was a significant increase in the number of patients transferred to elderly care, from 30% pre OPAL to 65% post OPAL ($p<0.001$) Mean time from admission to transfer decreased from 9.6 days (SD 8.3 days) to 2.5 days (SD 1.8 days) ($p<0.001$). There was a small reduction in the proportion of patients being readmitted within 28 days, from 26% pre OPAL to 20% post OPAL, but this was not significant ($p=0.504$)	N/R	UK	Authors point to the potential efficiency gains that could be achieved through the reduction in length of stay associated with early geriatric involvement with complex patients and potential saving but this was not quantified Lack of parallel control group OPAL has been adopted in three other teaching hospitals in the UK

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Lilly *et al.* 2011[50]	Prospective, unblinded, stepped-wedge study *n* = 6290 patients Pre intervention: *n* = 1529; post intervention: *n* = 4761 Data collected from June 2006 to April 2007	To quantify the association of a tele-ICU intervention with hospital mortality, length of stay and complications that are preventable by adherence to best practices	Adults aged ≥ 18 years admitted to one of seven ICUs in an academic teaching hospital	Tele-ICU intervention involving an off-site team of clinicians including an intensivist tasked with reviewing care of individual patients; performing real-time audits of best practice adherence; performing workstation-assisted care plan reviews for patients admitted at night; monitoring system-generated electronic alerts; auditing of bedside clinician responses to in-room alarms and intervening on delayed responses of bedside clinicians	Mean hospital length of stay was significantly shorter in the intervention group at 9.8 days (SD 10.0 days) compared with 13.3 days (SD 17.1 days) in the pre-intervention group ($p < 0.001$) Difference remained after adjustment for acuity, time trends, physiological factors, laboratory values and locus of care, with HR for discharge at 1.44 (95% CI 1.33 to 1.56; $p < 0.001$) in favour of the intervention	There was a significant reduction in mortality associated with the intervention, with an adjusted OR of 0.40 (95% CI 0.31 to 0.52; $p = 0.005$) The tele-ICU intervention period was also associated with lower rates of preventable complications [1.6% vs. 13% for ventilator-associated pneumonia (OR 0.15, 95% CI 0.09 to 0.23) and 0.6% vs. 1.0% for catheter-related bloodstream infection (OR 0.50, 95% CI 0.27 to 0.93]	The tele-ICU intervention was associated with higher rates of best clinical practice adherence for the prevention of deep-vein thrombosis (99% vs. 85%; OR 15.4, 95% CI 11.3 to 21.1); the prevention of stress ulcers (96% vs. 83%; OR 4.57, 95% CI 3.91 to 5.77); cardiovascular protection (99% vs. 80%; OR 30.7, 95% CI 19.3 to 49.2); and the prevention of ventilator-associated pneumonia (52% vs. 33%; OR 2.20, 95% CI 1.79 to 2.70)	N/R	USA	Generalisability limited by single-centre, pre–post design, with some heterogeneity among study participants Authors argue that because study did not exclude heterogeneous patients it is potentially more reflective of outcomes achieved in practice than are outcomes observed in RCT designs
Mains *et al.* 2009[60]	Retrospective before-and-after study with between-group comparison *n* = 15,297 patients Group 1: *n* = 6365; group 2: *n* = 6599; group 3: *n* = 2333 Data collected from 1999 to 2006	To assess whether or not staffing changes within the same level I trauma centre improved mortality and shortened hospital and intensive care unit length of stay for patients with trauma	Patients with trauma aged 18 years or older and who were not transferred from ED to another acute care facility	Staffing intervention within the trauma centre: Group 1: independent general surgery attendings with partial surgical resident coverage Group 2: a core trauma panel with in-house trauma surgeons but without residents Group 3: core trauma panel plus physician assistants	Adjusted (for mechanism of injury, injury severity score, age and head injury) mean and median length of stay were not significantly different for group 2 compared with group 1 (4.69 days vs. 4.62 days mean length of stay; $p = 0.59$) Mean length of hospital stay was reduced for group 3 compared with group 2 (4.32 days vs. 4.69 days; $p = 0.05$) as was median adjusted length of hospital stay (3.74 days vs. 3.88 days; $p = 0.02$)	Overall mortality was lower in group 2 than in group 1: 3.12% vs. 3.82% ($p = 0.05$) (OR 0.81, 95% CI 0.66 to 0.99) over study period (7 years) Overall mortality significantly lower in group 3 than in group 2: 2.80% vs. 3.76% ($p = 0.05$) (OR 0.74, 95% CI 0.55 to 0.99)	N/R	N/R	USA	No parallel control group Group 2 had a higher volume of severely injured patients, and surgeons performed higher volume of operations than group 1 Retrospective design precluded collection of covariates which could be significantly associated with outcomes such as changes in practice

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TABLE 4 Key characteristics of primary studies of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Morris *et al.* 2008[58]	Prospective cohort study Intervention: $n=165$; usual care: $n=165$ Data collected between 2004 and 2006	To assess whether or not a mobility protocol increased the proportion of ICU patients receiving physical therapy vs. usual care	MICU adult patients (aged 18 years and over) with acute respiratory failure, requiring mechanical ventilation on admission	Mobility team comprising critical care nurse, nursing assistant and physical therapist tasked with the implementation of a mobility protocol; the protocol contained four levels of activity therapy, and was initiated within 48 hours of mechanical ventilation through to ICU discharge to regular bed	Length of hospital stay was shorter for protocol patients at 11.2 days (95% CI 9.7 to 12.8 days) vs. 14.5 days (95% CI 12.7 to 16.7 days) ($p=0.006$), adjusted for body mass index, Acute Physiology and Chronic Health Evaluation II and vasopressor measures ICU length of stay was also significantly reduced for protocol patients (5.5 days vs. 6.9 days; $p=0.025$)	There was no significant difference in in-hospital mortality between protocol and usual care groups: 12.1% (20/165) vs. 18.2% (30/165) ($p=0.125$) Protocol patients were out of bed earlier, at 5.0 days (95% CI 4.3 to 5.9 days) vs. 11.3 days (95% CI 9.6 to 13.4 days) ($p<0.001$) (adjusted figures) There was no significant difference in mean number of ventilator-days between the two groups, with (adjusted) ventilator-days of 8.8 vs. 10.2 ($p=0.163$)	There were no statistically significant differences in discharge locations between groups or in the number of patients readmitted to ICU within the same hospital stay (8.5% vs. 9.7%; $p=0.702$)	There was no significant difference in cost per patient for usual care and protocol groups (US$41,302 vs. US$41,142; $p=0.262$) Total and average per-patient costs were lower for the protocol group Direct inpatient costs for protocol group inclusive of mobility team salaries were US$6,805,082 and for usual care group US$7,309,871 Average cost per patient was US$41,142 vs. US$44,302, but this difference was not significant ($p=0.262$)	USA	The study was not blinded, introducing a potential bias with the physicians, nurses, physical therapists and respiratory therapists who cared for patients in both arms of the study

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Needham *et al.* 2010[51]	Prospective before-and-after study *n* = 57 Pre intervention: *n* = 27 (3 months); post intervention: *n* = 30 (4 months) Data collected in 2007	To evaluate the effect of a project seeking to improve physical medicine and rehabilitation in medical intensive care on the number of physical therapy and occupational therapy consultations or treatments and on length of stay	MICU patients with acute respiratory failure and requiring mechanical ventilation	Intervention classified as QI project Multidisciplinary team with representatives from each relevant clinician group in the MICU and physical medicine and rehabilitation oversaw planning, executing and evaluating the QI project, including education of nurses and therapists about rehabilitation of mechanical-ventilated patients; developing guidelines for physical medicine and rehabilitation; increasing staffing to include full-time physical and occupational therapists	Mean length of hospital stay was reduced by 3.1 days (range 0.3–5.9 days) compared with before the QI project; 17.2 days vs. 14.1 days ($p = 0.03$) Average MICU length of stay was also reduced, by 2.1 days (95% CI 0.4 to 3.8 days)	Patients were more frequently alert (29% vs. 66% of MICU days; $p < 0.001$) and not delirious (21% vs. 53%; $p = 0.003$) compared with before the QI project There was no significant change in in-hospital mortality compared with before the QI project (21% vs. 23.3%; $p = 0.55$)	Compared with before the QI project, a lower proportion of MICU patients received benzodiazepines (96% vs. 73%; $p = 0.03$) and narcotics (96% vs. 77%; $p = 0.05$); there was a significant fall in proportion of MICU-days patients received benzodiazepines (50% vs. 25%; $p = 0.002$), and lower median doses of benzodiazepines and morphine given There was a greater median number of rehabilitation treatments per patient compared with before the QI project (1 vs. 7; $p = 0.001$) with a higher level of functional mobility (56% vs. 78%; $p = 0.03$)	N/R	USA	Study design did not include a parallel control and it is therefore difficult to assess the extent to which observed improvements can be attributed to the intervention alone; also small sample size limits generalisability of findings The authors noted that the study did not aim to test the efficacy of the intervention, as it built on existing evidence, but to undertake a structured QI process to assess whether or not routine clinical practice could be substantially and rapidly improved given the required transformation in culture for the multidisciplinary ICU team

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TABLE 4 Key characteristics of primary studies of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Nolan and Thomas 2008[62]	Cohort service improvement project *n* = 220 patients Intervention: *n* = 196; usual care: *n* = 24 Data collected June–November 2006	To assess the feasibility of individual exercise programmes for older hospitalised patients at risk of functional decline, and to evaluate impact on discharge outcomes	Patients aged 70 years and older admitted to a 500-bed acute metropolitan hospital	Individually tailored functional maintenance programme, prescribed and progressed by a physiotherapist, and supervised by an allied health assistant The allied health assistant role was not further defined	Mean length of stay was 1.93 days shorter in the intervention group (*n* = 163 completing the programme) than in the usual care group (*n* = 24): 10.01 days (SD 7.88 days) vs. 11.94 days (SD 8.36 days), equating to 15.7% reduction in average length of stay The odds of a shorter length of stay in the intervention group was OR 0.412 (95% CI 0.122 to 1.389) (adjusted for age and sex)	Where data were available, scores on the EMS improved in both groups during hospitalisation, with greater average EMS score improvement in the intervention group (5.95) than in the control group (4.82)	Significant decrease in intervention group of likelihood of referral for nursing home admission (OR 0.228, 95% CI 0.088 to 0.587; $p = 0.002$) and of approval for admission to residential care (OR 0.307, 95% CI 0.115 to 0.822; $p = 0.019$) There were 8% fewer readmissions within 28 days in the intervention group ($p = 0.153$)	N/R	Australia	Designed as a feasibility study Small sample size; lack of parallel control group. Control was created from subset of patients admitted to the same unit but unable to commence exercise within 48 hours of admission because of limited staff resources and who received usual physiotherapy
Rubin *et al.* 2011[52]	Before-and-after comparison *n* = 27,196 patients (cumulative in 2008; annual enrolment ≈7000, increasing from 940 in 2002) Benchmark: 2001 aggregate data (pre-HELP) Data collected 2002–8	To describe the evolution of the HELP in a community teaching hospital during 2002–8, including adaptations, patient outcomes, cost savings, challenges and successes	Hospital inpatients aged 70 years and older meeting the HELP criteria	The HELP incorporates targeted intervention protocols to prevent delirium in hospitalised older adults and is delivered by skilled interdisciplinary staff and trained volunteers The programme is designed to be superimposed on existing hospital units and does not require a separate, dedicated geriatric unit	Reduction of mean length of stay among patients with and without delirium receiving HELP compared with 2001 baseline pre-HELP For patients with delirium: length of stay 1.0 day shorter in 2002; 2.8 days shorter in 2008 For patients without delirium: length of stay 0.1 days shorter in 2002; 0.8 days shorter in 2008 No SD or statistical analysis reported	The rate of delirium decreased over the course of the intervention period by 15%, from 41% at baseline in 2001 to 26% in 2002, and by 23% to 18% in 2008 No statistical test reported. Patients reported high levels of satisfaction	N/R	Estimated financial return of the programme to be higher than US$7.3M per year during 2008, comprising cost savings from delirium prevention (US$2,031,440) and revenue generated from freeing up hospital beds (shorter length of stay of patients with and without delirium; estimated at US$5,337,109)	USA	The HELP has been implemented in over 60 hospitals in the USA, Canada, UK, Australia and Taiwan (Province of China) Study not designed as analytical study; describes the implementation, adaptation and evolution of the programme in a community teaching hospital ('real-world setting') but is of low methodological quality, lacking appropriate research design and statistical analysis

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures: Impact on length of stay	Outcome measures: Patient outcomes	Outcome measures: Other outcomes	Outcome measures: Cost measures	Country	Comment
Soguel *et al.* 2012[64]	Prospective before-and-after study Group A, baseline: *n* = 198 patients; group B, intervention: *n* = 179 patients; group C, intervention: *n* = 195 patients Data collected in April–June 2005 (group A), April–June 2006 (group B), May–June 2007 (group C)	To report the clinical impact of a two-step interdisciplinary quality nutrition programme	Patients in ICU for > 72 hours	Two-step intervention: 1. implementation of a nutrition protocol, developed by an interdisciplinary team and involving the provision of regular nutritional education by two dietitians of the interdisciplinary team to ICU staff 2. introduction of dedicated dietitian into the ICU with a predominantly advisory role for the physicians, nurses and nurse assistants	Length of stay varied substantially between groups; exclusion of outliers revealed no statistically significant difference in length of stay (–2.2 days, from 25.4 in period A to 23.2 in period C; *p*-value not stated)	Energy delivery and balance increased gradually; cumulated energy deficit on day 7 improved from –5870 kcal to –3950 kcal ($p < 0.001$) Hospital mortality increased with severity of condition in periods B and C, with the proportion of patients having died by day 180 at 10.1% in period A, 20% in period B and 21.5% in period C ($p = 0.004$); standardised ICU mortality was 37.7% in period A, 32.8% in period B and 37.5% in period C (not significant)	Feeding technique changed significantly with progressive increase in days with nutrition therapy (group A: 59% of days with nutrition therapy; group B: 69% of days with nutrition therapy; group C: 71% of days with nutrition therapy; $p < 0.001$)	N/R	Switzerland	Study lacks parallel control group
Somanchi *et al.* 2011[65]	Before-and-after study with control Intervention group, ward A: *n* = 168 (phase 1), 196 (phase 2); control group, ward B: *n* = 204 (phase 1), 199 (phase 2) Data collected during 2007 and 2008	To evaluate the role of early nutrition intervention in length of stay, diagnosis coding of malnutrition cases, calculating case mix index and reducing delays in implementing nutrition support to patients	Adults hospitalised in two medical wards in a university teaching hospital	Phase 1: Patients in wards A and B received Potential Nutrition Risk Screen Criteria at Admission assessment Phase 2: Nutrition intervention including daily assessment of nutrition status; nurse manager initiated clinical nutrition department consultation on evidence of malnutrition	There was a decline in length of stay in the malnourished group following the nutrition intervention to 6.11 days (SD 5.4 days), compared with 8.71 days (SD 11.7 days) at phase 1 ($p < 0.05$) In the severely malnourished group, length of stay decreased by almost 5 days: 7.98 days (SD 6.7 days) vs. 12.96 days (SD 13.4 days) ($p < 0.05$) Controlling for age, sex and case mix, the nutrition intervention decreased length of stay by an average of 1.93 days (95% CI –3.19 to –0.661 days)	N/R	There was an increase in the proportion of malnourished patients on ward A receiving nutrition consultation between phases 1 and 2, from 20% to 44%; the consultation time from the date of admission (in days) fell by 47%, but this was not significant [4.9 days (SD 7.34 days) vs. 2.63 days (SD 1.82 days)]	There was an estimated saving for patients with severe malnutrition of US$1514 in hospital costs (US$473/day × 3.2 days reduced length of stay) Reduction in length of stay combined with diagnosis coding of malnutrition cases was estimated to lead to a total annual saving of US$1.54M	USA	The study is only applicable to patients with mild and severe malnutrition Study used two controls to evaluate the data: historical control (patients in phase 1) and a control ward Cost estimations were not easy to follow

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TABLE 4 Key characteristics of primary studies of interventions targeted at the patient journey during the hospital stay (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Terceros *et al.* 2007[61]	Matched-pairs controlled study Intervention group: $n=40$; control group: $n=40$ Data collected November 2004	To assess the impact of a pharmacy resident's interventions on hospital length of stay	Adults admitted to a general internal medicine unit within tertiary teaching hospital	The intervention involved the addition to an internal medicine team (one attending physician plus five medical residents at different levels) of a pharmacy resident, involved in twice-weekly ward rounds, tasked with intervening and making recommendations to prevent adverse drug events and prescribing errors	The mean length of stay in the intervention group was significantly shorter than in the control group: 7.9 days (SD 7.2 days) vs. 10.9 days (SD 7.9 days) ($p=0.008$)	N/R	N/R	64 (25.6%) of the 250 accepted interventions were estimated to have resulted in direct cost savings of US$4155 The total cost of drugs initiated by the pharmacy resident was US$2068, which was translated into a net drug-related cost saving associated with the intervention of US$2087	USA	The study was small, with a short duration of the intervention (4 weeks), patient population limited to internal medicine unit and set in tertiary care teaching hospital, which all limit the generalisability of findings to other settings
Tobin and Santamaria 2008[53]	Before-and-after comparison $n=280$ patients Benchmark: retrospective data 1 year pre-intervention Data collected from 2003 to 2006	To test the hypothesis that tracheostomy care provided by an intensivist-led multidisciplinary team would shorten decannulation (extubation) time and reduce post-ICU length of hospital stay	Tracheostomy patients discharged from ICU alive and not under ear, nose and throat unit's care	Intensivist-led multidisciplinary team comprising intensivist, ICU liaison nurse, physiotherapist, speech pathologist and dietitian; intervention involves twice-weekly ward rounds to review patients, plan and oversee individualised tracheostomy weaning programme	The median length of hospital stay decreased over the study period, from 42 days (range 29–73 days) in 2003 to 34.5 days (range 26–53 days) in 2006 ($p=0.06$) Median hospital stay after ICU discharge also fell from 30 days (range 13–52 days) to 19 days (range 10–34 days) ($p<0.05$) Trends in length of hospital stay and hospital stay after ICU discharge were statistically significant ($p<0.05$)	There was a significant trend of reduced decannulation times from ICU discharge ($p<0.01$) Mortality decreased over the years but the trend was not statistically significant ($p=0.1$)	N/R	N/R	Australia	A major limitation of this study was the retrospective nature of data collection for the period prior to the formation of the team. This limited the nature of data available for comparison and raises the possibility that there were other factors influencing tracheostomy care

CGA, Comprehensive Geriatric Assessment; CHF, chronic heart failure; EMS, Elderly Mobility Scale; IGCT, inpatient geriatric consultation team; MI, myocardial infarction; MICU, medical intensive care unit; N/R, not reported; QI, quality improvement; TCM, trauma case management.

TABLE 5 Key characteristics of systematic reviews of interventions targeted at the discharge stage of the patient journey

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Fearon and Langhorne 2012[42]	Systematic review, Cochrane (1982–February 2012) 14 trials (1957 patients)	To establish the effects and costs of ESD services compared with conventional services for stroke patients	Any patient admitted to hospital with a clinical diagnosis of stroke (patients tended to be elderly with moderate disability)	ESD services Definition of ESD included 'any intervention that aimed to accelerate discharge from hospital with the provision of support (with or without a therapeutic rehabilitation intervention) in a community setting' In nine trials the ESD service comprised a multidisciplinary team which co-ordinated discharge and postdischarge care and provided rehabilitation at home	13/14 trials conducted reanalysis of data on length of stay. Significant reductions in the length of stay equivalent to approximately 7 days (mean difference –7.10 days, 95% CI –10.03 to –4.17 days; $p < 0.001$) 11/14 trials conducted subgroup analysis for stroke severity; greater reduction in length of stay for the severe stroke subgroup than for the moderate subgroup (mean difference 28 days, 95% CI 17 to 40 days vs. mean difference 3 days, 95% CI 1 to 7 days; $p < 0.001$)	14/14 trials measured odds of death. Pooled analysis found no significant difference (OR 0.91, 95% CI 0.67 to 1.25) 14/14 trials measured death or dependency. Significant reduction in the intervention groups (OR 0.80, 95% CI 0.67 to 0.97). This equates to an additional five patients regaining independence for every 100 receiving ESD services 14/14 trials measured death or institutionalisation. Significant reduction in intervention group (OR 0.78, 95% CI 0.61 to 1.00)	In 7/14 trials readmission rates during scheduled follow-up were very similar between treatment and control groups (31% vs. 28%)	7/14 trials estimated total costs up to 3 months (Montreal, 2000), 6 months (Adelaide, 2000; Newcastle, 1997) or 1 year (Glostrup, 2006; London, 1999; Stockholm, 1998; Trondheim, 2000) after randomisation. Mixed results, ranging from 23% saving to 15% greater costs for the ESD group in comparison with controls. These estimates were stable in sensitivity analyses	

continued

TABLE 5 Key characteristics of systematic reviews of interventions targeted at the discharge stage of the patient journey (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
				In three trials discharge home co-ordinated by multidisciplinary team and then handed over to community-based agencies In two trials patients had access to multidisciplinary care in hospital but this ended at discharge	Savings in length of stay were greater, though non-significant, for the ESD hospital outreach team than for the community in-reach team (mean difference 10 days, 95% CI 1 to 18 days vs. mean difference 4 days, 95% CI 1 to 7 days; $p = 0.24$) Excluding two trials where ESD ended at hospital discharge increases reduction in length of stay (mean difference 8 days, 95% CI 4 to 11 days; $p < 0.001$)	9/14 trials measured activities of daily living; there was no significant difference 9/14 trials measured improvements in patients' extended activities of daily living scores (SMD 0.12, 95% CI 0.00 to 0.25; $p = 0.05$) and 4/14 measured satisfaction with services, increased odds in the treatment group (OR 1.60, 95% CI 1.08 to 2.38; $p = 0.02$) 8/14 trials found no significant differences in carers' subjective health status, mood or satisfaction with services			

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures: Impact on length of stay	Outcome measures: Patient outcomes	Outcome measures: Other outcomes	Outcome measures: Cost measures	Comment
Larsen *et al.* 2006[43]	Systematic review and meta-analysis (April 2005) Seven studies; all RCTs (1108 patients)	To compare the effectiveness and efficiency of stroke units with or without home-supported discharge provided by a multidisciplinary team that plans, co-ordinates and delivers care-at-home extension	Patients with a diagnosis of stroke	EHSD team comprises physiotherapists and occupational therapists supported by speech therapists, physicians, nurses and social workers, whose teamwork is co-ordinated by regular meetings. Often the EHSD begins with one or more predischarge home visits, continues the day of discharge and goes on with more home sessions per week based on a patient-held recovery plan	Measured in all studies In six out of seven studies length of stay was significantly reduced (individual results not reported) In pooled analysis of all seven studies, EHSD significantly reduced length of initial stay by 10 days (95% CI 2.6 to 18 days) to an average length of stay of 22 days for both the acute phase and stroke unit rehabilitation	Death or institution: OR reduced significantly by EHSD (OR 0.75, 95% CI 0.46 to 0.95) Seven out of seven studies measured poor outcomes. Incidences reduced from 21.7% to 14.5%. No trial has a significant reduction but pooling data OR = 0.75 (95% CI 0.46 to 0.95)	Referrals to institution: Reduced by 5% in EHSD group, from 11.3% to 6.3% (OR 0.45, 95% CI 0.31 to 0.96)	EHSD is estimated to result in a net cost saving Cost of intervention has been estimated as a function of the average number of home sessions per patient (includes therapist time, transport costs). Average cost per EHSD is US$1340 Cost savings have been estimated as saved bed-days over a period of 12 months in a hospital or nursing home. Total saving estimated as US$1480. One study suggests savings will actually be greater as benefits of EHSD will extend beyond 1 year	There is a qualitative element of the study discussing the successful implementation of EHSD

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TABLE 5 Key characteristics of systematic reviews of interventions targeted at the discharge stage of the patient journey (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Phillips *et al.* 2004[44]	Systematic review (1966–October 2003) 18 studies; all RCTs (3304 participants)	To evaluate the effect of comprehensive discharge planning and postdischarge support on readmission rate	Older patients (mean age >55 years) with congestive heart failure	Programmes incorporating discharge planning, transitional care and postdischarge management	10/18 studies reported on initial length of stay. No significant difference between groups; mean of 8.4 days (SD 2.2 days) in intervention vs. 8.5 days in control ($p=0.60$)	14/18 studies reported on all-cause mortality: significantly lower in intervention group (RR 0.87, 95% CI 0.73 to 1.03) 6/18 studies measured quality of life (measured using different tools). During 8 months of follow-up, intervention group scores improved significantly more than control group scores ($p=0.01$). Percentage improvement in the intervention group 25.7% (95% CI 11.0% to 40.4%) vs. 13.5% (95% CI 5.1% to 22.0%) in control group	18/18 studies: readmission rates after mean of 8 months (range 3–12 months) were significantly lower in intervention group. Pooled analysis RR = 0.75 (95% CI 0.64 to 0.88). Evidence of heterogeneity ($p<0.001$), removing outlier did not change results (RR 0.74, 95% CI 0.67 to 0.81) Stratified by type of postdischarge support (five different interventions). All showed a reduction in readmissions although 'increased clinic follow up and/or frequent telephone contact' was non-significant Fewer readmissions as a result of chronic heart failure/ cardiovascular disease in intervention group (RR 0.65, 95% CI 0.54 to 0.79)	11/18 studies reported medical costs; components reported varied by trial: 8/11 with most complete data found similar or lower charges for medical care per patient per month for initial hospital stay, administering the intervention, outpatient care, readmission Stratified on region for non-US trials ($n=4$) cost saving of US$359 (95% CI –US$763 to US$45) vs. US trials ($n=4$) cost saving of US$536 (95% CI –US$956 to –US$115) Reported average cost for administering intervention per person per month US$55.76 in non-US vs. US$80.76 in US trials	Heterogeneity between studies because of difference in study size Readmission rates the primary outcome of interest Notes previous reviews as Parkes and Shepperd 2000[121] and Parker *et al.* 2002[122] Comprehensive discharge planning plus postdischarge support for older patients with congestive heart failure significantly reduced readmission rates and may improve health outcomes such as survival and quality of life without increasing costs

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Shepperd *et al.* 2010[31]	Systematic review and meta-analysis (March 2009) 21 studies; all RCTs (7234 patients)	To measure the outcome of discharge planning schemes	All patients in hospital (acute, rehabilitation or community), irrespective of age, sex or condition 14 RCTs with patients with medical condition (4509 patients); four RCTs with mix of medical and surgical (2225 patients); one RCT from psychiatric hospital (343 patients); one RCT from both psychiatric and general hospital (97 patients); one RCT of patients admitted following fall (60 patients)	Discharge planning: development of an individualised discharge plan for the patient prior to leaving hospital, with the aim of containing costs and improving patient outcomes	10/21 studies measured length of stay; 9/10 reported a significant reduction for patients who received discharge planning. Pooled analysis mean difference = –0.91 days (95% CI –1.55 to –0.27 days)	5/21 studies measured mortality at 6–9 months. Intervention did not appear to have a significant effect. Three out of five studies of elderly patients with medical condition, RR 1.04 (95% CI 0.74 to 1.46). One out of five studies of mix of surgical and medical patients, found no difference (16% vs. 16%). One out of five following a fall, RR 1.33 (95% CI 0.33 to 5.45) 10/21 studies measured patient health outcomes, including mental well-being, perception of health and self-esteem. Three had insufficient follow-up time; five out of seven had insufficient evidence; two out of seven had significant functional improvement 3/21 studies reported increased satisfaction for patients with a medical condition with discharge planning. 2/21 for pharmacy discharge plan, one out of two reported no difference, the other that it improved information exchange	11/21 studies measured rates of unscheduled readmissions within 3 months of discharge: small, significant reduction for elderly patients with medical condition; pooled analysis RR = 0.85 (95% CI 0.74 to 0.97) Results are reported individually for a further two studies. Neither found a significant difference after longer follow-up. One found a reduction in readmission rates at 4 weeks but not 9 months, the other found no significant difference at 6 months 2/21 studies looked at discharge destination. Pooled analysis found there was no difference in destination, home or residential care, between interventions (RR 1.03, 95% CI 0.93 to 1.14)	3/21 measured hospital care costs compared with usual care. One out of three found significant difference in total hospital charges for medical patients as a result of readmission costs up to 2 weeks (mean difference –$170,247, 95% CI –$253,000 to –$87,000) and up to 6 weeks follow-up (mean difference –$137,508, 95% CI –$210,000 to –$67,000), but not for surgical patients. One out of three observed lower laboratory costs (mean difference –£295 per patient, 95% CI –£564 to –£26). One out of three estimated saving of $412 per person in intervention (based on hospital utilisation and outpatient costs)	Update of the Cochrane EPOC Groups Trials Register, last searched in 2009 The definition of the intervention is not clear, and therefore not possible to fully understand the contribution of each component Studies conducted in different countries (USA, UK, Canada, Australia, Denmark and France); the orientation of primary care differs between countries Point in patient's stay that discharge planning commenced differed between studies; for some it was the moment patient was admitted, for others it was a set number of days prior to discharge

continued

TABLE 5 Key characteristics of systematic reviews of interventions targeted at the discharge stage of the patient journey (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Teasell *et al.* 2003[45]	Systematic review (1970–2002) 15 studies; 10 RCTs	To assess the effectiveness of ESD programmes in the context of stroke rehabilitation	Patients who had experienced a radiologically confirmed ischaemic or haemorrhagic cerebrovascular accident	ESD not further defined	Measured in eight out of nine studies; in six out of eight length of stay was significantly reduced in ESD group; in two out of eight there was no significant difference Length of stay reported as + or – in summary table. Individual results are reported by study: in six out of eight length of stay was significantly reduced in ESD group, ranging from 2.6 days to 15 days; in two out of eight length of stay was increased, significantly by 12.5 days and non-significantly by 2 days	8/10 studies measured functional outcome using different outcomes, with evidence of improvement in functional outcomes in some studies (4/10), but not in others (6/10)	N/R	3/10 studies performed an economic analysis; trend in reduction of cost, although only significant in one study One author noted cost of home-based rehabilitation was significantly related to age-adjusted disability, comorbidity and availability of caregiver	Results are reported descriptively; there are no clear summary tables. No meta-analysis

EPOC, Effective Practice and Organisation of Care; N/R, not reported.

TABLE 6 Key characteristics of primary studies of interventions targeted at the discharge stage of the patient journey

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Bakerly *et al.* 2009[70]	Controlled before-and-after study $n = 225$ Intervention: $n = 95$; control: $n = 130$ (retrospective control matched for age, sex, postcode) Data collected in 2003 and 2004	To compare the outcomes of two models of care	Patients admitted to a university hospital with AECOPD	An ACAS team comprising three full-time specialist respiratory nurses and a middle-grade physician reviewed daily admissions with AECOPD and assessed suitability for early discharge with home nurse support Early discharge defined as discharge from hospital before 10 days of hospital stay (the average length of stay before the initiation of ACAS)	Length of stay 7 days shorter on average in treatment group: 3.3 days (SD 3.9 days) compared with 10.4 days (SD 7.7 days) in control group ($p < 0.001$)	N/R	There was no difference in 2-month readmissions rates	Total mean cost per patient in the integrated care group £1653 (95% CI £1521 to £1802) and £2256 (95% CI £2126 to £2407) in the control group. Estimated cost saving £600 per patient ($p < 0.001$)	UK	
Barker *et al.* 2012[73]	RCT $n = 120$ Intervention: $n = 64$; control: $n = 56$ Date conducted not reported	To investigate the efficacy of a pharmacist-directed intervention (only) on mortality, health-care utilisation and quality of life in older patients with CHF following acute admission	Older patients with CHF (age not specified) with a hospital length of stay of at least 48 hours, who took four or more medications and met the Framingham criteria for CHF	Pharmacist-directed postdischarge medication review, with the aim of reducing acute exacerbations and related hospital admission through improved control of medication Both groups received home visit by pharmacist within 96 hours of hospital discharge, and at 1 and 6 months after discharge. Intervention involved provision of medication review, patient education, follow-up and liaison with community pharmacist to ensure continuity. Usual care consisted of general advice	Significant increase in all-cause and heart failure-related hospital inpatient-days in the intervention group compared with the control group at 6 months (a) All cause: 331 days vs. 231 days (IRR 1.25, 95% CI 1.06 to 1.48; $p = 0.009$) (b) Heart-failure related: 204 days vs.76 days (IRR 2.34, 95% CI 1.80 to 3.05; $p < 0.0001$)	No significant differences in health-related quality of life (AQoL and SF-36 utility) There were no between-group differences in mortality (HR 1.41, 95% CI 0.50 to 3.97; $p = 0.514$)	There were no differences in CHF hospitalisations (IRR 1.74, 95% CI 0.85 to 3.60; $p = 0.131$) over the 6-month follow-up period	N/R	Australia	Intervention and control groups differed; significantly more controls were classified as having asymptomatic cardiac disease and no limitation in usual physical activity ($p = 0.035$) Small sample size

continued

TABLE 6 Key characteristics of primary studies of interventions targeted at the discharge stage of the patient journey (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Finn *et al.* 2011[66]	RCT *n* = 872 Intervention: *n* = 440; control: *n* = 432 Data collected November 2008–April 2009	To assess whether or not embedding a nurse practitioner on a medical team to help physicians with the discharge process would improve communication, patient follow-up and hospital reutilisation	General medical inpatients	Discharge facilitator (nurse practitioner) embedded in medical team to assist with discharge process, arrange follow-up appointments and prescriptions, communicate discharge plans with nursing and primary care physicians and answer questions from discharged patients Discharge facilitator randomly assigned to one of five teams in the hospital; a similar resident team on a different floor served as the control. Patients assigned to teams on basis of bed availability	There was no difference in length of stay; 4 days on average for patients treated on both the control and intervention wards ($p = 0.84$)	Intervention group reported better awareness of postdischarge treatment plan: (a) 99% vs. 87% reported a better understanding of follow-up plans ($p = 0.0001$); (b) 96% vs. 87% reported better understanding of discharge medication ($p = 0.0001$); (c) 95% vs. 85% could identify who to call for questions ($p = 0.003$) Patients in intervention group reported higher satisfaction with discharge process, 97% vs. 76% ($p < 0.0001$)	Intervention group had higher proportion of completed discharge summaries, at 67% vs. 48% ($p < 0.0001$), with a lower median time to completion of 18.9 hours vs. 73.1 hours ($p < 0.0001$) Intervention ward rounds more likely to finish on time, at 45% vs. 31% ($p = 0.058$) Intervention had no effect on 30-day readmission (20% vs. 18%, $p = 0.55$) or 30-day ED visits (9% vs. 9%, $p = 1.00$)	Not reported in the results but commented on in the discussion: 'the intervention was not cost neutral. Paying for nurse practitioner help did not pay for itself through shorter length of stay, or decrease in readmissions or emergency department visits'	USA	Based in a single hospital, with one person as discharge facilitator in one team, limiting generalisability There was no improvement in readmission and ED utilisation; readmission and ED visits were not captured outside the intervention setting but this was not expected to have biased the study findings as participants were randomly assigned to receive the intervention

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
							Intervention patients had more follow-up appointments scheduled by the time of discharge (62% vs. 36%, $p < 0.0001$) and attended appointments more often within 2 weeks (36% vs. 23%, $p < 0.0002$) Nurses in intervention group reported completing paperwork on time more regularly (56% vs. 29%, $p = 0.041$), being less worried about discharge plan (44% vs. 57%, $p = 0.027$), fewer issues with medication/ prescriptions (61% vs. 82%, $p =$ ns) and being included more often in discharge planning (50% vs. 38%, $p =$ ns)			Restrictions in working hours required interventions that reduce workload. The intervention was more likely to finish on time, and authors suggest that this was due to fewer interruptions because the discharge facilitator was available for nurses' questions

continued

TABLE 6 Key characteristics of primary studies of interventions targeted at the discharge stage of the patient journey (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Harris *et al.* 2007[67]	Retrospective secondary analysis of three RCTs The RCTs were replications, using same method and protocol *n* = 471 Intervention: *n* = 257; control: *n* = 214	To determine whether or not transfer to a NLIU prior to discharge from hospital can improve clinical outcome and reduce length of stay and readmission rate for medically stable postacute patients assessed as requiring inpatient care	Medically stable postacute patients assessed as requiring inpatient care. Although NLIU admission criteria included all adults over 16 years, most of those admitted were elderly	Transfer of medically stable postacute patients to a NLIU under the care of a primary nurse, responsible for the planning and delivery of nursing care, and the co-ordination and leadership of the multidisciplinary team including referral for medical input when required and deciding when the patient was ready for discharge Control group received usual care in the acute hospital setting	Patients in intervention group had a longer length of stay, LSM = 33.4 days (95% CI 30.8 to 35.5 days) compared with control group, LSM = 28.7 days (95% CI 27.2 to 30.5 days), ($p = 0.003$)	Intervention group patients were more functionally independent at discharge than controls ($p < 0.001$), and showed better improvement in psychological well-being ($p = 0.001$) and lower health-related distress ($p = 0.025$)	Intervention group patients on the NLIU were less likely to be discharged to institutional care than to live independently in the community (OR 0.42, 95% CI 0.25 to 0.71) There was no significant difference in readmission rates to hospital within 7, 28, 90 and 180 days	N/R	UK	Authors put forward a number of suggestions that could explain increased length of stay. NLIU seen as an alternative to discharge home; nurses working with a rehabilitative focus and less eager to discharge
Kastelik *et al.* 2012[71]	Cross-sectional study *n* = 9716 Audit of 239 COPD units from 180 of 184 acute NHS trusts across the UK. Analysis of administrative data and retrospective case note audit	To assess SDPs with regard to resources and organisation of care and clinical outcomes	Patients with COPD	SDPs including admission prevention (early discharge from ED), rapid discharge (< 48 hours), assisted discharge (> 48 hours) and a combination of different types	For units treating one or more patients within SDPs, the median length of stay was 3 days (IQR 1–6 days) for 1630 patients treated within SDPs, and 6 days (IQR 3–11 days) for 3376 patients not accepted for SDPs ($p < 0.001$)	The mortality rate at 90 days after admission was 4.3% (69 of 1591) for patients treated within SDPs and 6.7% (212 of 3172) for patients not accepted for SDPs ($p < 0.001$)	No significant difference in readmission rates. Units providing SDPs reported better organisation and quality including measures related to having local COPD guidelines (75% vs. 56%; $p < 0.003$), discharge guidelines (54% vs. 32%; $p < 0.001$), non-invasive	N/R	UK	This study does not measure the impact of one intervention in particular, but the impact of having SDPs embedded into COPD units. Therefore there is no information on the specific components of SDPs

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
	Data collected between March and May 2008				Units offering all types of SDP had lower median length of stay: 4 days (IQR 3–5 days) vs. 6 days (IQR 5–7 days) ($p < 0.001$). 7-day services had lower median length of stay: 5 days (IQR 4–6 days) vs. 6 days (IQR 5–8 days) ($p = 0.004$)		ventilation quality score (lowest quartile 17% vs. 33%; $p < 0.005$), access for all patients with COPD to respiratory nursing (89% vs. 67%; $p < 0.001$) and any access to formal pulmonary rehabilitation (94% vs. 84%; $p < 0.02$)			
Lee and Lindstrom 2007[88]	Controlled before-and-after study $n = 225$ Intervention: $n = 125$; control: $n = 100$ (historical comparison) Data collected in 2003 and 2004	To assess the benefits and safety of early discharge guidelines	Patients with community-acquired pneumonia admitted to a respiratory medicine unit	Implementation of two guidelines: guideline for early switch to oral antibiotics and guideline for early discharge Implementation involved education of all departmental medical staff about the guidelines, daily review of patients by medical staff in line with guideline criteria and adherence to the recommendations Guidelines made readily accessible at the site of care; final decision to switch to oral antibiotics or discharge remained with the team doctors	Significant decrease in the mean length of stay in intervention compared with control, 7.62 days (± 0.60 days) vs. 8.36 days (± 0.55 days) ($p = 0.04$) Subgroup analysis by severity: treatment groups had a significantly shorter stay in all groups compared with usual care, except for class V group (most severe on the pneumonia severity index), for which there was no significant difference between control and treatment group	No significant difference between the comparison groups in classes I to IV. In patients who were in class V, the mortality rate was significantly higher in the controls (54% vs. 22%; $p = 0.015$) Overall satisfaction of patients (self-reported patient overall satisfaction with the hospital admission): 93.9%	Adherence to the local antibiotics guideline for the initial antibiotics choice significantly higher in the treatment group (95.2% vs. 82%; $p = 0.001$) Duration of intravenous antibiotics significantly shorter in the prospective group for classes I to IV ($p = 0.012$) but not for those in class V ($p = 0.94$)	Estimated savings of AUS$27,750 at least (product of the mean reduction in length of stay of 0.74 days × hospital cost per day, excluding consumables, of AUS$300 in 125 patients)	Australia	

continued

TABLE 6 Key characteristics of primary studies of interventions targeted at the discharge stage of the patient journey (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Ornstein *et al.* 2011[68]	Before-and-after comparison *n* = 532 Data collected from 2004 to 2006 (before) and 2006 to 2008 (after)	To evaluate a nurse practitioner-led transitional care programme embedded within an existing home-based primary care programme	532 patients (1088 discharges) registered with the home-based primary care programme	Nurse practitioner-led transitional care programme involving a protocol to improve co-ordination and continuity of care and tasking the nurse with (i) regular review records of newly admitted patients; (ii) care co-ordination in hospital; (iii) individual patient follow-up; (iv) discharge facilitation and support; (v) post discharge follow-up	(a) Mean length of stay during first admission was non-significantly higher during the intervention period, 6.60 days (±5.57 days) vs. 6.23 days (±5.42 days) ($p = 0.10$) (b) Mean length of stay during 30-day readmission was significantly higher during the intervention period, 6.83 days (±5.05 days) vs. 6.23 days (±4.74 days) ($p = 0.05$)	N/R	Positive feedback reported by all providers (focus groups): improved information sharing between providers, improved communication, improved job satisfaction 30-day readmission lower during the intervention period, mean 1.25 (±1.24) vs. 1.50 (±1.62) ($p = 0.08$)	Annual cost of the programme: US$197,000. Billable services generated by the two nurse practitioners per year: US$37,642 Significant increase ($p < 0.001$) in net revenue, support costs and direct care costs Median contribution to margin increased 5% from a median of US$5658 to US$5940 per admission, or US$282 per admission ($p = 0.34$)	USA	Intervention did not decrease length of stay but provided other benefits to the organisation (improved processes)
Pekmezaris *et al.* 2012[74]	RCT and matched cohort study *RCT:* *n* = 168 Intervention: *n* = 83; control: *n* = 85 *Matched cohort study:* *n* = 160 Intervention: *n* = 80; control: *n* = 80	To study the impact of RPM on heart failure, the most frequent diagnosis in hospitalised patients > 65 years of age	Patients recently discharged from hospital who had a primary or secondary diagnosis of heart failure and were referred for home care post hospitalisation	Intervention involved a combination of live nursing visits and RPM visits, facilitated by a video–patient station which replicates face-to-face consultation through two-way video monitoring by allowing patients and nurses to see and speak to each other, and exchange information while in different locations; monitoring by nurse	Length of stay was similar for both interventions in both studies *At 30 days* RCT: length of stay was 1.9 days (SD 4.4 days) in RPM group vs. 1.8 days (SD 12.2 days) in control Matched cohort: length of stay was 0.9 days (SD 3.0 days) in RPM group vs. 1.1 days (SD 3.3 days) in control	N/R	No significant difference in hospital utilisation Home care utilisation and home care cost increased in the RPM group in both studies (statistical significance not reported)	Context is not relevant as reported as cost to Medicare *At 30 days* RCT reported cost of RPM as US$4686 (SD US$11,447) compared with US$4149 (SD US$12,038) for usual care Matched cohort: RPM cost US$854 (SD US$2998) compared with US$1467 (SD US$5904) for usual care	USA	Large SD is a result of the small sample size Hospitalisation was for all causes, not just heart failure Remote group received more health-care contact; this is noted as a limitation, but this is the difference between the intervention and usual care and the benefit is that patients are assessed more regularly, either person to person or by telephone

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures: Impact on length of stay	Outcome measures: Patient outcomes	Outcome measures: Other outcomes	Outcome measures: Cost measures	Country	Comment
	Data collected June 2007–May 2009				*At 90 days* RCT: 4.9 days (SD 8.2 days) in RPM group vs. 4.8 days (SD 10.2 days) in control Matched cohort: 2.7 days (SD 6.7 days) in RPM group vs. 1.9 days (SD 5.0 days) in control No *p*-values reported			*At 90 days* RCT: RPM cost US$7267 (SD US$13,355), usual care cost US$8048 (SD US$15,118) Matched cohort: RPM cost US$3555 (SD US$7936), usual care cost US$2532 (SD US$7689)		
Preen *et al.* 2005[69]	RCT $n = 189$ Intervention: $n = 91$; control: $n = 98$ Date conducted not reported	To determine the impact of a hospital-co-ordinated discharge care plan, involving a multidisciplinary team of primary health-care providers	Patients with chronic cardiorespiratory diagnoses were recruited from respiratory, cardiovascular and general medical wards at two tertiary hospitals	Individual patient-tailored discharge care plan by research nurse, in line with Australian Enhanced Primary Care Initiative recommendations including (i) problem identification and patient/caregiver consultation; (ii) goal development and agreement with patient/caregiver; and (iii) identification of interventions and community service providers Computer-generated care plan completed approximately 24–48 hours before anticipated discharge, and shared with patient's GP for review and further amendment regarding treatment and service provision based on patient's health history	There was no significant difference between intervention and control groups, average length of stay at 11.6 days (SD 5.7 days) vs. 12.4 days (SD 7.4 days). No *p*-value reported	Mental quality of life was significantly improved from pre discharge to 7 days post discharge within the intervention group (score improved by 13.4%; $p = 0.003$), but was not significant for the control group (scores increased by 2.8%; $p = 0.32$) Greater satisfaction with input into discharge care planning at 36.5% vs. control ($p = 0.02$)	GPs of all intervention patients were notified before discharge, compared with average contact time for control group doctors at 4.4 days post discharge ($p = 0.002$) There were no other GP-reported improvements in any other aspect of the discharge procedure	N/R	Australia	Small study size Low response rate of GPs

continued

TABLE 6 Key characteristics of primary studies of interventions targeted at the discharge stage of the patient journey (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Stewart *et al.* 2012[75]	Prospective, multicentre RCT with blinded end-point adjudication $n=280$ HBI: $n=143$; CBI: $n=137$ Data collected from 2008 to 2011	To compare two common forms of multidisciplinary CHF management: a HBI vs. a specialised CHF CBI	Patients discharged to home with a clinical diagnosis of CHF who are experiencing persistent moderate-to-severe symptoms and have been admitted at least once to hospital	Outreach home-based patients were scheduled to receive a home visit by a trained CHF nurse within 1–2 weeks of hospital discharge. Nurse conducted a review of patient including a detailed clinical assessment and medication needs as well as an assessment of the patient's home environment. A report was provided to their GP and cardiologist, and planned management was arranged The clinic-based group received the same principles of assessment and follow-up, but directed through the clinic rather than at home	Length of stay was estimated as the number of days hospitalised. Average length of stay for all-cause unplanned hospitalisation was significantly lower in the HBI group (median 4.0 days, IQR 2–7 days) compared with CBI (median 6.0 days, IQR 3.5–13 days) ($p=0.004$) Average length of stay for planned hospitalisation was also lower in the HBI group, at 2.0 days (IQR 1–5 days) compared with 6 days (IQR 1–14 days) for the CBI group, although not significantly different ($p=0.67$)	There was no significant difference in death rates between interventions; 31/143 (21.7%) died in HBI compared with 38/137 (27.7%) in CBI ($p=0.25$) There was no significant difference in quality of life between interventions	There was no significant difference in the number of patients who had an unplanned hospitalisation between groups [96/143 (67.1%) for HBI compared with 95/137 (69.3%) for CBI; $p=0.89$]	The median cost of each intervention was very similar: AUS$1827 (IQR AUS$1813–1844) for HBI compared with AUS$1823 (IQR AUS$1820–1844) for CBI The median cost per day of follow-up was significantly lower in the HBI group, at AUS$34 (IQR AUS$13–81) compared with AUS$52 (IQR AUS$17–140) ($p=0.03$). A very detailed table of cost is provided	Australia	Difference in patient profile. Clinic patients were more advanced in age and had more comorbidity

ACAS, acute COPD assessment service; AECOPD, acute exacerbation of COPD; AQoL, adjusted quality of life; CBI, clinic-based intervention; CHF, chronic heart failure; HBI, home-based intervention; IQR, interquartile range; LSM, least squares mean; NLIU, nursing-led inpatient unit; N/R, not reported; ns, not significant; RPM, remote patient monitoring; SDP, supported discharge programme; SF-36, Short Form questionnaire-36 items.

TABLE 7 Key characteristics of systematic reviews of clinical pathways

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Kul *et al.* 2012[46]	Systematic review (1985–2010) Seven studies (3690 participants): three RCTs, one interrupted time series, three controlled clinical trials	Impact of care pathways on in-hospital treatment of heart failure	Patients admitted to hospital with a primary diagnosis of chronic heart failure	Definition of care pathway according to the European Care Pathway Association, which defines five characteristics of a care pathway: (i) an explicit statement of goals and key elements of care based on evidence, best practice, and patients' expectations and their characteristics; (ii) the facilitation of communication among team members and with patients and families; (iii) the co-ordination of the care process by co-ordinating the roles and sequencing the activities of the multidisciplinary care team, patients and their relatives; (iv) the documentation, monitoring and evaluation of variances and outcomes; and (v) the identification of the appropriate resources	Five out of seven studies (one RCT, four controlled clinical trials) reported on length of stay. Care pathway reduced length of stay in all studies, although this was only significant in three out of five. Pooled analysis (2095 participants) suggests care pathway significantly reduces length of stay (WMD –1.89, 95% CI –2.44 to –1.33). (Some evidence of heterogeneity, $I^2 = 42\%$)	Five out of seven studies (three RCTs, two controlled clinical trials) reported on mortality rates. All studies showed a reduction in mortality rates in the care pathway group compared with usual care, although only two out of five were significant. Pooled (2343 participants) RR = 0.45 (95% CI 0.21 to 0.94) ($p = 0.03$). (Evidence of heterogeneity, $I^2 = 73\%$)	Five out of seven studies (two RCTs, three controlled clinical trials) reported on readmission rates. All studies showed a reduction in readmission rates, although only one RCT provided weak evidence that the effect was significant (RR 0.95, 95% CI 0.78 to 1.00). Overall pooled (3006 participants) RR = 0.81 (95% CI 0.66 to 0.99). (Weak evidence of heterogeneity, $I^2 = 16\%$)	Three out of seven studies (one RCT, two controlled clinical trials) reported on costs per patient during hospitalisation. Controlled clinical trials found significantly lower costs in pathway group (WMD –2.35, 95% CI –4.11 to –0.58). RCT also suggests cost savings although this was not significant (WMD –0.11, 95% CI –0.25 to 0.03). Pooled analysis (1776 participants) showed no difference in cost (WMD –1.57, 95% CI –3.66 to 0.52)	Small number of studies. Relatively new tool More positive results for care pathways in non-randomised studies, differences in results might be explained by patient characteristics Heart failure was defined differently, and so was not controlled for in meta-analysis Definition of readmission rates differed in included studies; two reported on readmission within 31 days of discharge, one within 90 days and one within 6 months

continued

TABLE 7 Key characteristics of systematic reviews of clinical pathways (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Lodewijckx *et al.* 2011[47]	Systematic review (1990–2010) Four studies (two addressed the same pathway; one quasi-experimental, three pre–post studies)	To explore characteristics of existing care pathways for in-hospital management of COPD exacerbations and to address their impact on performance of care processes, clinical outcomes and team functioning	Patients with COPD	Care pathways defined as 'complex interventions for the mutual decision making and organisation of predictable care for a well-defined group of patients during a well-defined period, with the aim to enhance the quality of care across the continuum'	Three out of four studies reported a decrease in the mean length of stay from less than 1 day to 4 days. This difference was significant in one study, not significant in one and was not reported in the other study One out of four studies reported an increase in length of stay by 0.5 days; the level of statistical significance was not reported	Two out of four studies addressed in-hospital mortality. Both reported a decrease in hospital deaths in the pathway group, of 1% and 57%, respectively. Not statistically confirmed and for the latter no actual numbers provided In one out of four, standard care group had more complications than the pathway group (19 vs. 13, not significant)	Three out of four studies reported on readmission rates, providing contrary results. 30-day readmission ($n=2$) decreased in both studies by 4%; however, this was not statistically confirmed. 1-year readmission rate ($n=1$) was larger in the pathway group than in the control group (45.6% vs. 35.1%, $p=$ns), although time before readmission was longer in the pathway group (160.8 vs. 94.4 days, $p=$ns) Two out of four studies reported on the number of diagnostic tests performed per patient. One found a significant increase in the number of tests: 47% increase in blood sampling in the pathway group ($p=0.01$), 28% increase in daily weight measurement when ordered ($p=0.05$) and 27% increase in	N/R	Studies included are weak owing to design; no parallel controls for three out of four and assignment to intervention was non-random in the quasi-experimental study. Limited internal validity Results not clearly reported

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
							performance of arterial blood gases ($p = 0.05$). One study found smaller number of tests performed; number of chest X-rays performed decreased from 4.6 to 3.3 per patient ($p = 0.05$) and number of arterial blood gas measurements per patient decreased from 9.2 to 3.5 ($p < 0.05$). Significantly higher number of lung function tests per patient in the pathway group (3.1 vs. 7.4, $p = 0.05$)		
							Two out of four studies mentioned overall improvements in the performance of care processes, although no numerical data reported		

continued

TABLE 7 Key characteristics of systematic reviews of clinical pathways (*continued*)

Study	Design (number of studies)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures	
Rotter *et al.* 2010[22]	Cochrane review (1950–April 2008) 27 studies (11,398 participants): 19 RCTs, 4 cost–benefit analyses, 2 controlled clinical trials, 2 interrupted time series	To assess the effect of clinical pathways on professional practice, patient outcomes, length of stay and hospital costs	1. Health professionals involved in clinical pathway utilisation in the hospital setting 2. Hospitalised patients with conditions managed on a clinical pathway, irrespective of diagnosis 3. Hospitals evaluating the impact of clinical pathways	Clinical pathways are structured multidisciplinary care plans used by health services to detail essential steps in the care of patients with a specific clinical problem. They aim to link evidence to practice and optimise clinical outcomes while maximising clinical efficiency	15/20 primary studies classified as single-pathway interventions reported length of stay. 11/15 showed significant reductions in length of stay, while 2/15 reported an increase in length of stay associated with intervention, but were not statistically significant. Data pooling not appropriate because of substantial heterogeneity, therefore individual results reported Three out of seven primary studies classified as multifaceted interventions including a clinical pathway element reported on length of stay. Pooled analysis of length of stay vs. usual care: WMD –0.86 days (95% CI –2.52 to 0.81 days)	3/20 reported on in-hospital mortality. Pooled analysis provided no evidence of a difference between groups (OR 0.84, 95% CI 0.61 to 1.11) Two out of seven multifaceted interventions found no evidence of a statistically significant impact on mortality Clinical pathway vs. usual care: in-hospital complications ($n = 5$) combined OR 0.58 (95% CI 0.36 to 0.94). There was clinical variance in the range of follow-up period	Readmission up to 6 months ($n = 6$): no evidence of a difference (OR 0.6, 95% CI 0.32 to 1.13) Three out of seven multifaceted interventions including a clinical pathway reported on hospital readmissions up to 6 months. Two out of three were non-significant for all causes. One out of three reported a significant reduction in readmissions for hypoglycaemia in patients with diabetes ($p = 0.04$) Two studies report on improved documentation in the clinical pathway. Pooled analysis OR = 11.95 (95% CI 4.72 to 30.30)	Hospital costs: eight studies reported on a varying set of cost/charge measures. Estimates ranged from WMD US$261 favouring usual care to WMD –US$4919 favouring clinical pathways (standardised in 2000) No estimation of a pooled effect owing to substantial statistical inconsistency	Considerable heterogeneity prevented meta-analysis of length of stay and hospital costs Length of stay influenced by institutional context, and as such reflects hospital practices with respect to hospitalisation Clinical pathways are associated with reduced in-hospital complications and improved documentation without having a negative impact on length of stay and hospital costs Difficult paper to extract from, involved review of reviews first for some topics then review of primary studies (which we have focused on here)

N/R, not reported.

TABLE 8 Key characteristics of primary studies of clinical pathways

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Corbelli *et al.* 2009[76]	Observational pre and post cohort study $n = 2949$ Pre ACSETS: $n = 1240$; post ACSETS $n = 1709$ Data collected 2002–4	To evaluate the introduction of a critical care pathway, ACSETS, developed in four hospitals	Patients discharged with a clinical diagnosis of acute coronary syndrome (either myocardial infarction or unstable angina)	The ACSETS care pathway is initiated in the ED and continued beyond discharge. It uses standing order sheets that clearly outline guideline-based risk stratification criteria and designate corresponding recommended therapy, in order to encourage adherence to evidence-based treatment	There was an 18% relative reduction in length of stay in the ACSETS compared with the pre-ACSETS group. The difference was statistically different (Cox proportional HR 0.82, 95% CI 0.72 to 0.9)	Inpatient mortality was 5.5% in the pre-ACSETS group compared with 4.1% in the ACSETS group, although this difference was not statistically significant (Cox proportional HR 1.00, 95% CI 0.71 to 1.41) The difference in 1-year mortality between groups remains non-significant, although stratifying on condition reveals the myocardial infarction group to have a significant 19% decrease in adjusted 1-year mortality (HR 0.81, 95% CI 0.66 to 0.99)	Readmission rates within 1 year of discharge were reduced in ACSETS compared with pre-ACSETS group, at 49.4% vs. 53.0% ($p = 0.062$) Adherence to guideline-based acute and discharge acute coronary syndrome medication: the use and prescription of all medications were significantly greater in the ACSETS group. Individual results are presented for four medications	N/R	USA	No parallel control group, confounding associated with using a historical control To be included in the study physicians had to have used at least one of the ACSETS forms; this might have resulted in selection of patients with more motivated physicians, although baseline characteristic before and after for patients was similar The observed increase in drug utilisation 'faded gradually post discharge'. Authors suggested that this would support extending the pathway to include post discharge

continued

TABLE 8 Key characteristics of primary studies of clinical pathways (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Panella *et al.* 2012[77]	Cluster RCT 14 hospitals, $n = 448$ Clinical pathway: $n = 229$ in seven hospitals; usual care: $n = 219$ in seven hospitals Data collected July 2005–May 2007	To determine whether or not clinical pathways increase the appropriateness of the care provided, and whether or not clinical pathways help in implementing organised care in stroke care facilities	Patients admitted to hospital with a principal diagnosis of acute ischaemic stroke, admitted within 24 hours of stroke onset	Implementation of clinical pathways. Health-care workers in the clinical pathway arm received 3 days of training in quality improvement of clinical pathways and in use of a standardised package including information on evidence-based key interventions and indicators	Average length of stay was longer, although not significantly, for patients on clinical pathways (11.78 ± 6.6 days) vs. those receiving usual care (10.88 ± 7.9 days) ($p = 0.19$)	Mortality rates at 7 days and 30 days were lower in the clinical pathway group, although non-significant. After controlling for confounders in multivariate analysis, the risk of 7-day mortality was significantly reduced (OR 0.10, 95% CI 0.01 to 0.95), 30-day mortality remained non-significant Significantly lower rates of adverse functional outcomes, expressed as the odds of not returning to pre-stroke functioning in daily life, calculated in multivariate analysis (OR 0.42, 95% CI 0.18 to 0.98)	Implementation of evidence-based key interventions in daily practice through the continuum of care was more frequent in the clinical pathway group; 14 steps are identified and the results are presented separately, with all stages performed more frequently in the clinical pathway group although 2/14 are non-significant Organised care is used more frequently in the clinical pathway group. Results for seven indicators are reported separately and they are all highly significant ($p < 0.001$)	N/R	Italy	Randomisation process unclear Care delivered in the clinical pathway was significantly more evidence based, which seemed to result in more effective treatment Patient assessment was not undertaken prior to admission; this means that stroke severity or comorbidities were not randomised, which might have led to some selection bias Study did not measure time to admission and therefore could not control for the influence of early arrival

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Neuman *et al.* 2012[78]	Multicentre retrospective cohort study $n = 19,710$ patients in 41 hospitals (13 had CAP CPG in place) Data collection July 2009–June 2011	To describe the characteristics of institutional pneumonia CPGs and to evaluate the association between institutional CPGs and clinical management of patients	Children aged 1–18 years hospitalised with CAP	Institutional CPG for patients with CAP CPG could be a written algorithm or electronic order entry, with recommendations relating to diagnostic testing and antibiotic therapy	There was no difference in the length of hospital stay of children with pneumonia between institutions with and without a CAP CPG: median 2 days (interquartile range 1–3 days in both groups; $p = 0.269$)	N/R	There was no difference in the proportion of children readmitted within 14 days in hospitals with and without a CPG (2.3% vs.1%; $p = 0.4$) Institutions where a CPG recommended the use of penicillin or aminopenicillins as first-line agents in children were more likely to do so compared with those without a CPG (46.3% vs. 23.9%; adjusted OR 2.7, 95% CI 1.4 to 5.5)	Presence of a CAP CPG was not associated with differences in the cost of hospitalisation for the index visit, or the total cost per episode of illness (including repeat visits with hospitalisation within 14 days): no CPG US$13,265 vs. CPG US$9478 (mean difference US$1843, 95% CI –US$1861 to US$5547; $p = 0.329$)	USA	Assessment of the presence of a CPG was based on responses received from the quality directors at each institution but this was not validated

continued

TABLE 8 Key characteristics of primary studies of clinical pathways (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Schouten *et al.* 2008[79]	Before-and-after study 23 multidisciplinary stroke service teams, $n = 4549$ Stroke collaborative I included nine services, and stroke collaborative II included 14 services Data collected from 2002 to 2004	To explore the effects of a quality improvement programme for improving stroke care and the determinants of success at the team and hospital levels	Patients with stroke	Service improvement programme: 23 multidisciplinary stroke service teams participated in a quality improvement collaborative designed to set up stroke services and reduce the length of stay. Monitored the length of stay and the discharge delay during the project and measured indicators of well-organised stroke services at baseline and after the intervention	Before the intervention length of stay ranged from 1 day to 121 days; at the end of the intervention, the length of stay ranged from 1 day to 54 days. There was heterogeneity in the mean length of stay per site, varying from 10.6 days to 33.7 days at baseline vs. 9.2 days to 20.9 days at the end of the study Comparing outcome measures at the start and end of the intervention, the total length of stay reduced by 27% from 18.3 days to 13.3 days (no statistical results reported, no SDs) in the study services, compared with a reduction of 5.7% (19.2 days vs. 18.1 days) in all the other hospitals in the Netherlands	N/R	Discharge delay diminished significantly from 5.9 days to 1.7 days, a decrease of 71% The number of key features of stroke services included in the treatment increased after the intervention by 27% Teams reporting higher scores for team functioning showed higher scores in relation to organisation of stroke services	N/R	Netherlands	No SDs reported for mean length of stay and no statistical test Service improvement programmes so no parallel control Results were hard to follow Reduction in length of stay appeared to be a result of the reduction in waits and delay, given that discharge delay was reduced Authors linked large heterogeneity in length of stay between services to team functioning. Reflecting the importance of several team characteristics: composition, collaboration, stability, time allotted for the various tasks, having a team leader and specialist clinic leader

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
					The length of stay was significantly shorter for hospitals whose teams reported higher scores for team functioning. The effect of team functioning scores on length of stay was –5.37 days (95% CI –9.89 to –0.85 days)					Measurement of length of stay did not control for any of the known predictors of length of stay at the patient level, such as stroke severity
Verdu *et al.* 2009[80]	Controlled non-randomised cohort study $n = 90$ Before: $n = 50$; after: $n = 40$ Data collected in 2002 and 2004	To design, implement and assess a clinical pathway, including impact on length of stay	Patients admitted to the internal medicine department with a diagnosis of lower-extremity DVT. Exclusion criteria: suspected pulmonary embolism, pregnancy, need for a calf vein filter owing to haemorrhagic complications or contraindications to anticoagulation, appearance of DVT during admission for any other reason and active cancer	A clinical pathway for lower-extremities DVT in order to improve standard of care. This was established in the first stage of the study. The clinical pathway is detailed in the results section; designed a time-task matrix consisting of five columns which showed in days the location of the patient, and five rows which described in detail the main interventions: patient assessments, complementary tests, medical treatment, nursing interventions, activity and motility, and information given to patient and relatives	Mean length of stay reduced by 2.06 days from 6.78 days in 2002 before the implementation of the clinical pathway to 4.7 days in 2004 ($p = 0.012$) Increase in the proportion of shorter hospital stays: 65% had a hospital stay < 4 days in treatment group, vs. 30% in the control group ($p < 0.014$)	Half of the patients who followed the pathway filled in a satisfaction survey about their whole hospital stay. Satisfaction rate was 67%	N/R	Cost savings were estimated using the number of days saved and the cost of internal medicine hospital stay. This represents an overall saving in 2004 with respect to 2002 of between €17,093.20 and €21,393.18	Spain	No parallel control Clinical pathway was designed specifically for the hospital it was implemented in and in collaboration with hospital staff Implementation rates of the clinical pathway were high (95%) Patient satisfaction survey had a low response rate

continued

TABLE 8 Key characteristics of primary studies of clinical pathways (*continued*)

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
Walker *et al.* 2012[89]	Before-and-after study $n = 328$ Number of patients per year ranged from 28 to 66, median = 50 Data collected between 2003 and 2010	To assess the impact of a clinical pathway on patient treatment and outcomes	328 infants with bronchiolitis, over a period of 7 years; mean age 75 days	A clinical pathway introducing joint medical and nursing case records for all admissions, standardising practice and providing nursing staff greater autonomy in the management of bronchiolitis. The pathway was adapted from the UK SIGN guidelines with a few alterations, details of which are listed	Median length of stay decreased from 79 hours (95% CI 5 to 474 hours) before to 66 hours (95% CI 1 to 336 hours) after clinical pathway was introduced ($p = 0.010$) The length of stay was inversely related to the number of infants admitted ($p = 0.007$), and remained shorter when expressed as hours of admission/infant admitted. Median was 1.9 hours/infant/winter before intervention introduced and 1.2 hours after ($p < 0.0001$)	N/R	The number of infants readmitted remained constant before and after implementation of clinical pathway There was a progressive reduction in the proportion of infants administered bronchodilators, but no significant difference in antibiotics. Those infants prescribed antibiotics had a longer length of stay, 76 days vs. 128 days ($p < 0.0001$)	N/R	UK	No parallel control Several confounders could have affected length of stay (disease severity, geography, time of day, weather) that have not been captured. The impact of the clinical pathway is not clear Data collected retrospectively so likelihood of missing data such as readmission rates

Study	Design (number of participants)	Stated objective	Condition(s) or populations targeted	Definition of intervention	Outcome measures				Country	Comment
					Impact on length of stay	Patient outcomes	Other outcomes	Cost measures		
										Authors noted that reduced length of stay may have been in part because of clearer criteria for fitness to discharge following introduction of clinical pathway Changes in bronchodilator prescriptions did not result in a change in length of stay as a significant decrease in prescription did not happen until 2 years after the introduction of the clinical pathway

ACSETS, acute coronary syndrome emergency treatment strategies; CAP, community-acquired pneumonia; CPG, clinical practice guideline; DVT, deep-vein thrombosis; N/R, not reported; SIGN, Scottish Intercollegiate Guidelines Network.

Appendix 5 Studies excluded at full-text review stage

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