

Integrated interventions to reduce pressure on acute hospitals

Evidence review



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Abbreviations

Abbreviation	Explanation
AU\$	Australian dollars
CA\$	Canadian dollars
CI	confidence interval
DOH	Department of Health (in Ireland)
€	Euro
GB£	Great Britain pound or pound sterling
HRB	Health Research Board
IRL€	Ireland punts or pounds
MeSH	medical subject headings
NHS	National Health Service
RCT	randomised controlled trial
SEK	Swedish krona
UK	United Kingdom
USA	United States of America

Glossary

Bias is a systematic overestimation or underestimation of the association in research. There are many types of bias, such as selection, recall, and interviewer. Bias is minimised through good study design and implementation. Blinding is one method used to control for bias.

Blinding is a method used in research to ensure that the people involved in a research study – participants, clinicians, or researchers – do not know which participants are assigned to each study group, or which participants experienced the exposure or outcome of interest. Blinding is used to make sure that knowing the type of exposure, treatment, or diagnosis does not affect a participant's response to the treatment, a healthcare provider's behaviour, or an interviewer's approach to data collection.

A **confidence interval** is the range of values (for example, proportions) in which the true value is likely to be found with a degree of certainty (by convention a 95% degree); that is, the range of values will include the true value 95% of the time.

Chance is sampling variability which can give rise to a particular result. It is the luck of the draw. It is an unsystematic over- or underestimation of the cause-effect relationship. The p-value measures the probability or likelihood that the observed result occurred by chance alone.

In statistics, study **heterogeneity** is a problem that can arise when attempting to undertake a meta-analysis. Ideally, the studies whose results are being combined in the meta-analysis should all be undertaken in the same way and to the same experimental protocols; study heterogeneity is a term used to indicate that this ideal is not fully met. Heterogeneity is often seen where different populations are included in the study and different timeframes or time points are used to measure outcomes; in this review, heterogeneity is measured using I^2 . This describes the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance).

Thresholds for the interpretation of I^2 are as follows:

- 0% to 40%: might not be important
- 30% to 60%: may represent moderate heterogeneity*
- 50% to 90%: may represent substantial heterogeneity*, and
- 75% to 100%: considerable heterogeneity*.

* The importance of the observed value of I^2 depends on (i) the magnitude and direction of effects and (ii) the strength of evidence for heterogeneity (e.g. the p-value from the chi-squared test).

Incidence is a term used to describe the number of new cases of disease or events that develop among a population during a specified time interval. **Relative risk** is a comparison of incidence in the intervention group to that of the control group. **Absolute risk** or **risk difference** is the proportion of the risk (in this case benefit) that can be attributed to the intervention under examination.

In research, **meta-analysis** comprises statistical methods to combine results from different studies in the hope of arriving at an overall result. Meta-analysis can be thought of as 'conducting research about previous research'. In its simplest form, meta-analysis is done by identifying a common statistical measure that is shared between studies, such as effect size or p-value, and calculating a weighted average of that common measure. This weighting is usually related to the sample sizes of the individual studies, although it can also include other factors, such as study quality.

Mean difference is the difference between the means or averages in two groups, usually the intervention and control group.

The **number needed to treat** is an epidemiological measure used in communicating the effectiveness of a healthcare intervention. The number needed to treat is the average number of patients who

need to be treated to prevent one additional poor outcome. It is defined as the inverse of the absolute risk reduction.

An **observational study** is a quantitative study in which the predetermined outcomes for self-selected individuals who experience an exposure of interest are compared to the outcomes for self-selected individuals who do not experience the exposure. The follow-up can be prospective, retrospective, or conducted at the same time. No attempt is made to affect the outcome (for example, no treatment is given). The outcome is measured using either relative risk (followed from exposure to outcome) or odds ratio (followed from outcome back to exposure).

Publication bias is a bias with regard to what research results are published compared to results that are not published. One problematic and much-discussed bias is the tendency of researchers, editors, and pharmaceutical companies to handle the reporting of experimental results that are positive (i.e., showing a statistically significant finding) differently from results that are negative (i.e. supporting the null hypothesis) or inconclusive, leading to a misleading bias in the overall published literature.

A **randomised controlled trial (RCT)** is a quantitative study in which people are allocated at random (by chance alone) to receive one of two or more interventions. One of these interventions is the standard of comparison or control. The control may be a standard practice, a placebo, or no intervention at all. RCTs seek to measure and compare the outcomes after the participants receive the interventions using relative risk which is a comparative study of the incidence of the outcomes in the intervention group(s) compared to the control group. In sum, RCTs are quantitative, comparative, controlled experiments in which investigators study two or more interventions.

The procedure followed in the implementation of **realist evaluation**, once hypotheses have been generated and data collected, is that the outcomes of the programme are explored, focusing on the groups that the programme benefitted and those who did not benefit. The effectiveness of a programme is thus not dependent on the outcomes alone (cause-effect); rather, there is a consideration of the theoretical mechanisms that are applied, and the sociohistorical context in which the programmes were implemented. Thus, the final explanation of a programme effect using a **realist approach** considers context, mechanism, and outcome.

A **systematic review** is a literature review focused on a research question that tries to identify, appraise, select, and synthesise all high-quality research evidence relevant to that question. Systematic reviews provide an overview of the effects of exposures or interventions with respect to health and, where possible, an estimate of the size of any benefits or harms of these exposures or interventions. Each review covers a specific and well-defined area of health, and evidence from studies (preferably clinical trials or prospective cohort studies) is included or excluded on the basis of explicit quality criteria. Data in reviews are often combined statistically to increase the power of the findings of numerous studies which on their own may be too small to produce reliable results.

An **umbrella review** synthesises findings from multiple systematic reviews. Like systematic reviews, it allows reviewers to assess the effectiveness of an intervention and to identify whether or not the evidence base is consistent or contradictory. Umbrella reviews are particularly relevant to decision-makers who require an overview of the most relevant and reliable data.

Executive summary

Purpose

The Houses of the Oireachtas Committee on the Future of Healthcare published the *Sláintecare Report* (2017), which outlines a 10-year strategic plan for the reform of the Irish healthcare system. Central to this plan is the vision that the future direction of the Irish healthcare system will be premised on a new model of integrated care, and a key objective of developing and implementing this model is to relieve the growing pressure on the acute hospital system network in Ireland. The Department of Health (DOH) is tasked with playing a leading role in the proposed reconfiguration of the acute hospital network within the new model of integrated care. As part of its deliberations in considering options for the reconfiguration of the acute hospital network, the DOH asked the Evidence Centre in the Health Research Board (HRB) to examine the published peer-reviewed evidence on integrated interventions that have been targeted at reducing pressure on acute hospitals.

Research questions

This review examined integrated health system interventions that have the potential to reduce pressure on acute hospitals. The outcomes for assessing reduced pressure on acute hospitals were decreases in: unplanned admissions to hospital, readmissions, length of stay in hospital, and emergency department visits, as well as the effect on healthcare costs. The HRB identified three populations that use acute hospitals: people with chronic diseases regardless of age, older people, and those requiring surgical or medical treatment for an acute illness. There is some overlap between these populations.

Methods

The HRB used an umbrella review approach (otherwise known as a review of reviews) which is considered a useful approach to bring together evidence from a number of interventions and a large number of pre-existing systematic reviews. This umbrella review provides a high-level review of the interventions to reduce pressure on acute hospitals that may be available to policy-makers and service planners. The HRB based its approach to completing this umbrella review on the Joanna Briggs Institute's protocol for such reviews. As a first step, the HRB undertook an initial brief scoping search for relevant literature to help it frame the parameters of the work. Arising from this initial search, the HRB identified an umbrella review undertaken by Damery *et al.*, published in 2016. The HRB noted that Damery *et al.* had asked the question, "Does integrated care reduce hospital activity for patients with chronic diseases?" As this question mirrored very closely the DOH's research question, the HRB undertook a closer examination of the work by Damery *et al.*

The HRB developed a precise search of two databases, MEDLINE and the Cochrane Database of Systematic Reviews, using MeSH terms and keywords for the identified hospital system outcomes of interest and terms used for systematic reviews. Pairs of authors screened, quality assessed, and extracted the required data. The HRB described each intervention using a systematic approach to cover the context of each review, and to document the findings related to hospital system outcomes. In addition, the statistical effect from each meta-analysis or narrative review was characterised according to four categories: positive or negative associations, mixed findings, or no association. Heterogeneity in study populations, interventions, and the measurement of hospital system outcomes prevented the HRB from being able to pool the numeric effects of interventions in a meta-synthesis of the included reviews. Instead, the HRB extracted the findings on system outcomes from each review and presented a statement of effectiveness for each intervention by outcome measured and by population, as well as a statement summarising the findings of the reviews of each intervention. The HRB used the 'corrected covered area' measure to assess overlap of primary studies between systematic reviews.

Technical findings

Database searching identified a total of 2,286 individual records. Following title and abstract screening, 80 were obtained as full-text articles and assessed for eligibility and quality. Following full-text screening, a further four were excluded based on inclusion criteria. Following quality assessment, 39 were excluded, as they scored less than 8 out of a possible 10 points in terms of quality. In total, 36 systematic reviews and Damery *et al.*'s umbrella review were used in the final review. Due to time and resource limitations, the HRB decided to summarise Damery *et al.*'s umbrella review findings to cover the 11 chronic disease populations specified by them, as the research was published in a high-quality peer-reviewed journal and it scored strong using the HRB's chosen quality assessment tool. Of note, the HRB did not update Damery *et al.*'s review.

Research findings

Integrated interventions

Damery *et al.* and the HRB identified a number of integrated interventions that were tested to determine if they reduced pressure on acute hospital services (emergency and inpatient services).

The interventions identified were: discharge management with and without a quality improvement approach, medication management, the chronic care model, chronic disease management, complex interventions for chronic disease patients, multidisciplinary teams for chronic disease patients, self-management, hospital at home, alternatives or additions to emergency department services, case management, specialised multidisciplinary rehabilitation for hip fracture, and interactive telemedicine.

The HRB noted that Damery *et al.* confined their work to examining interventions targeting patients with 11 named chronic diseases. Specifically, they included reviews that covered patients with hypertension, diabetes, depression, coronary heart disease, stroke, transient ischaemic attack, chronic obstructive pulmonary disease, cancer, heart failure, dementia, and arthritis. The HRB team agreed that it would be futile to re-examine the literature on patients with these chronic diseases, given the extensive work completed by Damery *et al.*

The HRB identified two additional patient populations of interest: patients with acute medical and/or surgical conditions, and older people.

The HRB also identified one additional chronic disease in the literature, specifically asthma.

Finally, the HRB identified three interventions which could be used for any one of the three populations of interest but were not covered by Damery *et al.*: medication management, hospital at home, and interactive telemedicine.

The HRB summarised the findings from both Damery *et al.*'s umbrella review of 50 moderate or strong-quality systematic reviews and narratively synthesised the findings of 36 strong-quality reviews.

The HRB synthesised the strong-quality reviews only to reduce the risk of bias. In the next section, we summarise the findings by intervention and, where relevant, by population of interest.

Discharge management summary

Discharge management was used as an intervention for three distinct population groups: chronic disease populations, general medical and/or surgical populations, and older people.

Chronic disease population

Damery *et al.* describe discharge management and post-discharge support for hospital inpatients as the most effective of the chronic disease interventions identified in their umbrella review. They reported an overall reduction in hospital readmissions and length of stay; however, the findings for costs were mixed. Le Berre *et al.*'s findings (in a subsequent strong-quality review) support Damery *et al.*'s for the same two hospital outcomes, but report substantial heterogeneity between the 92 randomised controlled trials (RCTs) included in their review; of note, the presence of substantial heterogeneity reduces the certainty of the findings. Other hospital outcomes were not examined in the literature reviewed for this population group.

Acute medical and surgical population

The HRB examined the evidence for discharge management for people following hospitalisation for acute medical or surgical conditions by reviewing eight meta-analyses of randomised and non-randomised controlled trials in six strong-quality reviews. Five of the eight meta-analyses reported a reduction in hospital readmissions, but there was moderate heterogeneity reported in three of the five meta-analyses. The HRB found evidence that discharge management reduces hospital readmissions for people with an acute medical or surgical condition, but the inclusion of non-randomised trials and the identification of heterogeneity reduces the certainty of the findings. Discharge management had no effect on length of stay in hospital for this group in the one review available. Two meta-analyses measured the effect of discharge management on emergency department visits and did not find any differences between discharge management and usual care groups.

Older population

The HRB also examined the evidence for discharge management for older people following hospitalisation by reviewing five meta-analyses of RCTs in five strong-quality reviews. Four of five meta-analyses found that discharge management for older people had no effect on hospital readmissions. The three meta-analyses that examined length of stay in hospital reported conflicting results and also identified low to moderate heterogeneity between studies. The HRB found one meta-analysis examining discharge management for older people and emergency department visits and found that this intervention did not reduce emergency department visits, but there was high heterogeneity between the included studies. There is no consistent evidence that discharge management for older people following hospitalisation reduces hospital system outcomes.

Costs

The evidence on costs of discharge planning compared to usual care for any of the three populations comes from one Cochrane review and is mixed, with two studies demonstrating overall savings, one study demonstrating savings only for readmissions, two studies reporting no savings, and one study reporting savings on laboratory costs only. However, due to different mechanisms for costing and charging, the findings are not sufficiently comparable to make a conclusive statement either way. In addition, any potential reduction in costs may be offset by an increase in the provision of community services and their associated costs.

Inconsistency in outcome measures

It should be noted that follow-up times for readmissions, length of stay, and emergency department visits varied from 5 days to 18 months, thereby increasing heterogeneity. In addition, some reviews included observational studies, thereby reducing the certainty of the evidence. The discharge planning intervention usually consisted of a number of components, but the HRB could not identify

which individual components were most likely to contribute the greatest effect with respect to reducing hospital use or if individual components interacted with one another to enhance the overall effect.

Pharmacist-led medication management summary

Three high-quality systematic reviews examining multi-component pharmacist-led medication management for patients discharged from hospital were identified. Three review teams completed meta-analyses to identify the effect of pharmacist-led medication management on hospital readmissions. Two of these reviews completed their meta-analyses using RCTs and reported low levels of bias. The meta-analyses from these two reviews found that pharmacist-led medication management when compared to usual care does not appear to reduce hospital readmissions among adults. There is some evidence from meta-analyses of controlled trials and observational studies to suggest that pharmacist-led interventions may reduce emergency department visits, but levels of heterogeneity in both meta-analyses were high. The lack of randomisation and the presence of heterogeneity reduces the certainty of the evidence for pharmacist-led medication management reducing emergency department visits. Overall, the review of costs showed mixed results and, in some cases, the assessment of costs was inadequate.

Chronic care model summary

Damery *et al.* concluded that chronic care models based on multiple components were effective overall. For example, use of the chronic care model reduced hospital admissions, hospital length of stay, and emergency department visits. However, it is not clear which individual components contribute the greatest effect to reducing hospital use and cost outcomes, or if individual components interacted with one another to enhance the overall effect.

Chronic disease management summary

The HRB concludes that the chronic disease management programme for asthma was less effective than the chronic care model for other chronic diseases based on Damery *et al.*'s reported conclusions. The review authors, Peytremann-Bridevaux *et al.* highlighted that intervention fidelity varied across the studies on asthma. The review authors also reported that the data in the nine primary studies that measured admissions to hospital were skewed and too heterogeneous to combine. Peytremann-Bridevaux *et al.*'s narrative conclusion is that the evidence that chronic disease management for asthma reduced the number of admissions to hospital is inconclusive. Chronic disease management did not appear to reduce the number of emergency department visits, but once again the data are skewed and heterogeneous. The lack of similarity between the study methods reduces the certainty of the systematic review findings.

Complex interventions for chronic diseases summary

Damery *et al.* concluded that complex interventions for chronic diseases reduced hospital admissions, readmissions, hospital length of stay, and emergency department visits, but again, it is not clear which individual interventions contribute the greatest effect to the positive hospital system outcomes reported or if individual interventions interacted with one another to enhance the desired outcomes.

Multidisciplinary team care for chronic diseases summary

Damery *et al.* concluded that multidisciplinary team care for chronic diseases, particularly when condition-specific specialist doctors, specialist nurses, or pharmacists were part of the team, showed promising evidence of effectiveness. There is evidence that sometimes they reduce hospital admissions, while all reviews show that they reduce length of stay in hospital.

Self-management summary

Damery *et al.* concluded that self-management for chronic diseases showed most promise when incorporated into the chronic care model or multidisciplinary team care or when tailored patient education was included in a discharge-planning intervention. When integrated into a multicomponent intervention, self-management may reduce hospital admissions and readmissions.

The HRB found two strong-quality reviews of RCTs examining self-management or education for asthma. The findings from two meta-analyses found that asthma self-management or education interventions may be effective in reducing hospital admissions, but the level of heterogeneity, where measured, was moderate. The asthma self-management intervention may be effective in reducing the number of emergency department visits, but heterogeneity was not measured. The education intervention was not effective in reducing the number of emergency department visits. The narrative findings on costs are mixed. The authors of one of these reviews, Pinnock *et al.*, noted that “effective self-management for asthma should be tailored to cultural, clinical and demographic characteristics and is most effective when delivered in the context of proactive long-term care management” and these authors’ comments are similar to those of Damery *et al.*

Hospital at home summary

Hospital at home can be used to avoid hospital admission for older people and people with stroke or chronic obstructive pulmonary disease, or to permit early discharge for elective surgery cases, older people, and people following a stroke. There is some low-level evidence in the reviews that hospital at home may reduce institutionalisation, but this is not an outcome that the HRB examined systematically. The HRB notes that three recent reviews of RCTs of hospital at home indicate that these interventions may be as safe as care in an acute hospital, use fewer hospital bed days (though the data were heterogeneous in one of the two meta-analyses), and may be provided at equal or lower costs (though the comparability of the costings is questioned by the authors of the respective reviews). However, total length of stay, including days in the home, is longer than total conventional length of stay in hospital and this requires investigation. Hospital at home can also be used to provide end-of-life care, but in this case, using data from four trials, the findings for this intervention preventing hospital readmissions is mixed and the authors classify the certainty of the evidence as moderate. However, there is low certainty of evidence from two trials that hospital at home for terminally ill people may lower costs by using fewer hospital bed days. The authors in three reviews recommend that hospital at home may be useful to relieve pressure on acute hospital beds, but that it is not a replacement for acute hospitals. The reviews’ authors also noted that better planned multi-centred trials (including agreement upon clinical, hospital, and cost measures) are required. The role of advanced portable medical devices and communication technologies in admission avoidance among those using hospital at home could also be investigated in future studies.

Non-traditional emergency department interventions summary

The HRB found that seven different interventions in three systematic reviews were used to reduce emergency department use. However, Morgan *et al.*’s review included 39 studies, 34 of which were observational; such studies are more likely to report effective findings, so the conclusions from this review about managed care, prehospital diversion, and patient financial incentives should be interpreted with caution. The Kangura *et al.* review is based on three non-randomised controlled trials.

Three interventions (managed care, prehospital diversion, and patient financial incentives) reduced emergency department visits, but the evidence is taken from a mix of controlled trials and observational studies with author-acknowledged heterogeneity, and therefore the level of certainty for this evidence is low. General practitioners providing out-of-hours care located in or beside emergency departments reduced hospital admissions, but this finding is based on three non-randomised controlled trials with heterogeneity across the trials, indicating that this evidence has a very low level of certainty. Three interventions (out-of-hours general practitioners, managed care,

and creation of additional capacity in non-emergency department settings) may reduce costs to the health service, but once again, the certainty of the evidence is very low because of the study design used and the differences between studies.

Case management summary

Damery *et al.* concluded that case management for chronic disease was the least effective integration intervention in their systematic review and that there are more effective integrated interventions for chronic diseases.

The HRB notes that case management for older people being discharged from hospital may reduce length of stay in hospital (based on narrative findings from three RCTs) in one strong-quality systematic review and also reduce the frequency of emergency department visits (based on one trial), but is very unlikely to reduce readmissions to hospital (based on meta-analysis of three trials). The finding on costs of case management for older people, based on narrative analysis of two trials, is that it may save money. The review authors note that the included studies are heterogeneous and trials with negative findings may not be published. There is a low level of certainty in the findings of this case management review.

Specialised multidisciplinary rehabilitation for hip fracture summary

The HRB concludes, based on RCTs included in two strong-quality systematic reviews, that intensive rehabilitative exercises for older people with surgical intervention following hip fracture may shorten length of stay in hospital (narrative analysis of 8 out of 11 trials with heterogeneity) but is unlikely to reduce readmissions to hospital (a single meta-analysis of six trials with low heterogeneity between studies). One trial used an early discharge hospital at home approach and reported that hospital at home and acute hospital care had similar outcomes for older people who had surgery for a hip fracture. Only one of the two reviews examined costs, and it reported that specialised multidisciplinary rehabilitation may be marginally more expensive than usual care. However, specialised multidisciplinary rehabilitation is suitable for cognitively impaired older people. It is clear there is a lack of high-quality multi-centre trials investigating what interventions work to improve independence and reduce hospital use among this group. The HRB concludes that there may be an opportunity to relieve hospital pressure through early discharge and intensive rehabilitation for this group, but high-quality, well-organised trials are required.

Interactive telemedicine summary

There is one high-quality systematic review examining the effectiveness of interactive telemedicine. The HRB concludes that telemedicine interventions do not increase or reduce hospital admissions for cardiovascular disease (narrative analysis of 11 RCTs with high heterogeneity), readmissions for heart failure (18 trials), length of stay in hospital (10 studies with low heterogeneity), or emergency department visits, so as an intervention it may be as safe as face-to-face monitoring and consultation for the specific conditions tested. However, the narrative findings on costs are mixed and depend on the type of technological intervention used and the disease monitored.

Summary evidence on integrated interventions by population

Chronic disease population – Low evidence of reduction in system outcomes, moderate, or good

Chronic disease	Discharge management	Chronic care model	Complex intervention	Multi-disciplinary team	Self-management	Hospital at home (stroke)	Interactive telemedicine (diabetes)
Hospital admission		Moderate	Moderate		Good		No effect
Hospital readmission	Moderate		Moderate				No effect
Length of stay in hospital	Moderate	Moderate	Moderate	Moderate		Moderate	
Emergency department visits		Moderate	Moderate				
Cost							No effect

For patient populations with medical and/or surgical conditions – Low evidence of reduction in system outcomes or moderate

Medical and/or surgical conditions	Discharge management	Medication management	Hospital at home	Primary care professionals in or beside emergency departments	Additional capacity in non-emergency facilities	Managed care	Prehospital diversion	Patient financial incentives
Hospital admission				Moderate				
Hospital readmission	Moderate	No effect	No effect					
Length of stay in hospital	No effect		Moderate					
Emergency department visits		Moderate				Low	Low	Low
Cost				Low	Low			

For the older patient population – Low evidence of reduction in system outcomes

Older people	Hospital at home	Case management	Specialised rehabilitation for hip fracture
Hospital readmission	No effect	No effect	No effect
Length of stay in hospital	Low	Low	Low
Emergency department visits		Low	
Cost	Low		

*Meta-analysis

Conclusions

Damery *et al.* and the HRB identified a number of integrated interventions that were tested to determine if they reduced pressure on acute hospital services (emergency and inpatient services).

Some interventions demonstrated moderately promising results in relieving pressure on hospitals. Discharge management for patients with chronic diseases and patients admitted to hospital with general medical and surgical needs was the most promising of the interventions. However, the HRB examined data from five high-quality meta-analyses and one narrative review, and found that discharge management for older patients failed to demonstrate effectiveness on hospital outcomes. The HRB notes that discharge planning for older patients leaving hospital is an area currently receiving some attention in an umbrella review protocol in the United Kingdom (UK). In addition, two protocols have been published to undertake a realist review on the role of context in care transition interventions for medically complex older adults, and on supporting shared decision-making for older people with multiple health and social care needs, respectively.

Other promising interventions the HRB identified in the literature reviewed were the chronic care model, complex interventions for chronic diseases, multidisciplinary care for single chronic diseases, and hospital at home for a number of target populations. Managed care and prehospital diversion in or beside emergency departments may also be useful but need a higher level of evidence.

Some interventions have been shown to be more effective when combined with other effective interventions. For example, self-management when combined with discharge management, or the chronic care model or multidisciplinary care and likewise medication management when combined with the three aforementioned interventions may be more effective. Interactive telemedicine may have potential when combined with the chronic care model, multidisciplinary teams, or hospital at home, but more research is required, as telemedicine is an evolving set of interventions. There is also evidence from other umbrella reviews that combining interventions may be beneficial in reducing pressure on hospitals. The HRB concurs with other umbrella review authors that a combination of interventions, combining effective active components and delivered across each patient's journey from hospital to the community, are more likely to relieve pressure on the acute hospital system.

The HRB bases the combined intervention argument on the recognition that there appears to be an array of ubiquitous interventions already delivered across different healthcare systems, including approaches to discharge management, hospital at home, pharmacist- or nurse-led medication management, self-management, and case management. Early or timely discharge from hospital consists of communication and monitoring between providers and patients. Such communication and monitoring involves providing useful information, recording observations, giving reassurance, and ensuring a three-way link between the patient, hospital, and community health service. The HRB recognises that these interventions work for some people; however, the HRB needs more information on who the interventions work for, under what conditions they work, and why they work for some people some of the time and not all of the time. The HRB would argue that the evaluation of what appear to be complex multicomponent interventions may need a different approach to the one adopted via the experimental trial methods. Berwick suggests an alternative evaluation model, namely the realist evaluation pioneered by Pawson and Tilley. The realist approach seeks to explain why an intervention works, for whom, and under what conditions by elucidating the configuration of context (C), mechanism (M), and outcome (O). For example, according to Pawson and Tilley (1997), programmes that work have successful 'outcomes' only insofar as the programmes introduce the appropriate ideas and opportunities, known as mechanisms, to groups in the appropriate social and cultural conditions, known as contexts. Towards the end of the HRB's work on this umbrella review, the team identified one recently published realist review of integrated care programmes targeting older adults with complex needs by Kirst *et al.* (2017).

Kirst *et al.* undertook this work to identify, test, and refine the theory of why integrated care programmes achieve certain specified outcomes, and what contextual conditions constrain or enable the programmes to succeed. Kirst *et al.* identified two context-mechanism-outcome configurations: (i) trusting multidisciplinary team relationships (M) within a context of strong leadership to establish a shared vision, time to build trusting team relationships, and an organisational culture of team participation (C); and (ii) provider commitment to, and understanding of, the integrated care model (M) within the context of strong leadership/organisational culture, the time to build infrastructure, provider expertise and training, flexibility in implementation, and provider incentives (C). These mechanisms were triggered within the contextual conditions outlined to achieve the outcomes of reduced health system utilisation, improved patient health, and improved patient/caregiver experience (O).

On a separate but related topic, more research is required to determine the effect of specialised multidisciplinary rehabilitation for hip fracture in patients with different degrees of cognitive impairment in terms of reduced length of stay in hospital and preventing institutionalisation in the short term. Case management is not useful for chronic diseases but may have some potential for older people being discharged from hospital, as it may reduce some but not all hospital system outcomes, and this requires more research.

Damery *et al.* and the HRB present a number of promising integrated interventions to help reduce pressure on acute hospitals and to provide more specialised support to patients living at home. However, if the Irish healthcare system decides that some of these interventions are appropriate to implement, then perhaps these interventions need to be adapted to the context of the Irish healthcare system and evaluated for their effectiveness within the Irish context. On the other hand, it is likely that some of these interventions, either in a partial format or in a comprehensive format, may already be implemented in some parts of the Irish healthcare system. In this case, it may be useful to undertake a mapping exercise to identify the interventions that are currently used and how their implementation may be improved within the Irish context.

1 Introduction

1.1 Policy background

The *Houses of the Oireachtas Committee on the Future of Healthcare: the Sláintecare Report (2017)*¹ outlines a 10-year strategic plan for the reform of the Irish healthcare system. Central to this plan is the vision that the future direction of the Irish healthcare system will be premised on a new model of integrated care, and a key objective of developing and implementing this model is to relieve the growing pressure on the acute hospital system network in Ireland.

The Committee defines integrated care as:¹

“Healthcare delivered at the lowest appropriate level of complexity through a health service that is well organised and managed to enable comprehensive care pathways that patients can easily access and service providers can easily deliver. This is a service in which communication and information support positive decision-making, governance and accountability; where patients’ needs come first in driving safety, quality and the coordination of care.’ This definition of integrated care puts patients’ needs at its centre and values communication and information to support positive decision-making, good governance and accountability. Recalibrating the system to build up primary and social care capacity is paramount to this approach. This enhanced capacity in primary and social care will in turn relieve some pressure on the acute hospital system, and free up capacity to deal with care that can only be provided there...” (p. 74).

The Department of Health (DOH) is tasked with playing a leading role in the proposed reconfiguration of the acute hospital network within the new model of integrated care. For example, the Business Plan of Acute Hospital Unit 1 in the Department of Health (DOH) states that it will “lead on the development of the acute model of care as part of an integrated model of care for health services.” In response to this task, the DOH has proposed a rebalancing of service orientation towards prevention and disease management in the community to relieve pressure on the acute hospital network. For example, in the report *Better Health, Improving Health Care*,² the DOH proposed that:

“...Disease management should be located at the lowest possible level of complexity, starting with the patient themselves. The vast majority of health care needs should be addressed in primary care with a strong focus on keeping patients well, active management of patients’ needs and the minimum possible level of admission to acute hospitals...” (p. 4–5).

Notwithstanding these proposed shifts in orientation, the DOH also recognises that the acute hospital network will remain a central plank within the Irish healthcare landscape but will require urgent attention to make it fit for purpose while reducing pressure on its operational capacity. To this end, the DOH states that:²

“...While acute hospital care will always be an essential part of the health service, it needs to be provided within an integrated model which seeks to avoid unnecessary hospital stays. Where patients need acute services the transition between primary, acute and community care must be well-managed so that it is effective, efficient and safe...” (p. 2).

As part of this work in considering options for the reconfiguration of the acute hospital network within an integrated model of healthcare delivery in Ireland, the DOH commissioned the Evidence Centre in the Health Research Board (HRB) to examine the published research evidence on integrated interventions that have been targeted at reducing pressure on acute hospitals.

1.2 Purpose

The *Sláintecare Report* commits the DOH to the development of an acute model of care within an integrated model of care framework.¹ In order to contribute to the development of an acute model of care, this umbrella review will examine the effectiveness of interventions that can reduce pressure on acute hospitals, thus providing an evidence base to underpin the development of a model aimed at delivering patient-centred care in the right place, at the right time, by the right people.

This review is not clinically focused or disease specific. Instead, it focuses on the systems level, identifying interventions that have an evidence base in alleviating pressure on acute hospitals. This literature review will guide the development of the policy in this area.

1.3 Research questions and outcomes of interest

The DOH question is:

What health system-based interventions reduce pressure on acute hospitals in an integrated health system?

The outcomes assessing reduced pressure on acute hospitals are:

- Emergency (unplanned) admissions to hospital
- Readmissions
- Length of stay in hospital
- Emergency department use or visits, and
- Cost to the healthcare service.

2 Background

2.1 Pressure points in Ireland's acute hospital system

Acute care can be unplanned (emergency) or planned. In Ireland, a large proportion of acute care takes place in its approximately 60 acute hospitals. Emergency care is initiated in the emergency department and proceeds, if required, to assessment units and acute hospital wards. Some patients who present to emergency departments are not emergencies, and these cases need to be redirected to appropriate services in the community. If they cannot be redirected, then the emergency department becomes overcrowded and its resources become stretched. This represents inappropriate emergency department use, which creates pressure on the acute hospital service. For example, Smyth *et al.*³ reported that in 2015 there were 865,057 adult emergency department attendances in 26 adult hospitals in Ireland. Of these, 68% were 17–64 years old, 21% were 65–84 years old and 5% were 85 years old and over. Approximately 1 in 2 adults aged 65 years and over presenting to emergency department was admitted, compared to 1 in 5 adults aged 17–64 years. Of the 865,057 adult emergency department attendances, 95,300 (11%) attendances were admitted to an acute medical assessment unit and 46% of such admissions were adults aged 65 years and over. There were 271,867 emergency calls to the ambulance service in 2015. Almost one in five emergency calls to the ambulance service was by a person classified as non-serious or non-life-threatening condition or as minor illness or injury, indicating that these patients could be treated in alternative services.

Planned care takes place in outpatient clinics, day wards, and acute inpatient wards. However, when a patient attends a specialist at an outpatient clinic and the specialist recommends that an investigation or procedure is required, the patient goes on a waiting list and waits for the service. The waiting time for the service is influenced by how many other people require the service and the availability of hospital beds and other facilities. Long periods on waiting lists create another pressure point. For example, Smyth *et al.*³ reported that there were 2,887,592 adult outpatient department attendances in 2015, which included 789,327 new patients. Smyth *et al.*³ do not provide the total numbers waiting for an outpatient appointment (specialist assessment) or for a procedure (elective surgery or internal investigation), but it appears that more than 275,000 were waiting for an acute hospital service, and of these, 10% were waiting 12 months or more.

Emergencies are prioritised over planned patients for beds in acute hospitals. When the number of emergency patients who require inpatient care exceeds the availability of beds, then planned patients' treatments are delayed, and when all of the elective beds are used by emergencies then temporary beds or trolleys are used. Emergencies that require inpatient treatment create further pressure on acute inpatient hospital services. For example, Smyth *et al.*³ reported that the average number of patients in Irish hospitals on trolleys per day was 292 in 2015 and 326 in 2016.

A delayed discharge is the continued occupation of a hospital bed after an inpatient's ready-for-discharge date has passed and the patient no longer requires acute medical care and is clinically ready to move to a more appropriate setting (such as the patient's home or a nursing home), but cannot because there is no appropriate social care or community-level healthcare available or because there are unresolved issues with the patient/carer/family. However, these create another pressure point in the hospital. The average number of delayed discharges in 2015 was 648 per month, which was lower than in 2014 at 692 per month. In 2015, 48% of delayed discharges aged 65 years and over were awaiting the Nursing Homes Support Scheme or an appropriate home care package.

In 2015, adults aged 65 years or older represented 13% of the population but used approximately 54% of the total hospital inpatient bed days, while adults aged 85 years or over represented 1.4% of the population but used approximately 14% of the total hospital inpatient bed days.

2.2 Investigating responses to pressure points in Ireland's acute hospital system

The HRB set out to identify integrated health system interventions that reduce pressure on acute hospitals (in particular, inpatient services and the emergency department). The HRB's outcomes of interest for assessing interventions to deal with pressure points were reductions in: unplanned hospital admissions, readmissions, hospital length of stay, and emergency department visits. This would ideally, but not necessarily, be provided at equal cost for individual patients but may increase the cost of the whole system, as the system would be capable of dealing with more patients.

Integrated health system interventions, in this case, are interventions that require the acute hospital system and both the primary and community care systems to work together to provide investigation, treatment, or care for the patient by integrating each team's particular expertise. In order to do this, it is important to determine if the specialist healthcare provided within the hospital can be provided outside the hospital with the same clinical outcomes, which would require sharing hospital-based specialisms to increase the capability of, and capacity in, primary care clinics and the community.

The HRB identified a number of integrated interventions and the international evidence base for these as a starting point.

2.3 NHS England's experience of integrated models of care

National Health Service (NHS) England is going through a similar national-level process and is testing models for integrating acute health services (hospitals, general practitioners, and social or community care). The evidence was being collected at the time this report was being written, so the HRB will report interim findings. It is important to note that these pilot studies appear to be before and after studies providing Level III evidence and may not be generalisable to other countries.

The NHS *Five Year Forward View* (2014)⁴ proposes new models of care that involve acute hospitals and other community-based health services working as a single local system. The NHS is testing the new models through 50 pilot projects. The NHS says that it needs to evaluate new care models to establish which produce the best experience for patients and the best value for money. They expect the new models to dissolve the traditional boundaries between acute hospitals, general practitioners, and other community health and social services and to develop networks of care. The NHS wants partnerships with patients with chronic diseases over the long term and with services that are integrated around the patient, rather than providing single, unconnected episodes of care. The NHS envisages that the vast majority of healthcare is to take place outside of the hospital. NHS England has developed a number of models: the Multispecialty Community Provider Model, the Primary and Acute Care Systems Model, the Urgent and Emergency Care Networks Model, and Enhanced Health in Care Homes. The models are based on national and international experience and are being tested to determine their effectiveness.

2.3.1 Multispecialty Community Provider Model

The Multispecialty Community Provider Model⁴ permits groups of general practitioners to combine with nurses, other community health services, hospital specialists, and perhaps mental health and social care to create integrated out-of-hospital care. NHS England says that "early versions of these models are emerging in different parts of the country, but they generally do not yet employ hospital consultants, have admitting rights to hospital beds, run community hospitals or take delegated control of the NHS budget," all of which would be expected in the full version of the model.

For example, in Kent, 20 general practitioners and almost 150 staff operate from three modern sites providing many of the tests, investigations, treatment for minor injuries, and minor surgery usually provided in hospital.⁵ The NHS says "it shows what can be done when general practice operates at scale. Better results, better care, a better experience for patients and significant savings." However, the HRB advises caution with respect to the results demonstrating effect, as they appear to be based

on routine surveillance and would not provide the same level of evidence of effect as a randomised controlled trial (RCT).

Naylor *et al.* (2015)⁶ described the King's Fund's most recent indicative evaluation results of integrated service models, where acute hospitals take a more proactive role in integrated care. The High Risk Patient Programme focuses on coordinating services for older people and people with long-term conditions at high risk of hospital admission in Northumberland and North Tyneside. The programme has been running since 2012 and involves integrating services across primary, community, secondary, and social care through locality-based multidisciplinary teams working in general practices and aligned with hospital services. In this model, consultant geriatricians work as part of practice-based multidisciplinary teams. The key service processes of the programme include: identifying high-risk patients in general practice; creating a practice high-risk register; carrying out an initial nursing assessment for these patients; holding regular practice-based multidisciplinary team meetings; assigning a 'key worker' for each patient; undertaking care planning and tailored reviews; and holding complex case conferences as necessary. The High Risk Patient Programme, delivered by the Northumbria Healthcare NHS Foundation Trust and partners, has been associated with a significant drop in avoidable admissions and emergency readmissions in 2013–2014. However, these improvements were not experienced in 2014–2015. The HRB would caution that the findings come from a before and after internal evaluation, and the evaluation methods are not provided.

There are 14 other Multispecialty Community Provider pilot projects which move specialist care out of hospitals into the community throughout England,⁷ although there are no results reported to date.

2.3.2 Primary and Acute Care Systems Model

The Primary and Acute Care Systems Model⁴ is the integration of the hospital and the primary care provider, combining for the first time general practice and hospital services, similar to the health maintenance organisations in the United States of America (USA) such as Kaiser Permanente.

In Cornwall, trained volunteers and health and social care professionals work side by side to support patients with long-term conditions to meet their health and life goals, which would be only one aspect of an Accountable Care Organisation.⁴ The HRB cautions that this is an example rather than evidence that the intervention provides better care.

Naylor *et al.*⁶ described the King's Fund's most recent indicative evaluation results of integrated service models where acute hospitals take a more proactive role in integrated care.

Right First Time is a city-wide partnership in Sheffield established in 2011 that brings together commissioners and providers on an equal footing.⁶ It includes the local acute trust, mental health trust, children's trust, clinical commissioning group, and local authority, all of which cover roughly the same geographical area. The trust and relationships developed through Right First Time have allowed partner organisations to align systems and experiment with different approaches to integration, for example involving the transfer of staff from the local authority to the acute hospital trust. Since the Right First Time programme in Sheffield was initiated, there has been a drop in bed usage among people with ambulatory care-sensitive conditions. The HRB advises caution with respect to the results demonstrating effect, as they appear to be based on routine surveillance and would not provide the same level of evidence of effect as an RCT.

The South Warwickshire NHS Foundation Trust, community care partners, and social care worked together to develop the Discharge to Assess programme that seeks to integrate acute and post-acute care through the use of a discharge coordinator from the time of admission.⁶ After admission, patients undergo early, comprehensive geriatric assessment, visible to and trusted by all organisations involved in the pathway. Patients are placed on one of three pathways according to need: Pathway 1 serves patients assessed as able to return home and receive a rehabilitation package based in their home; Pathway 2 serves medium-high complex rehabilitation needs patients, who receive a rehabilitation package based in a community hospital and then in their home; and Pathway 3 serves patients with the most complex needs, assessed as likely to need a long-term care home placement. The use of Discharge to Assess in South Warwickshire was associated with a 33%

reduction in length of stay, a 15% drop in new admissions to nursing homes post-discharge, and a 15% drop in mortality. The HRB advises caution with respect to the results demonstrating effect, as they appear to be based on routine surveillance and would not provide the same level of evidence of effect as an RCT.

There are nine integrated Primary and Acute Care Systems pilot projects in England which seek to integrate general practice, hospital, community, and mental health services.⁷ There are no results reported to date.

2.3.3 Urgent and Emergency Care Networks

Across the NHS, accident and emergency departments, general practitioner out-of-hours services, urgent care centres, NHS 111, and ambulance services are being redesigned to integrate into urgent and emergency care services or networks.⁴ There are eight pilot approaches to urgent and emergency care so as to improve the coordination of services and reduce pressure on accident and emergency departments.⁷ There are no results reported to date.

2.3.4 Enhanced Health in Care Homes

Enhanced Health in Care Homes is an intervention allowing secure interactive telecommunications between care homes and hospitals 24 hours per day, so that care home staff and their residents can communicate with specialist nurses and doctors when required.⁴ In the Bradford and Airedale region, there has been significant progress in developing a common IT platform shared by local partners.⁶ The Airedale NHS Foundation Trust, the Bradford District Care NHS Foundation Trust, the Bradford Metropolitan District Council, and local commissioners worked on this agenda collectively, supported by GB£6 million in funding from the Integrated Digital Care Technology Fund. This money has been invested across the health economy in a series of specific developments, primarily focused on installing SystemOne as the clinical IT system for all providers. The following entities are now using the common platform or are in the process of adopting it, enabling them to share the same patient records: almost all general practices locally, the Airedale NHS Foundation Trust, community services provided by the Bradford District Care NHS Foundation Trust, and social care teams provided by Bradford Metropolitan District Council. In Airedale, nursing and residential homes are linked by secure video to the hospital, allowing consultations with nurses and consultants both in and out of normal hours for everything from cuts and bumps to diabetes management to the onset of confusion. Emergency admissions from these homes have been reduced by 35%⁴ or 37%⁶ and accident and emergency attendances by 45%⁵ or 53%.⁴ Residents rate the service highly. The HRB advises caution with respect to the results demonstrating effect, as they appear to be based on routine surveillance and reported experience, and would not provide the same level of evidence of effect as an RCT.

There are six Enhanced Health in Care Homes pilot projects which offer older people better, seamless healthcare and rehabilitation services,⁷ although no results have been reported to date.

3 Methods

Arising from the HRB's discussion with the Acute Hospitals Policy Unit 1 of the DOH regarding their information needs, the HRB was asked to undertake a review of the literature to identify and synthesise the evidence for integrated interventions targeted at reducing pressure on acute hospitals. As a first step, the HRB undertook an initial brief scoping search for relevant literature to help it frame the parameters of the work. Arising from this initial search, the HRB identified an umbrella review undertaken by Damery *et al.*,⁸ published in 2016, including systematic reviews published between 2000 and 2015. The HRB noted that Damery *et al.*⁸ had asked the question, "Does integrated care reduce hospital activity for patients with chronic diseases?" As this question mirrored very closely the research question the HRB had agreed with the DOH, the HRB undertook a closer examination of the work by Damery *et al.*

The HRB noted that Damery *et al.*⁸ confined their work to examining interventions targeting patients with 11 named chronic diseases. Specifically, they included reviews that covered patients with hypertension, diabetes, depression, coronary heart disease, stroke, transient ischaemic attack, chronic obstructive pulmonary disease, cancer, heart failure, dementia, and arthritis. The HRB team agreed that it would be futile to re-examine the literature on patients with chronic diseases, given the extensive work completed by Damery *et al.*. Due to time and resource limitations, the HRB also decided it was not feasible to update the Damery *et al.* review. The HRB noted that Damery *et al.*⁸ had not specifically examined interventions targeting non-chronic medical or surgical patients and/or older people, so the HRB decided that it would undertake a review of the literature on integrated interventions primarily targeting medical or surgical patients and/or older people.

The HRB further noted that Damery *et al.*⁸ had described an integrated healthcare intervention as being implemented in any health or social care setting (primary, secondary, or community) as long as it crossed the boundary between two or more settings, i.e. the hospital and community or primary care; the community setting included care given in the community, in patient homes, or by a social care professional.⁸ The HRB decided to adopt this definition of an integrated healthcare intervention as it met with the criteria that were agreed with the DOH.

Furthermore, the HRB noted that Damery *et al.*⁸ had included reviews that assessed one or more of the following outcomes: emergency (unscheduled or unplanned) hospital admissions or readmissions, length of hospital stay, emergency department use, and healthcare costs. They had selected these outcomes based on their scoping of the literature which predated their published umbrella review. The HRB decided to examine evaluations of integrated interventions that had assessed these identical outcomes either as primary or secondary outcomes for integrated interventions targeted to non-chronic medical and surgical conditions and older populations.

As part of the HRB's initial brief scoping search of published literature, the HRB identified a number of systematic reviews^{8,9} that assessed the impact of interventions on hospital activity. In addition to the completed umbrella review by Damery *et al.*,⁸ the HRB also identified an umbrella review of interventions to reduce emergency department activity⁹ and two protocols to undertake umbrella reviews¹⁰ covering the HRB's topic of interest. The first protocol, by O'Connell Francischetto *et al.* (2016),¹⁰ plans to review discharge interventions for older patients leaving hospital, and the second protocol, by Bobrovitz *et al.*,¹¹ plans to review interventions to reduce unscheduled hospital admissions among adults. However, the results of these two protocols will not be published by the HRB's deadline.

The existence of the Damery *et al.*⁸ review, coupled with the short timeframe the HRB had to complete the work (five months), led to the pragmatic decision to undertake an umbrella review – a review of systematic reviews – on integrated interventions either primarily targeting or including non-chronic medical or surgical patients and/or older people that assessed emergency (unplanned)

hospital admissions or readmissions, length of hospital stay, emergency department visits, and healthcare costs.

In addition to serving the interests of pragmatism within a limited timeframe, the HRB also reasoned that undertaking an umbrella review is a useful method of summarising evidence from more than one systematic review of different interventions or different conditions, problems or populations.^{12,13} The HRB elected to undertake the umbrella review using guidance from the *Joanna Briggs Institute Reviewer's Manual*.¹³ Furthermore, the HRB decided that combining the results of multiple systematic reviews would enable it to provide a synthesis of high-level relevant evidence to inform a broader health policy or health systems question.¹³

3.1 Search methods for identification of reviews

In approaching the search for this umbrella review, the HRB's intention was to identify high-level evidence (systematic reviews) of integrated interventions that addressed the outcomes of interest: emergency (unplanned) hospital admissions, readmissions, length of hospital stay, emergency department visits, and healthcare costs for medical or surgical patients and/or older people. Given the short timeframe the HRB had agreed with the DOH to complete the review, the HRB designed a search strategy with a balance in favour of search precision. Precision measures the ability of the search to retrieve records that are genuinely relevant and, as a result, a highly precise search can result in a set of studies, most of which are of genuine relevance.

3.1.1 Search terms and period

In terms of choosing which databases to search, the HRB was conscious that there is no gold standard number of databases required (to date) for an umbrella review. Robinson *et al.* (cited in Golder and Wright¹⁴) note that organisations who undertake systematic reviews and who offer guidance on the integration of existing systematic reviews into new reviews "...recommend using specific databases and search filters to aid in locating existing systematic reviews. Commonly recommended databases include: Database of Abstracts of Reviews of Effects (DARE), Cochrane Database of Systematic Reviews (CDSR), Health Technology Assessment Database, MEDLINE and Embase..." (p. 6).¹⁴ With this in mind, and given the time limitations for the review, the HRB decided to search the MEDLINE database for its wide coverage of healthcare-related topics and the Cochrane Database of Systematic Reviews (CDSR) for its coverage of high-quality systematic reviews in healthcare.

The search was broken into two main concepts (outcomes and systematic reviews) and a range of medical subject headings (MeSH) terms and keywords were selected and combined for each concept.

In order to focus the search further, major topic MeSH headings were selected where possible. The concepts were combined ([outcome terms] AND [systematic review terms]) and developed into a full search strategy first in MEDLINE and then translated using syntax suitable for the CDSR.

The HRB limited the search to citations published between January 2000 and August 2017, as Damery *et al.*⁸ had indicated that the search was unlikely to retrieve relevant systematic reviews prior to the year 2000. The HRB also applied a language limitation and searched for systematic reviews published in the English language only. Due to the short timeframe for this review, the HRB did not systematically search the bibliographies of the included reviews for additional systematic reviews. The final two search strategies are provided in Appendix A.

The HRB imported the records retrieved from the search into EndNote X7, removed duplicates, and then screened titles and abstracts for full text inclusion. Following title and abstract screening, the included records were then uploaded into EPPI-Reviewer 4 (an online tool designed to support various types of literature reviews) for full-text screening by two reviewers. A full outline of the search and screening process is presented in Figure 1.

3.2 Screening and review selection

Two authors (CC and LF) independently screened 1,809 MEDLINE records by title and abstract for inclusion/exclusion. Disagreements were resolved through discussion and consensus. For the results of the search of the CDSR, one reviewer (LF) screened 1,130 records by title and abstract for inclusion/exclusion. At this stage of the screening process, the focus was on identifying systematic reviews that evaluated integrated interventions on the outcomes of emergency (unplanned) hospital admissions, readmissions, length of hospital stay, emergency department use, and healthcare cost. The HRB decided that reviews that focused exclusively or primarily on populations of chronic disease patients would be excluded at this stage, as this population was already well-covered and described in Damery *et al.*⁸ (As previously stated, the HRB did not update the Damery *et al.* review, which included systematic reviews published between 2000 and 2015.) In addition, the HRB excluded reviews that were included in the umbrella review by Damery *et al.*⁸ In essence, the HRB included systematic reviews for full-text screening if they met the following inclusion criteria:

- Explicitly reported methods, i.e. searching more than two databases for relevant studies
- Evaluated an integrated intervention/interventions that crossed between the hospital and community setting, and
- Assessed the outcomes of emergency (unplanned) hospital admission, readmission, length of hospital stay, emergency department use, and healthcare cost.

The Damery *et al.*⁸ review specifically excluded the following interventions: palliative care interventions; purely psychosocial interventions or those related to spirituality, mindfulness, health literacy, or the use of complementary and alternative medicines; interventions focusing solely on diet and lifestyle factors; treatment or medication adherence; the effectiveness of surgical or diagnostic techniques; caregivers; pregnancy; and interventions implemented in low- and middle-income countries.

For the most part, the HRB followed the logic of Damery *et al.*⁸ and applied similar exclusion criteria. In addition, the HRB was conscious that it was working with a short timeframe and it would not have been feasible to examine all types of interventions that may have been evaluated in the literature. However, it is important to note that the HRB decided to include medication management, hospital at home, and telemedicine interventions, as these were tested to determine if they reduced pressure on acute hospitals and were not covered by Damery *et al.*⁸ The HRB also included interventions to deal with asthma, as this condition was not one of Damery *et al.*'s⁸ 11 chronic diseases.

At the next stage of the HRB's screening process, 80 potentially eligible full-text articles were retrieved and assessed for inclusion by pairs of reviewers (CC, LF, MK, JL, and GON), and disagreements were resolved through discussion and consensus. Once the HRB's final decisions were made on the number and type of reviews to be included in the HRB review summary, these reviews were then assessed for the quality of their methods.

3.3 Quality assessment

The HRB used an adapted version of the Health Evidence Quality Assessment Tool for systematic reviews (Appendix B). This tool was chosen, as it provides a broader rating score that classifies reviews as weak (1 to 4/10), moderate (5 to 7/10) or strong (8 to 10/10), which enables it to identify and select the strongest reviews for synthesis. This assessment was undertaken independently by two groups of reviewers (CC and LF, and MK, JL, and GON) using the 10 quality criteria outlined in the

Health Evidence Quality Assessment Tool, and a final quality rating for each review was assigned. As a key objective the HRB's work was to identify and review the best evidence available, the HRB only included reviews in the final evidence review that were assigned a quality rating of 8 or above out of a possible 10; that is, those that were rated as strong.

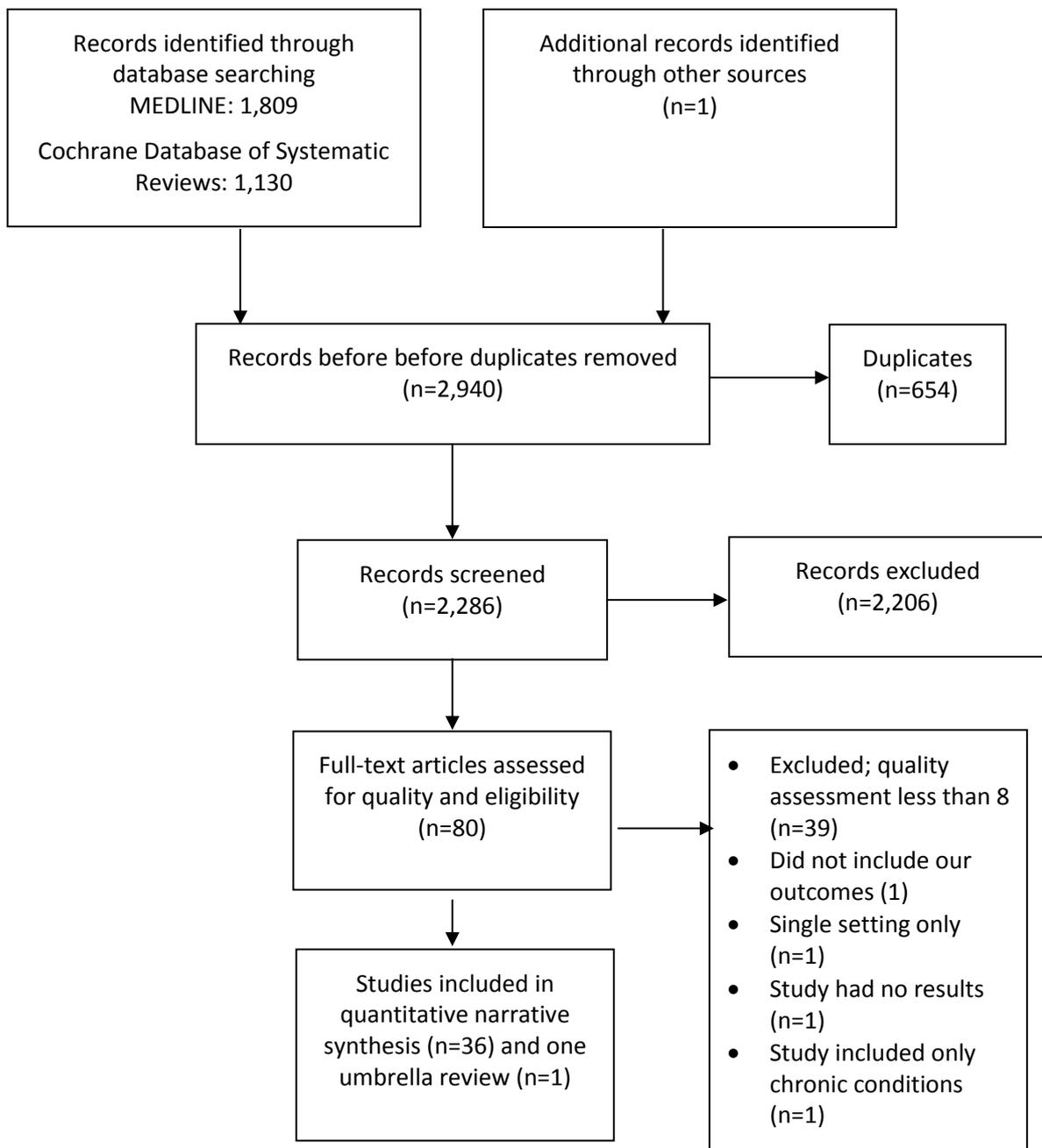


Figure 1: PRISMA flow chart for screening identified literature

3.4 Data extraction

Data from 36 systematic reviews and one umbrella review were extracted by two reviewers using a predefined data extraction spreadsheet. Data on the review characteristics and findings were extracted by pairs of reviewers (CC and LF, and GON and JL). The extraction sheet contained the following parameters: the review objectives, review design, number of primary studies included, level of evidence of included studies, range of years of publication for included studies, countries where primary studies were completed, number and profile of participants included in studies, age and clinical conditions of participants, definition of intervention, description of comparators, outcomes assessed, and findings for intervention compared to control group. A link to the full data set of characteristics extracted from the included reviews is provided in Appendix D.

3.5 Data analysis and synthesis

The HRB identified a number of the interventions by population group that were assessed in the literature, and these are as follows:

- Discharge management for three populations: chronic diseases, general medical and surgical conditions, and older people and discharge management using a quality improvement approach
- Pharmacist-led medication management
- Chronic care model
- Chronic disease management
- Complex interventions for chronic diseases
- Multidisciplinary teams for chronic diseases
- Self-management
- Case management for two populations: chronic diseases and older populations
- Hospital at home
- Non-traditional emergency department interventions
- Specialised multidisciplinary rehabilitation for hip fracture, and
- Interactive telemedicine.

For the purpose of providing adequate detail and context for the HRB's findings, we also reports the definition of the intervention, the quality of the review, the objective of the review, the control group, the outcome measured, the countries where evaluations were undertaken, the number of primary studies included, and the finding related to hospital outcomes.

In addition, the statistical effect from each meta-analysis or narrative review was characterised according to four categories: significant positive or negative associations, mixed findings, or no association.

Similar to the challenges encountered by Damery *et al.*⁸ in their umbrella review, heterogeneity in study populations, interventions and outcomes assessed prevented the HRB from being able to pool the effects of interventions in a meta-synthesis across the included reviews. Instead, the HRB extracted the findings from each review as they applied to the interventions and presented a summary statement of effectiveness for each outcome measured by population for each review and

for the overall intervention. The HRB has not formally applied the GRADE approach¹⁵ to rating the quality and certainty of the evidence, but it has applied its principles of bias (considering study design and publication bias where reported), inconsistency (considering heterogeneity), and imprecision (considering meta-analysis and confidence intervals) in its conclusions on each intervention.

3.5.1 Overlap of primary studies

Pieper *et al.* developed a methodology to assess overlap of primary studies between systematic reviews of the same interventions.¹⁶ They call this measure the 'corrected covered area'. The HRB used this measure to assess overlap where there was more than one systematic review covering an intervention. The results are reported in the findings chapter..

3.6 Technical results

3.6.1 Results of the search

Database searching identified a total of 2,940 records. After duplicates were removed, 2,286 records remained. The number of irrelevant records was 2,206. From the remaining records, 80 were obtained as full-text articles and assessed for eligibility. The number of records excluded with reason was 43. The final number of included reviews was 36 systematic reviews and one umbrella review (Table 1)..

3.6.2 Included studies

Thirty-six systematic reviews met the inclusion criteria and had extractable data to describe integrated interventions measured by our selected outcomes. Each study is summarised and described in *Characteristics of included studies* table in (Appendix D).. The publication language of all 36 included systematic reviews and the umbrella review were in English.

3.6.3 Results of quality assessment

In total, 80 reviews (79 systematic reviews and one umbrella review) were assessed on the quality of their methods; 36 systematic reviews and one umbrella review were rated as strong (8–10/10) and were included in the final evidence review.

The 39 systematic reviews that were assigned a rating of low or moderate quality (0–7) tended to contain a number of fundamental flaws and were excluded if:

- They did not undertake a quality appraisal of the primary studies included in the review
- The choice of synthesis to combine the data was inappropriate and therefore the findings were not usable, or
- The intervention was already covered by at least one other included systematic review that was rated as strong (8–10) in the HRB's quality assessment.

3.6.4 Excluded studies

A total of 43 reviews were excluded, either due to a moderate or low rating, as described above, or because on closer examination, they did not measure the desired outcomes, the outcomes took place in a single setting and not an integrated healthcare setting, or the study only addressed patients with chronic conditions, a population already covered by the Damery *et al.* review. A full list of the excluded studies, with reasons for exclusion, can be found in Appendix C .

4 Findings: Integrated interventions to reduce pressure on acute hospitals

4.1 Integrated interventions that address pressure on acute hospitals

The HRB used 36 systematic reviews and one umbrella review (comprising 50 systematic reviews) to write the findings presented in Section 4 (Table 1). The 36 systematic reviews and the umbrella review were rated as strong quality and scored between 8 and 10 out of a possible 10 points using the Health Evidence Quality Assessment Tool for systematic reviews (Table 1). The 50 systematic reviews in the umbrella review were rated as strong or moderate quality and were not reviewed by the HRB authors.

Table 1: List of included reviews

Author and year of publication	Focus of the reviews	Quality score
Damery <i>et al.</i> 2016 ⁸	Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews.	10
Allen <i>et al.</i> 2014 ¹⁷	Quality care outcomes following transitional care interventions for older people from hospital to home: a systematic review.	9
Braet <i>et al.</i> 2016 ¹⁸	Effectiveness of discharge interventions from hospital to home on hospital readmissions: a systematic review.	10
Chu <i>et al.</i> 2016 ¹⁹	Community-based hip fracture rehabilitation interventions for older adults with cognitive impairment: A systematic review.	9
Conroy <i>et al.</i> 2011 ²⁰	A systematic review of comprehensive geriatric assessment to improve outcomes for frail older people being rapidly discharged from acute hospital: 'interface geriatrics'.	9
De Oliveira <i>et al.</i> 2017 ²¹	Effectiveness of pharmacist intervention to reduce medication errors and health-care resources utilization after transitions of care: A meta-analysis of randomized controlled trials.	8
Domingo <i>et al.</i> 2012 ²²	Effectiveness of structured discharge process in reducing hospital readmission of adult patients with community acquired pneumonia: A systematic review.	10
Donald <i>et al.</i> 2015 ²³	Hospital to community transitional care by nurse practitioners: A systematic review of cost-effectiveness.	10
Flodgren <i>et al.</i> 2015 ²⁴	Interactive telemedicine: effects on professional practice and health care outcomes.	10
Fox <i>et al.</i> 2013 ²⁵	Effectiveness of early discharge planning in acutely ill or injured hospitalized older adults: a systematic review and meta-analysis.	10
Gonçalves-Bradley <i>et al.</i> 2017 ²⁶	Early discharge hospital at home.	10
Gonçalves-Bradley <i>et al.</i> 2016 ²⁷	Discharge planning from hospital.	10
Handoll <i>et al.</i> 2009 ²⁸	Multidisciplinary rehabilitation for older people with hip fractures.	9
Hansen <i>et al.</i> 2011 ²⁹	Interventions to reduce 30-day rehospitalization: a systematic review.	10
Hesselink <i>et al.</i> 2012 ³⁰	Improving patient handovers from hospital to primary care: a systematic review.	10

Author and year of publication	Focus of the reviews	Quality score
Huntley <i>et al.</i> 2013 ³¹	Is case management effective in reducing the risk of unplanned hospital admissions for older people? A systematic review and meta-analysis.	9
Khangura <i>et al.</i> 2012 ³²	Primary care professionals providing non-urgent care in hospital emergency departments.	10
Le Berre <i>et al.</i> 2017 ³³	Impact of transitional care services for chronically ill older patients: A systematic evidence review.	10
Leppin <i>et al.</i> 2014 ³⁴	Preventing 30-day hospital readmissions: a systematic review and meta-analysis of randomized trials.	10
Lockwood <i>et al.</i> 2015 ³⁵	Pre-discharge home assessment visits in assisting patients' return to community living: A systematic review and meta-analysis.	9
Lowthian <i>et al.</i> 2015 ³⁶	Discharging older patients from the emergency department effectively: a systematic review and meta-analysis.	10
Mabire <i>et al.</i> 2016 ³⁷	Effectiveness of nursing discharge planning interventions on health-related outcomes in discharged elderly inpatients: a systematic review.	10
Mekonnen <i>et al.</i> 2016 ³⁸	Effectiveness of pharmacist-led medication reconciliation programmes on clinical outcomes at hospital transitions: a systematic review and meta-analysis.	8
Mistiaen and Poot. 2006 ³⁹	Telephone follow-up, initiated by a hospital-based health professional, for postdischarge problems in patients discharged from hospital to home.	10
Morgan <i>et al.</i> 2013 ⁴⁰	Non-emergency department interventions to reduce ED utilization: a systematic review.	10
Nazar <i>et al.</i> 2015 ⁴¹	A systematic review of the role of community pharmacies in improving the transition from secondary to primary care.	9
Nuckols <i>et al.</i> 2017 ⁴²	Economic evaluation of quality improvement interventions designed to prevent hospital readmission: A systematic review and meta-analysis.	10
Peytremann-Bridevaux <i>et al.</i> 2015 ⁴³	Chronic disease management programmes for adults with asthma.	10
Pinnock <i>et al.</i> 2017 ⁴⁴	Systematic meta-review of supported self-management for asthma: a healthcare perspective.	10
Rennke <i>et al.</i> 2013 ⁴⁵	Hospital-initiated transitional care interventions as a patient safety strategy: A systematic review.	10
Shepperd <i>et al.</i> 2016a ⁴⁶	Hospital at home: home-based end-of-life care.	10
Shepperd <i>et al.</i> 2016b ⁴⁷	Admission avoidance hospital at home.	10
Spinewine <i>et al.</i> 2013 ⁴⁸	Approaches for improving continuity of care in medication management: a systematic review.	8
Tapp <i>et al.</i> 2007 ⁴⁹	Education interventions for adults who attend the emergency room for acute asthma.	8
Thomas <i>et al.</i> 2014 ⁵⁰	Pharmacist-led interventions to reduce unplanned admissions for older people: a systematic review and meta-analysis of randomised controlled trials.	10
Verhaegh <i>et al.</i> 2014 ⁵¹	Transitional care interventions prevent hospital readmissions for adults with chronic illnesses.	10
Villa-Roel <i>et al.</i> 2016 ⁵²	Effectiveness of educational interventions to increase primary care follow-up for adults seen in the emergency department for	10

Author and year of publication	Focus of the reviews	Quality score
	acute asthma: a systematic review and meta-analysis.	

4.1.1 Interventions that address chronic diseases

Damery *et al.*⁸ is rated as a strong quality review and is used to summarise the findings on 11 chronic diseases. Damery *et al.*⁸ reported that for the purposes of their umbrella review, interventions could be implemented in any health or social care setting (primary, secondary, or community care), as long as they crossed the boundary between primary and secondary care or community and secondary care. The community setting encompassed care given in the community, in patient homes, or by social care professionals in an office setting. Damery *et al.*'s⁸ final list of interventions comprised: discharge management, the chronic care model, complex interventions, multidisciplinary teams, self-management, and case management. The HRB identified some of these interventions or others like them that were used to address asthma, a chronic disease not included in Damery *et al.*'s group of 11 diseases. The HRB also identified a 2017 systematic review on discharge management interventions for chronically ill older people to add to Damery *et al.*'s findings.

4.1.2 Interventions that address acute general medical and surgical conditions and older populations

The HRB identified two population groups in addition to Damery *et al.*'s chronic disease population: people with acute medical and surgical conditions and older people. There is overlap between the two groups and there is also some overlap between these two groups and the chronic disease population. The HRB identified integrated interventions using a similar definition to Damery *et al.*⁸ and identified an additional five interventions which could relieve pressure on acute hospitals; these were pharmacist-led medication management, hospital at home, non-traditional emergency department interventions, specialised multidisciplinary rehabilitation for hip fracture, and interactive telemedicine.

4.2 Discharge management

4.2.1 Definitions of discharge management

Damery *et al.* (2016)⁸ defined discharge management as interventions that are designed to facilitate effective transition from hospital care to other settings (for instance home or nursing home). Discharge management interventions typically include a pre-discharge phase of support, transitional care for the move between the hospital and other setting, and post-discharge follow-up and monitoring, often incorporating rehabilitation or reablement support.⁸

Many of the HRB's included reviews provided definitions of discharge management that align with Damery *et al.*'s⁸ definition, with minor variations or additions. For instance, Braet *et al.* (2016)¹⁸ used a definition describing interventions aiming to ease the transition from hospital to home and performed at least partly by hospital professionals. They also noted that discharge management interventions can comprise of a single action, for instance a telephone call after discharge, or a variety of interventions¹⁸ One review (Mistiaen and Poot, 2006)³⁹ examined a single aspect of discharge management, post-discharge telephone follow-up. It involved telephone follow-up initiated by a hospital-based health professional to a patient who was discharged to his/her own home setting. The telephone follow-up had to be performed at least once within the first month after discharge and may have had any kind of structure (for instance, completely open or completely structured). It could contain one or more elements, such as gathering information, giving reassurance, giving advice on several topics, counselling, or referral where required.

Gonçalves-Bradley *et al.* (2016)²⁷ emphasised that discharge planning involves an individualised discharge plan for a patient prior to them leaving hospital for home or residential care. They also divided the process of discharge planning according to the steps identified by Marks (1994),⁵³ which include: pre-admission assessment, case finding on admission, inpatient assessment and preparation of a discharge plan based on individual patient needs, implementation of the discharge plan, and monitoring in the form of an audit to assess if the discharge plan was implemented.

Discharge management is also referred to as transitional care. Rennke *et al.* (2013)⁴⁵ defined transitional care as "interventions initiated before hospital discharge with the aim of ensuring the safe and effective transition of patients from the acute inpatient setting to home" (p433). Verhaegh *et al.* (2014)⁵¹ defined transitional care according to the core components described by Naylor and Sochalski in 2010⁵⁴ and Naylor *et al.* in 2011⁵⁵. Naylor *et al.* in 2010⁵⁴ and 2011⁵⁵. According to Naylor *et al.*,⁵⁴ the primary goal of transitional care is to prevent avoidable readmissions and negative health outcomes after a hospital discharge, specifically targeting chronically ill or vulnerable adults and their informal caregivers. Additionally, the interventions should be initiated during hospital admission and should continue after discharge, through home visits or telephone follow-up, for at least one month.

Admission	Discharge plan starts within 48 hours of admission
	Assessment on admission
	Medication management
Bridging	Self-management education
	Caregiver involvement
	Discharge plan
	Reassessment of need
	Care coordination by nurse
	Primary care provider(s) communication
Post-discharge	Home visit within 3 days (reassessment)
	Medication management
	Total number of home visits within 30 days
	Telephone follow-up
	Number of telephone follow-ups
	Reablement support
	Rehabilitation support
	Total duration of the intervention

Figure 2: Possible components of discharge management

Despite variations in definitions between studies, all of the studies covering discharge management identified the core elements of discharge management as an intervention aiming to effectively transition patients from hospital to other settings.

4.2.2 Discharge management for chronic disease patients

Damery *et al.*⁸ identified 15 moderate or strong-quality reviews that examined the effectiveness of discharge planning for patients with chronic diseases on hospital system outcomes and/or costs. The HRB found an additional review³³ (rated as strong quality) to supplement evidence on discharge management for chronic diseases.

The control intervention in Damery *et al.*⁸ could be: usual care, no intervention, or comparison to one or more other interventions. Hospital system outcomes measured were readmissions to hospital and length of stay in hospital. Damery *et al.*⁸ found that 6 of the 15 reviews on discharge management interventions reported significant reductions in readmission rates, ranging from decreases of 15% to 66% for patients with heart failure, chronic obstructive pulmonary disease, and general chronic diseases (Appendix E). One review of discharge management for general chronic diseases reported a reduced length of stay. In contrast, the authors reported that discharge management for patients who had stroke was notably ineffective in reducing readmission rates in four reviews on stroke patients, although length of stay was reduced in two of these four reviews. Discharge management interventions were judged to be cost-effective in four of the nine reviews where costs were measured. Notably, Damery *et al.* describe discharge planning and post-discharge support for hospital inpatients as the most effective of the chronic disease interventions identified in their umbrella review.

In a systematic review published in 2017, subsequent to the Damery *et al.*⁸ review, Le Berre *et al.*³³ determined the effectiveness of interventions targeting the transition from hospital to the primary care setting for older patients with chronic disease on hospital system outcomes. The hospital system outcomes were hospital readmissions (76 studies), total readmission days or length of stay (20 studies), and emergency department visits (41 studies). The comparison group was usual care or non-structured follow-up. The review included 92 trials with representation from 19 high-income countries and China (1 study). The high-income countries were the USA (27), Australia (15), Spain (7), the UK (7), Canada (5), Denmark (4), Hong Kong (4), Sweden (4), Italy (3), the Netherlands (3), Austria (2), Germany (2), Belgium (1), Finland (1), Ireland (1), Japan (1), New Zealand (1), Slovenia (1), and Switzerland (1). In addition, there was one multi-European countries study.

Le Berre *et al.*³³ found that transitional care (or discharge management) for older patients with chronic disease who were discharged from hospital to home led to a reduced risk of readmission at 3, 6, 12, and 24 months, a lower average number of readmissions at 24 months, and reduced length of stay following readmission at 3, 6, 12, and 18 months; However there was no association at one month (Table 2).

Table 2: Summary of effectiveness for each outcome for discharge management for chronic disease by review

Intervention by study	Target population	Hospital admission	Hospital readmission	Length of stay in hospital	Emergency department visits	Cost
Le Berre <i>et al.</i> 2017 ³³	Older people with one or more of 17 chronic diseases	Not measured	No association* (n=3,301)	No association* (n=745)	No association* (n=1,231)	Not measured

*Meta-analysis

In the review by Le Berre *et al.*,³³ 76 trials measured readmission to hospital. The authors report that there was no difference in the absolute risk of readmission between the transitional care group and the usual care group at one month following discharge; however, the HRB's reading of the random effects meta-analysis is that there is a significant reduction in absolute risk of readmission (P=0.02) at one month, which is similar to that found at six months (P=0.03). The absolute risk of readmission in the transitional care group was significantly lower than in the usual care group at three months post-

discharge, indicating that the use of a transitional care intervention can prevent one in seven readmissions at this time point (risk difference: -0.08 [95% confidence intervals (CI) -0.14 to -0.03], $I^2=75\%$); the absolute risk of readmission in the transitional care group was also lower at 6, 12, and 18 months post-discharge, indicating that the use of a transitional care intervention can prevent 1 in 20 readmissions at 6 months and one in nine readmissions at 12 and 18 months. However, the studies included in four of the five random effect meta-analyses had considerable heterogeneity and the HRB would question the validity of these results. Like Damery *et al.*,⁸ Le Berre *et al.*³³ reported a reduction in readmissions but also reported significant heterogeneity.

The mean number of readmissions per patient was significantly lower in the transitional care group than in the usual care group at 24 months post-discharge (mean difference: -1.03 [95% CI -1.81 to -0.24], $I^2=90\%$).³³ However, the studies included in the random effect meta-analysis had considerable heterogeneity. The mean number of readmissions per patient was not different at 1, 3, 6, and 12 months. This outcome was not measured by Damery *et al.*⁸

Twenty trials measured emergency department visits.³³ The absolute risk of an emergency department visit in the transitional care group was significantly lower than in the usual care group at three months post-discharge, indicating that the use of a transitional care intervention can prevent 1 in 13 emergency department visits at this time point (mean difference -0.08 [95% CI -0.15 to -0.01], $I^2=20\%$). However, the risk of an emergency department visit was not different at 1, 6, and 12 months. This outcome was not measured by Damery *et al.*⁸

Data on the number of emergency department visits were only available at three and six months post-discharge.³³ There were no significant differences between the mean number of emergency department visits in the transitional and usual care groups at these two time points. This outcome was not measured by Damery *et al.*⁸

Forty-one trials measured readmission days or length of stay.³³ The mean number of readmission days was not different at one month. However, the mean number of readmission days was significantly lower in the transitional care group than in the usual care group at three months (mean difference -1.33 [95% CI -2.15 to -0.52], $I^2=49\%$), six months (mean difference -1.42 [95% CI -2.33 to -0.50], $I^2=38\%$), 12 months (mean difference -3.37 [95% CI -5.21 to -1.53], $I^2=76\%$), and 18 months post-discharge (mean difference -3.16 [95% CI -5.68 to -0.64], $I^2=60\%$). However, the studies included in the four random effect meta-analyses had moderate heterogeneity. Damery *et al.* reported reduced length of stay for one study.⁸

4.2.3 Discharge management for general medical and surgical conditions

HRB identified 10 strong-quality reviews^{18 22 27 29 30 34 35 39 45 51} that examined the effectiveness of discharge management relative to hospital system outcomes and/or costs for patients with medical and surgical conditions. Hospital system outcomes included hospital admissions, hospital readmissions, length of stay in hospital, and emergency department visits. Six of these reviews undertook a meta-analysis.

Gonçalves-Bradley *et al.*²⁷ conducted a meta-analysis of 15 RCTs conducted in five countries: the USA (9), Canada (2), France (1), Slovenia (1), and the UK (2). They examined the association between discharge management interventions and hospital readmissions for patients with general medical conditions. They reported that when compared to usual care, patients who were allocated to discharge planning interventions had reduced hospital readmissions (relative risk 0.87 [95% CI 0.79 to 0.97], $I^2=28\%$).

A meta-analysis by Braet *et al.*¹⁸ examined the association between discharge interventions from hospital to home and hospital readmissions for patients with general medical and surgical conditions. Braet *et al.*¹⁸ reported that the methodological quality of the primary studies varied widely, with 75% of the primary trials scoring less than 7 out of 10 points on the quality assessment tool employed by

the authors. They included 47 RCTs conducted in the USA (21), Canada (3), China (3), the UK (3), Australia (2), Spain (2), Taiwan (2), Belgium (1), Croatia (1), France (1), Ireland (1), Israel (1), Italy (1), the Netherlands (1), New Zealand (1), Sweden (1), Switzerland (1), and one country that was not specified. They found that interventions designed to improve the care transition from hospital to home were effective in reducing hospital readmissions when compared to usual care (relative risk 0.77 [95% CI, 0.70 to 0.84], $P < 0.00001$, $I^2 = 34\%$). The review authors also conducted a subgroup analysis which found that interventions starting during hospital stay and continuing after discharge were more effective in reducing readmissions when compared to interventions starting after discharge (between subgroup difference $P = 0.01$). Notably, there was no association between discharge management interventions and return to the emergency department (relative risk 0.75 [95% CI, 0.55 to 1.01], $P = 0.06$).

Leppin *et al.* (2014)³⁴ conducted a meta-analysis of RCTs examining interventions focusing on the hospital to home transition and its association with 30-day hospital readmissions versus any comparator. The review included patients with general medical and surgical conditions, and the interventions had to focus on the hospital to home transition, permit patients across arms to have otherwise similar inpatient experiences, and be generalisable to contexts beyond a single patient diagnosis. The meta-analysis included 42 RCTs conducted in 16 countries. Fifty per cent of the trials were completed in the USA and 29% in European countries. The review authors found that the tested discharge management interventions prevented early readmissions (relative risk 0.82 [95% CI 0.73 to 0.91], $P = 0.03$, $I^2 = 32\%$). They noted that the more effective interventions were more complex and supported patient capacity for self-care. Specifically, subgroup analyses found that interventions with multiple components were 1.4 times more effective than single interventions ($P_{\text{interaction}} < 0.01$) and that interventions supporting patient capacity for self-care were 1.3 times more effective than those that did not include self-care ($P_{\text{interaction}} = 0.04$). Additionally, trials published before 2002 were 1.6 times more effective than those tested later ($P_{\text{interaction}} = 0.01$).

In a meta-analysis of two studies, Lockwood *et al.* (2015)³⁵ examined pre-discharge home assessment visits conducted by an occupational therapist, which represents a standalone form of discharge management. They described home assessment visits as taking place prior to discharge from hospital with the aim of determining when and if a hospitalised person should return to their own home. The home assessment visits involved taking patients to their home in order to assess and practise transfers, mobility, and daily living activities within the patient's own environment and were most often a single visit prior to discharge. They also involved provision of education, advice, and recommendations on home adaptations and equipment. In their meta-analysis, Lockwood *et al.*³⁵ focused on patients with general medical conditions, and they included two RCTs and one prospective observational cohort study. The studies were conducted in Australia (2) and France (1). The meta-analysis found that when compared to standard care, the risk of readmission to hospital was reduced by 53% in the intervention group (relative risk 0.47 [95% CI 0.33 to 0.66], $I^2 = 0\%$) based on low-quality evidence.

Verhaegh *et al.*⁵¹ based their approach to defining transition care interventions on the elements included in each intervention in the 26 primary trials that they identified in their review. They identified 11 measures of intervention intensity in the 26 primary trials, which were: assessment on admission, self-management education, caregiver involvement, discharge planning, care coordination by a nurse, primary care provider communication, home visit within three days, number of home visits, telephone follow-up, number of telephone follow-ups, and total duration of the intervention. They assigned a positive or zero score to each element for each trial; the maximum score was 16 and the minimum score was zero. Interventions were defined as high-intensity if they scored between 9 and 16. Verhaegh *et al.*⁵¹ examined the effect of transitional care interventions as a whole and separately as high-intensity and low-intensity transitional care interventions. The review authors wished to determine if transitional care interventions were associated with a reduction of short-term (30 days or less), intermediate-term (31–180 days), and long-term (181–365 days) all-cause hospital readmission rates in chronically ill patients with general medical or surgical conditions, compared to usual care. Of the 26 trials in the review, there were 11 from the United States, 3 from Hong Kong, 2

from Australia, and 1 each from 9 countries (Canada, China, Germany, Ireland, Italy, Spain, Sweden, Taiwan, and the UK). In addition, a collaborative study between two European countries (Spain and Belgium) was included. Verhaegh *et al.*⁵¹ reported that transitional care was effective in reducing all-cause intermediate-term and long-term readmissions. However, only high-intensity transitional care interventions were effective in reducing short-term readmissions. The individual study and pooled odds ratios using a random-effects model showed that transitional care was associated with an absolute risk reduction of 5% in intermediate-term readmissions (odds ratio: 0.77 [95% CI 0.62 to 0.96], $I^2=61\%$) and 13% in long-term readmissions (odds ratio: 0.58 [95% CI: 0.46 to 0.75], $I^2=32\%$). Yet transitional care (high and low combined) was not effective in reducing short-term readmissions (odds ratio: 0.76 [95% CI 0.52 to 1.10], $I^2=61\%$). High-intensity interventions were associated with reduced short-term (odds ratio: 0.59 [95% CI 0.38 to 0.9], $I^2=\text{not available}$), intermediate-term (odds ratio: 0.69 [95% CI 0.51 to 0.92], $I^2=\text{not available}$), and long-term readmissions (odds ratio: 0.57 [95% CI 0.35 to 0.92], $I^2=\text{not available}$). The absolute risk reduction for high-intensity transitional care interventions was 5% for short-term, 7% for intermediate-term, and 13% for long-term readmissions. Verhaegh *et al.*⁵¹ concluded that high-intensity transitional care was associated with a reduced rate of readmission in chronically ill patients aged 60 years or over. However, the level of heterogeneity is not reported.

Mistiaen and Poot³⁹ determined the effects of follow-up telephone calls in the first month post discharge, initiated by hospital-based health professionals, to patients discharged from hospital to home, with regard to psychosocial and physical outcomes in the first three months post-discharge. Figure 3 presents an overview of the possible components of telephone call. The effects of telephone follow-up were compared to usual care or other types of hospital follow-up. Mistiaen and Poot³⁹ reported that health services-oriented outcomes were measured in 11 studies from Canada or the USA; they measured readmissions (10 trials) and emergency department visits (5). Two of the 10 trials identified fewer readmissions in the intervention group, while eight trials found no differences. Meta-analyses were presented for two groups of patients: cardiac patients (three trials, relative risk 0.75 [95% CI 0.41 to 1.36] $I^2=44\%$) and surgical patients (four trials, relative risk 0.65 [95% CI 0.28 to 1.55], $I^2=22\%$). Both of these meta-analyses reported no difference between post-discharge telephone follow-up and usual care. One trial found fewer emergency department visits for the telephone follow-up group; however, four trials did not identify differences in this respect. Emergency department visits for surgical patients were examined in meta-analyses of two studies and there was no difference between the post-discharge telephone follow-up group and the usual care group (relative risk 1.47 [95% CI 0.85 to 2.53], $I^2=0\%$).

Telephone call or home visit	Gathering of information
	Giving reassurance
	Giving advice on specific topics
	Counselling
	Referral where required

Figure 3: Possible components of telephone call or home visits

The HRB identified four reviews in which a narrative synthesis was conducted because heterogeneity between studies precluded meta-analysis. Hesselink *et al.* (2012)³⁰ carried out a review that included RCTs of interventions aiming to improve discharge from hospital to primary care for patients with general medical or surgical conditions. They included 13 RCTs that examined outcomes relevant to the current umbrella review, including hospital readmissions, emergency department use, and length of stay in hospital. The RCTs took place in the USA (6), Australia (2), Canada (1), China (1), Denmark (1), Ireland (1), and the UK (1). The HRB's analysis of these trials identified 11 that examined readmissions, and 9 of these trials found that there was no association between discharge management and readmission rates when comparing intervention and control groups. Two of the 11 trials found that discharge management interventions significantly reduced readmission rates in the intervention group when compared to usual care. Regarding emergency department use, two trials reported no association between discharge interventions and length of stay, and one trial reported a significant reduction in emergency department use in the intervention group assigned to a hospital to home transitional care model. Two trials reported no association between discharge interventions and length of stay in hospital.

Hansen *et al.* (2011)²⁹ examined interventions aiming to reduce 30-day readmissions for patients with general medical conditions and included 43 studies in a narrative synthesis. Hansen *et al.* reported that the primary studies included in the review had design limitations: 27 used a non-randomised design, 9 of the 16 remaining trials had inadequate sample sizes, and 60% of all had incomplete outcome data. Of the 43 studies, the HRB's analysis identified 31 that involved transitions across health or social care settings. Thirteen of these studies were RCTs; among these, nine trials reported no difference between intervention and control groups in 30-day readmissions, and four trials reported significantly lower readmission rates among intervention groups assigned to discharge management. The 31 studies the HRB identified also included 13 quasi-experimental or cohort studies, 9 of which reported significantly lower readmission rates among the intervention group and 4 of which reported no difference between intervention and control groups in 30-day readmissions. It is important to note that quasi-experimental and cohort studies are more likely to be prone to bias and therefore are more likely to result in positive findings. Five of the 31 identified studies were non-controlled before-and-after studies, of which 1 reported significantly lower readmission rates among the intervention group and 4 reported no difference between the intervention and control groups in 30-day readmissions.

In a narrative synthesis, Rennke *et al.*⁴⁵ examined transitional care interventions in 46 studies. The HRB used 12 (8 RCTs and 4 controlled clinical trials) of the 46 studies that examined the effect of transitional care bridging interventions. All 12 measured hospital readmissions at 30 days, but only 7 studies measured the number of emergency department visits. The comparison was described as usual discharge care. Overall, the findings for hospital readmissions and emergency department visits were mixed. Three studies (one RCT and two controlled clinical trials) reported a statistically significant lower number of readmissions for patients who received transitional care, and nine studies (seven RCTs and two controlled clinical trials) reported no difference in the number of readmissions between transitional and usual care. One trial reported a statistically significant lower number of

emergency department visits for patients who received transitional care, and six studies (three RCTs and three controlled clinical trials) reported no difference in the number of emergency department visits between transitional and usual care groups. As mentioned above, non-randomised studies are prone to bias and are therefore more likely to have positive findings.

Domingo *et al.* (2012)²² focused on discharge management specifically for patients with community-acquired pneumonia. The quality of the primary studies was strong, but concealment of the intervention was compromised in two studies. This review included two studies that reported hospital readmissions; one was an RCT that took place in the USA and the other was a quasi-RCT that took place in Canada. The structured discharge process in the two interventions incorporated medication reconciliation with follow-up telephone calls. Based on a narrative synthesis, Domingo *et al.* concluded that there was no association between discharge management and hospital readmissions for patients with community-acquired pneumonia.

Four of the six meta-analyses indicated that discharge management significantly reduced readmissions for those who had acute medical or surgical conditions (Table 3). The two meta-analyses that did not report a reduction in readmissions did telephone follow-up only. The two meta-analyses that measured the effect of discharge management on emergency department visits did not find any differences between the discharge management and usual care groups. Length of stay in hospital was measured in one narrative review and no difference was observed between discharge management and usual care.

It is important to note that some primary studies were included in a number of the reviews and when the overlap was calculated employing Pieper *et al.*'s¹⁶ methodology it was 6.4, which indicates that there is moderate overlap between the primary studies included in the 10 reviews examined in this sub-section. This indicates that the 10 individual reviews are not providing 10 independent results; rather, they are reaffirming the main result that discharge management can prevent hospital readmissions.

Table 3: Summary of effectiveness for each outcome for discharge management for medical and/or surgical conditions by review

Intervention by study	Target population	Hospital readmission	Length of stay in hospital	Emergency department visits	Cost
Braet <i>et al.</i> 2016 ¹⁸	Medical or surgical conditions	Negative association* (n=3,190)	Not measured	No association* (n=2,290)	Not measured
Domingo <i>et al.</i> 2012 ²²	Community acquired pneumonia	No association (n=209)	Not measured	Not measured	Not measured
Gonçalves-Bradley <i>et al.</i> 2016 ²⁷	Medical conditions	Negative association* (n=4,743)	Not measured	Not measured	Aggregated measure (n=1,028)
Hansen <i>et al.</i> 2011 ²⁹	Medical conditions	Mixed findings (n=876,917)	Not measured	Not measured	Not measured
Hesselink <i>et al.</i> 2012 ³⁰	Medical or surgical conditions	Mixed findings (n=1,501)	No association	Mixed findings (n=3,682)	Not measured
Leppin <i>et al.</i> 2014 ³⁴	Medical or surgical conditions	Negative association* (n=15,007)	Not measured	Not measured	Not measured
Lockwood <i>et al.</i> 2015 ³⁵	Medical conditions	Negative association* (n=486)	Not measured	Not measured	Not measured
Rennke <i>et al.</i> 2013 ⁴⁵	Medical conditions	Mixed findings (n=7,380)	Not measured	Mixed findings (n=4,705)	Not measured
Verhaegh <i>et al.</i> 2014 ⁵¹	General medical or surgical conditions with low- and high- intensity discharge interventions	No association* (n=3,323)	Not measured	Not measured	Not measured
	General medical or surgical conditions with high- intensity discharge interventions	Negative association* (n=2,407)	Not measured	Not measured	Not measured
Mistiaen and Poot 2006 ³⁹	General surgery	No association* (n=616)	Not measured	No association* (n=333)	Not measured
	Cardiac surgery	No association* (n=460)	Not measured	Not measured	Not measured

*Meta-analysis

4.2.4 Discharge management for older people

HRB identified six strong-quality reviews^{9 17-21} that examined the effectiveness of discharge management relative to hospital system outcomes and/or costs for older people. Hospital system outcomes included hospital admissions, hospital readmissions, length of stay in hospital, readmission length of stay, and emergency department visits. Five of these were meta-analyses.

Gonçalves-Bradley *et al.*²⁷ conducted a meta-analysis of 11 trials conducted in Australia (1), Canada (2), Switzerland (1), the UK (1), and the USA (6) examining the association between discharge management and length of stay for older patients with a general medical condition. They reported that when compared to usual care, patients who were allocated to discharge planning interventions had reduced length of stay (mean difference -0.73 [95% CI -1.33 to -0.12], $I^2=9\%$). They also conducted a meta-analysis of two RCTs conducted in France and Taiwan examining discharge management interventions for older people admitted to hospital following a fall. The review authors concluded that it is uncertain whether discharge planning reduces readmission rates in this group of patients (relative risk 1.36 [95% CI 0.46 to 4.01], $I^2=22\%$).

A meta-analysis by Mabire *et al.* (2016)³⁷ examined the effectiveness of discharge planning interventions involving at least one nurse and focusing on elderly patients. They identified 10 RCTs that assessed readmissions in Australia (3), China (2), Canada (1), Finland (1), and the USA (3). Mabire *et al.*³⁷ found that, based on very low-quality evidence, nurse discharge planning did not significantly reduce hospital readmission rates (odds ratio 0.73 [95% CI 0.53 to 1.01], $P=0.06$, $I^2=70.8\%$). They also conducted a meta-analysis of six RCTs that assessed length of hospital stay and reported that, based on low-quality evidence, nursing discharge interventions increased length of stay (weighted mean difference 0.29 more days [95% CI 0.24 more to 0.35 more], $P<0.01$, $I^2=0\%$).

In a meta-analysis, Lowthian *et al.* (2015)³⁶ included studies focusing on interventions comprised of holistic geriatric assessment with targeted referral to community services. Four studies were included; two were RCTs that took place in the USA and Australia, one was a controlled comparative study in Australia, and one was a before-and-after observational study in Canada. Compared with usual care, the review authors reported no appreciable benefit for transitional care strategies for older patients with regard to unplanned emergency department reattendance up to 30 days (4 studies, odds ratio 1.12 [95% CI 0.84 to 1.48], $P=0.44$, $I^2=69\%$) or hospital readmission up to 30 days (3 studies, odds ratio 0.90 [95% CI 0.70 to 1.16], $P=0.40$, $I^2=0\%$).

Fox *et al.* (2013)²⁵ compared the effectiveness of early discharge planning to usual care in reducing index length of hospital stay, hospital readmissions, and readmission length of hospital stay for older adults admitted to hospital with an acute illness or injury. The authors identified seven RCTs and two quasi-RCTs, of which six were completed in the USA. The other three studies were completed in Australia, France, and Taiwan. Index length of hospital stay was reported in seven studies and meta-analysis of these studies identified no significant differences in older adults who received early discharge planning compared with those who received usual care (mean difference -0.41 [95% CI -1.19 to 0.36], $I^2=38\%$). Seven studies reported on hospital readmissions within one month (one study), two months (one study), three months (three studies), six months (one study), or 12 months (one study) of index hospital discharge. Meta-analysis of these seven studies identified that older adults who received early discharge planning experienced significantly fewer hospital readmissions within 1 to 12 months of index hospital discharge (relative risk 0.78 [95% CI 0.69 to 0.90], $I^2=0\%$) when compared with those who received usual care. This amounts to a reduction of 22% in hospital readmissions, favouring early discharge planning. Three studies reported on readmission length of hospital stay within three months (two studies) or within 12 months (one study) of index hospital discharge, and meta-analysis of these three studies identified that older adults who received early discharge planning experienced a lower readmission length of hospital stay of almost 2.5 days when compared to usual care (mean difference -2.47 [95% CI -4.13 to -0.81], $I^2=0\%$). The authors reported that there was limited information regarding study methods, and therefore they were limited in their ability to draw conclusions regarding level of performance and detection bias.

Conroy *et al.* (2011)²⁰ conducted a meta-analysis focusing on comprehensive geriatric assessment as a transitional care strategy. Comprehensive geriatric assessment is defined as a diagnostic process

focused on determining a frail older person's medical, psychological, and functional capability in order to develop a coordinated and integrated plan for treatment and follow-up. The meta-analysis included five studies, of which four were RCTs and one was a pseudo-RCT. The countries where the trials took place were not stated. The authors reported that there was no clear evidence of benefit for comprehensive geriatric assessment interventions in terms of readmissions (relative risk 0.95 [95% CI 0.83 to 1.08], $P=0.141$, $I^2=42.1\%$). However, they noted that few trials have been carried out and their overall quality was poor.

The HRB identified one review in which a narrative synthesis was conducted because heterogeneity between studies precluded meta-analysis. Allen *et al.* (2014)¹⁷ focused on hospital to home transitional care interventions for older people. They included 12 RCTs, more than half of which took place in the USA. The rest were completed in Australia (3), Denmark (1), and France (1). The HRB's analysis of these trials identified 10 that examined readmissions. Five of these trials found no association between transitional care interventions and readmissions, four found that the interventions reduced readmissions, and one found that the interventions increased readmissions when compared to standard hospital discharge practices. Regarding length of hospital stay, five RCTs reported no association between transitional care interventions and length of stay, one reported that length of stay decreased in the intervention group, and one reported that length of stay increased in the intervention group. Four RCTs reported cost as an outcome; of these, three found no association between transitional care interventions and cost outcomes and one reported that the interventions reduced costs. Finally, one RCT included in the review examined emergency department use and reported that older people assigned to the intervention group were significantly less likely to attend the emergency department when compared to those assigned to the standard hospital discharge group.

In summary, only one of the five meta-analyses indicated that discharge management significantly reduced readmissions for older people (Table 4). The three meta-analyses that examined the effect of discharge management on hospital length of stay compared to usual care reported three conflicting results: one reported a decreased length of stay, one reported an increased length of stay, and the remaining study reported no effect on length of stay. One meta-analysis measured the effect of discharge management on emergency department visits and did not find any differences between discharge management and usual care groups. One narrative review measured the effect of discharge management for older people on emergency department visits and reported no difference.

It is important to note that some primary studies were included in a number of the reviews and when the overlap was calculated employing Pieper *et al.*'s¹⁶ methodology it was 4.2, which indicates that there is slight overlap between the primary studies included in the six reviews. This indicates that the overlap is unlikely to affect the overall findings.

Table 4: Summary of effectiveness for each outcome for discharge management for older people by review

Intervention by study	Target population	Hospital admissions	Hospital readmissions	Length of stay in hospital	Emergency department visits	Cost
Allen <i>et al.</i> 2014 ¹⁷	Older people	Not measured	Mixed findings (n=5,402)	Mixed findings (n=3,226)	Negative association (n=665)	Mixed findings (n=2,223)
Conroy <i>et al.</i> 2011 ²⁰	Frail elderly	Not measured	No association* (n=2,474)	Not measured	Not measured	Not measured
Fox <i>et al.</i> 2013 ²⁵	Older people with medical and surgical conditions	Not measured	Negative association* (n=1,525)	No association* (n=798)	Not measured	Not measured
Gonçalves-Bradley <i>et al.</i> 2016 ²⁷	Older people with general medical conditions	Not measured	Not measured in the way required for this paper	Negative association* (n=2,193)	Not measured	Aggregate d measure (n=1,028)
	Older people admitted to hospital following a fall	Not measured	No association* (n=110)	Not measured	Not measured	Not measured
Lowthian <i>et al.</i> 2015 ³⁶	Older people	Not measured	No association* (n=4,502)	Not measured	No association* (n=6,698)	Not measured
Mabire <i>et al.</i> 2016 ³⁷	Elderly people	Not measured	No association* (n=3,213)	Positive association* (n=2,370)	Not measured	Not measured

*Meta-analysis

4.2.5 Nurse practitioners and discharge management

In a review that rated as strong quality, Donald *et al.* (2015)²³ determined the cost-effectiveness of nurse practitioners delivering transitional care by comparing nurse practitioner-delivered transitional interventions in combination with usual care to usual care alone. The intervention was transitional care delivered by a nurse practitioner who had completed a formal post-baccalaureate or graduate nurse practitioner education programme or who was licensed as a nurse practitioner. The review included four RCTs completed in Canada, the UK, and the USA. The main measure was nurse practitioner cost-effectiveness compared to that of usual nursing care. Donald *et al.*²³ found no significant differences between groups for any patient outcomes or any health system outcomes; they claim equal effectiveness and equal resource use. Results of two meta-analyses, one of re-hospitalisations over the short term (30 and 42 days) with 766 patients (relative risk 0.69 [95% CI: 0.34 to 1.43], $I^2=0\%$; two trials) and one of re-hospitalisations over the long term (120 and 180 days) with 800 patients (relative risk 0.87 [95% CI: 0.69 to 1.09], $I^2=32\%$, two trials) were not significant.

With respect to cost effectiveness, all four of these studies scored very low on the Quality of Health Economic Studies scale, and three had a high risk of bias. No studies linked costs to outcomes. For two of the trials, resource use and costs were similar for nurse practitioners. For the other two trials, both found that nurse practitioners were more effective and one found them to be less costly. The authors cannot conclude that nurse practitioners are superior to other nurses when managing discharge. This section is based on one review, therefore there is no overlap.

4.2.6 Costs associated with discharge planning from hospital

Gonçalves-Bradley *et al.*²⁷ was one of the few reviews of discharge management reporting on the costs or savings. Six of 30 trials included in Gonçalves-Bradley *et al.* dealt with the effects of discharge planning on health service costs concerning patients with a medical condition, but direct costs or savings were not reported in these cases.

Jack (2009), cited by Gonçalves-Bradley *et al.*,²⁷ reported a difference between study groups in total cost (combining actual hospital utilisation cost and estimated outpatient cost) of US\$149,995 in savings for 738 participants in the intervention group, which translated to an average savings of US\$412 per person who received the intervention; this represents a one-third (33.9%) savings for the treatment group. Another trial based in Paris (Legrain [2011], cited by Gonçalves-Bradley *et al.*²⁷) reported that cost savings, balanced against the cost of the intervention, were €519 per participant. However, there are no standard deviations or confidence intervals. In Naylor (1994), cited by Gonçalves-Bradley *et al.*,²⁷ which recruited participants with a medical condition, both the discharge planning and control groups incurred similar costs for their initial hospital stay. A difference was reported for hospital charges, which included readmission costs, at two weeks follow-up (difference of –US\$170,247 [95% CI –US\$253,000 to –US\$87,000]) and again at two to six weeks follow-up (difference of –US\$137,508 [95% CI –US\$210,000 to –US\$67,000]), with the 276 participants receiving discharge planning incurring lower costs; savings per participant were not reported. Overall, Naylor reported that there was no savings in initial length of hospital stay for medical patients in the discharge planning group compared to the usual care group, but that there was significant savings on readmissions up to six weeks following discharge.

In Gillespie (2009), cited in Gonçalves-Bradley *et al.*,²⁷ hospital admission and readmission costs were not different between the discharge planning and usual care groups. Naughton (1994), cited by Gonçalves-Bradley *et al.*, reported lower costs for laboratory services for participants receiving discharge planning (mean differences per participant –GB£295 [95% CI –GB£564 to –GB£26]), but not for diagnostic imaging, pharmacy, rehabilitation, or total costs. However, Naughton (1994), from the USA, reported that the overall health service costs were not significantly lower for the treatment group (mean difference: –US\$1,949 [95% CI –US\$4,204 to US\$306]). Another trial in the USA (Rich [1995], cited by Gonçalves-Bradley *et al.*²⁷) reported a non-significant reduction in costs of –US\$460 (relative risk 0.80 [95% CI 0.61 to 1.07]).

The evidence from Gonçalves-Bradley *et al.*²⁷ is mixed, with two studies demonstrating overall savings, one study demonstrating savings on readmissions only, two studies reporting no savings, and one study reporting savings on laboratory costs only. The authors concluded,²⁷ “It is uncertain whether there is any difference in the cost of care when discharge planning is implemented with patients who have a medical condition (very low certainty evidence, five trials) (p18).” Overall, it appears that any savings accrued by the health service may be shifted in the form of costs to caregivers and patients (p18).

4.2.7 HRB conclusion – Discharge management

Discharge management was used as an intervention for three distinct population groups: chronic disease populations, general medical and/or surgical populations, and older people.

Damery *et al.* describe discharge management and post-discharge support for hospital inpatients as the most effective of the chronic disease interventions identified in their umbrella review. They reported an overall reduction in hospital readmissions and length of stay; however, the findings for costs were mixed. Le Berre *et al.*'s findings (in a subsequent strong-quality review) support Damery *et al.*'s for the same two hospital outcomes, but report substantial heterogeneity between the 92 randomised controlled trials (RCTs) included in their review; of note, the presence of substantial heterogeneity reduces the certainty of the findings. Other hospital outcomes were not examined in the literature reviewed for this population group.

The HRB examined the evidence for discharge management for people following hospitalisation for acute medical or surgical conditions by reviewing eight meta-analyses of randomised and non-randomised controlled trials in six strong-quality reviews. Five of the eight meta-analyses reported a reduction in hospital readmissions, but there was moderate heterogeneity reported in three of the five meta-analyses. The HRB found evidence that discharge management reduces hospital readmissions for people with an acute medical or surgical condition, but the inclusion of non-randomised trials and the identification of heterogeneity reduces the certainty of the findings. Discharge management had no effect on length of stay in hospital for this group in the one review available. Two meta-analyses measured the effect of discharge management on emergency department visits and did not find any differences between discharge management and usual care groups.

The HRB also examined the evidence for discharge management for older people following hospitalisation by reviewing five meta-analyses of RCTs in five strong-quality reviews. Four of five meta-analyses found that discharge management for older people had no effect on hospital readmissions. The three meta-analyses that examined length of stay in hospital reported conflicting results and also identified low to moderate heterogeneity between studies. The HRB found one meta-analysis examining discharge management for older people and emergency department visits and found that this intervention did not reduce emergency department visits, but there was high heterogeneity between the included studies. There is no consistent evidence that discharge management for older people following hospitalisation reduces hospital system outcomes.

The evidence on costs of discharge planning compared to usual care for any of the three populations comes from one Cochrane review and is mixed, with two studies demonstrating overall savings, one study demonstrating savings only for readmissions, two studies reporting no savings, and one study reporting savings on laboratory costs only. However, due to different mechanisms for costing and charging, the findings are not sufficiently comparable to make a conclusive statement either way. In addition, any potential reduction in costs may be offset by an increase in the provision of community services and their associated costs.

It should be noted that follow-up times for readmissions, length of stay, and emergency department visits varied from 5 days to 18 months, thereby increasing heterogeneity. In addition, some reviews included observational studies, thereby reducing the certainty of the evidence. The discharge planning intervention usually consisted of a number of components, but the HRB could not identify which individual components were most likely to contribute the greatest effect with respect to reducing hospital use or if individual components interacted with one another to enhance the overall effect.

4.3 Quality improvement interventions

Hospital readmissions are costly, both in economic terms and in human terms. In order to reduce readmissions, hospitals and healthcare systems can implement quality improvements. The HRB identified one strong-quality review that examined the economic effectiveness of quality improvement interventions. Nuckols *et al.* (2017)⁴² suggest that readmissions occurring within the first week after discharge are often related to the stress of acute illness as well as heightened self-care needs, new medications, and impaired function, whereas those occurring after one week usually reflect chronic illness. Therefore, some quality improvement interventions include practices that are implemented around the time of discharge (pre-discharge), while others are maintained longer term (bridging or post-discharge). Quality improvement interventions at the pre-discharge stage to decrease readmissions may include assessment of the patient's risk or needs (that is, needs for education, coaching, or care and risk of clinical deterioration), engagement with the patient or caregiver, communication with the post-discharge provider, and reconciliation of medications. Quality improvement intervention at the bridging stage may have a dedicated transition provider, but even without a dedicated transition provider the intervention needs to ensure provider continuity and provide discharge instruction or access to the personal health record. Quality improvement interventions at the discharge stage include re-assessment of risks and needs, communication with the outpatient provider, communication with the patient by telephone, and making home visits.

Nuckols *et al.*⁴² reviewed 50 articles to economically evaluate quality improvement interventions designed to prevent readmissions in a strong-quality review. The majority of the studies were completed in the USA (58%, 29 studies) while the remainder were completed in Australia, the EU, and Hong Kong. The studies reviewed comprised 25 studies limited to heart failure, 21 in general populations, and 4 in unique populations. The majority of these included components of the interventions described above.

Figure 4 presents a description of the components and timing of the quality improvement interventions.

Individual practices											Group of practices according to purpose								
Pre-discharge			Bridging		Post-discharge														
Assess risk or needs	Engage patient or caregiver	Communicate with post-discharge provider	Dedicate transition provider	Ensure provider continuity	Provide discharge instruction or health record	Assess risk or needs	Engage patient or caregiver	Reconcile medication	Schedule appointment	Communicate with outpatient provider	Call patient	Telemonitor patient	Have provider available by phone	Make home visit	Assess risk or needs	Engage patient or caregiver	Reconcile medication	Connect patient to usual provider	Supplement care by usual provider

Figure 4: Components of quality improvement

Source and reproduced from: Nuckols *et al.* (2017)⁴²

Nuckols *et al.*⁴² reported that quality improvement interventions were classified into “5 groups based on the purpose of the intervention. The groups were (1) assess patient risks and needs, (2) engage patient and/or caregiver, (3) reconcile medication, (4) connect patient to usual clinicians, and (5) supplement care by usual clinicians” (p. 976). Nuckols goes on to state that “Nearly all studies involved supplementing care by usual clinicians, and most involved assessing patients’ risks or needs, engaging patients or caregivers, and undertaking steps to connect patients to their usual clinicians” (p. 978). These interventions were undertaken as part of a Hospital Readmission Reduction Program. The question posed by Nuckols *et al.*⁴² was: “Are quality improvement interventions designed to reduce hospital readmissions associated with net savings to the health system?” (p976) Based on data for more than 16,700 patients, hospital readmissions declined by an average of 12.1% among

populations with heart failure and 6.3% among general populations, but net savings to the health system were variable. In general populations, interventions that involved engaging patients and caregivers were associated with similar effectiveness but resulted in substantially larger net savings to the health system than other interventions. The clinical outcome was the risk difference, meaning the change in the readmission rate, calculated by subtracting the percentage of patients who were readmitted in the intervention group from the percentage readmitted in the control group. The economic outcome was the incremental net cost to the health system per enrolled patient ('net cost'), calculated by summing incremental programme and readmission-related costs.

Of the 50 studies examined by Nuckols *et al.*,⁴² 44 were cost analyses, whereas 6 were cost-effectiveness or cost-benefit analyses. Forty-two studies considered the health system perspective, one considered the hospital perspective, three used the payer perspective, one used both the hospital and health system perspectives, and three considered the societal perspective.

Nuckols *et al.*⁴² identified 25 studies of quality improvement interventions in heart failure patients. The HRB acknowledges that heart failure is one of the chronic diseases included by Damery *et al.*, but this is a 2017 paper and it supports Damery *et al.*'s findings. In the case of populations limited to heart failure, costs were negative in one study (Anderson *et al.* [2005], cited in Nuckols *et al.*⁴²), meaning that the intervention saved money even without a change in readmissions, implying that home care services were provided more efficiently in the intervention group. Programme costs were smaller than savings from reduced readmissions in all but 1 of the 25 studies, leading to net savings. However, net financial losses occurred in five studies. In one of these studies, both readmissions and costs rose (Soran *et al.* [2010], cited in Nuckols *et al.*⁴²).

In another primary study, readmissions declined, but length of stay in hospital increased in the intervention group. In a modelling analysis from the UK, readmissions declined but the cost per readmission was low in the first place, leading to costs rather than savings (Kasper *et al.* [2002], cited in Nuckols *et al.*⁴²). Finally, costs were particularly high in two studies (Stauffer *et al.* [2011], cited in Nuckols *et al.*⁴²), including one in which readmissions did not decline (Byrnes *et al.* [2015], cited in Nuckols *et al.*⁴²). Among patients with heart failure, the weighted mean percentage of patients who were readmitted during the study period (lasting a median of 197 days) was 50.0% in the control group and 37.9% in the intervention group, based on 22 studies with complete data. This corresponds to a statistically significant risk difference of 12.1% (95% CI, 8.3% to 15.9%, $P < 0.001$).

4.3.1 HRB conclusion-Quality improvement

Based on regression analyses, readmissions declined by an average of 12.1% among patients with heart failure (95% CI 8.3% to 15.9%; $P < 0.001$; based on 22 studies with complete data) and by 6.3% among general populations (95% CI 4.0% to 8.7%; $P < 0.001$; 18 studies). The mean net saving to the health system per patient was US\$972 among patients with heart failure (95% CI -US\$642 to US\$2,586; $P = 0.23$; 24 studies), and the mean net loss was US\$169 among general populations (95% CI -US\$2,610 to US\$2,949; $P = 0.90$; 21 studies), reflecting non-significant differences in both cases. Among general populations, interventions that engaged patients and caregivers were associated with greater net savings, but this was not the case among patients with heart failure. The HRB found that quality improvement interventions pertaining to discharge planning can reduce readmissions for both medical conditions and heart failure and costs for medical conditions, but not costs for heart failure (Table 5). It is important to note here that this review was examining quality improvement interventions using discharge planning as its example and so there is overlap between the section on discharge management and this section on quality improvement. Of the 50 studies included in Nuckols *et al.*⁴², 16 are also included in the general medical and surgical discharge management section, which is based on 10 reviews, including 147 studies.

Table 5: Summary of effectiveness for each outcome for quality improvement of discharge management by review

Intervention by study	Target population	Hospital admissions	Hospital readmissions	Length of stay in hospital	Emergency department visits	Cost
Nuckols <i>et al.</i> 2017 ⁴²	General medical populations	Not measured	Negative association* (n=10,445)	Not measured	Not measured	Negative association* (n=10,445)
	Heart failure	Not measured	Negative association* (n=5,768)	Not measured	Not measured	No association* (n=5,768)

*Meta-analysis

4.4 Pharmacist-led medication management at care transition

The HRB identified five high-quality reviews that it coded as ‘medication management’.^{21 38 41 48 50} The countries where the primary studies were completed were Australia, Canada, Ireland, the Netherlands, Spain, Sweden, the UK, and the USA. The primary focus in these five reviews^{21 38 41 48 50} was to examine the evidence on interventions that were designed and implemented to improve the prescribed medication regimes for patients and reduce their utilisation of healthcare resources (measured using hospital readmissions, emergency department visits, and costs). An additional common feature across all five reviews was to assess the effectiveness of pharmacists in delivering these interventions to patients. In addition, the five reviews evaluated the intervention across healthcare transitions such as from the hospital to the patient’s home or nursing home. Notwithstanding these common features shared by all five reviews, there are some variations in the design and implementation of the intervention for medication management, the populations studied, the number and design of the included studies, and the outcomes assessed. Damery *et al.*⁸ excluded medication adherence from their review.

4.4.1 Definition of pharmacist-led medication management interventions

De Oliveira *et al.* (2017)²¹ examined the effectiveness of pharmacist-led transition of care interventions on the reduction of medication errors and/or the subsequent utilisation of healthcare resources (i.e. hospital readmission and/or emergency department visits) after hospital discharge compared to usual care. The authors provide some examples of the types of pharmacist-led interventions they included. According to De Oliveira *et al.*,²¹ they “...included RCTs that compared a pharmacist intervention (i.e. medication reconciliation and/or patient education) with an inactive usual care control group in patients undergoing transitions of care from a hospital setting back to the community (i.e. their own home or the nursing home)...” (p. 2). The authors also reported that “...most pharmacist interventions occurred in the first 2 weeks of the hospital discharge...” (p. 4). The intervention tended to be delivered via telephone or in-person visits by the patient to the pharmacy.

Mekonnen *et al.* (2016)³⁸ investigated the effect of pharmacist-led medication reconciliation programmes compared to usual or standard care. ‘Usual or standard care’ was defined as any care where targeted medication reconciliation was not undertaken as an intervention, or where, if an intervention was conducted, it was not provided by a pharmacist. The authors adopted the definition of ‘medication reconciliation’ advocated by the Institute for Healthcare Improvement as “...the process of identifying the most accurate list of a patient’s current medicines, including the name, dosage, frequency and route—and comparing them to the current list in use, recognising and documenting any discrepancies, thus resulting in a complete list of medications...the included interventions had to start in the hospital and be performed primarily by a pharmacist, with the aim of improving care transitions to and from a hospital...” (p. 2).

Nazar *et al.* (2015)⁴¹ investigated the role played by community pharmacists in improving the transfer of care of patients from secondary to primary care settings. The authors report that interventions had to be delivered by a community pharmacist or a member of the community pharmacy team; however, in contrast to the Mekonnen *et al.*³⁸ review, Nazar *et al.*⁴¹ reported that their primary focus was to examine interventions delivered post-discharge from the hospital setting that focused on continuity of care, transfer of care, or follow-up care. The intervention was compared to usual care, which was not described in any detail.

Thomas *et al.* (2014)⁵⁰ reviewed studies that evaluated the effectiveness of interventions led by hospital or community pharmacists compared to usual care (not described). The authors report that the interventions were all provided by pharmacists either in the hospital setting or in community settings. Interventions delivered in the hospital setting consisted of pharmacists compiling accurate lists of patients’ medications either at admission or prior to discharge, with recommendations provided to the physician in charge of care in either written or oral communication. This type of intervention was also investigated by Mekonnen *et al.*³⁸ but described as medication reconciliation. Interventions delivered in the community setting in the review by Thomas *et al.*⁵⁰ targeted patients after discharge from hospital with either telephone- or home-based monitoring; some were delivered

in the pharmacy when a patient returned for a repeat prescription, some in the patient's home, and one in the primary care physician's office.

Spinewine *et al.* (2013)⁴⁸ examined the effects of different approaches to optimise continuity of care in medication management between primary and secondary care settings compared to usual care. In contrast to the other four reviews, Spinewine *et al.*⁴⁸ did not explicitly report a primary focus on the role and effect of pharmacists in delivering medication management interventions. However, the review documents the characteristics of the included studies, and the roles of both the hospital and the community pharmacists in delivering the interventions are recorded. Spinewine *et al.*⁴⁸ report that the interventions designed to manage medication issues among patients included a consideration of the patients' medication histories, the communication of detailed discharge information to the healthcare provider, patient education and counselling before discharge, patient education and counselling before and after discharge, interventions targeting both patients and primary care providers, or interventions focusing on both admission and discharge.

The multifaceted nature of the hybrid of components included in the interventions reported on by Spinewine *et al.*⁴⁸ also features to some extent in the other four reviews. For example, De Oliveira *et al.*²¹ included studies that provided medication reconciliation and/or education to patients, where the intervention was delivered face to face or via the telephone. Mekonnen *et al.*³⁸ report that "...some studies compared comprehensive medication reconciliation programmes, for example, multifaceted interventions, including telephone follow-up and/or home visit, and patient counselling, or both telephone/home visit and patient counselling..." (p. 3). Nazar *et al.*⁴¹ report that interventions that involved community pharmacies post-discharge included at least one of the three elements: information, coordination of care, and/or communication, while Thomas *et al.*⁵⁰ reported that interventions included education and counselling of patients to address issues of adherence and increasing knowledge of their conditions and awareness of medications. The interventions continued after discharge from hospital with either telephone- or home-based monitoring. Some involved the pharmacist checking what items were required, compliance, and any side effects or interactions. During the home visits, pharmacists assessed compliance, provided education and counselling about the medications and the patients' diseases/conditions, and provided compliance aids when required.

Figure 5 presents the possible components that could be included in pharmacist-led medication management and that could be interventions themselves. These components are not necessarily included in each definition of pharmacist-led medication management in each of the five studies included in this review.

Medication review	Medication history or list the patient's current medications
	Prescription review or list the medications currently needed
	Medication reconciliation or compare the lists, make a new list based on the comparison
	Adherence support review, communicate the new list to the patient and the caregivers
	Clinical review of prescribing
	Patient/carer education or self-management or communicate the new list to the patient and the caregivers

Figure 5: Components of medication management to facilitate continuity of care

4.4.2 Methodological considerations in pharmacist-led medication management

4.4.2.1 Number and description of the populations included in the reviews

There are some variations in the populations targeted by the interventions both within and between the included studies in the five reviews. For example, De Oliveira *et al.*²¹ reported that a total of 3,503 adult patients with various medical conditions (i.e. non-surgical) and who were discharged from regular hospital wards were included in the trials reviewed. Mekonnen *et al.*³⁸ reported that a total of 21,342 adult patients discharged from hospital were included in the studies they reviewed. Most studies recruited high-risk patients (including elderly patients, patients with multiple medications, and patients at risk of medication-related events). Five studies focused on a disease-specific patient population, such as patients with heart failure or chronic obstructive pulmonary disease.

Nazar *et al.*,⁴¹ Thomas *et al.*,⁵⁰ and Spinewine *et al.*⁴⁸ do not report the total number of patients included in their reviews; the work of Nazar *et al.*⁴¹ and Spinewine *et al.*⁴⁸ are narrative reviews and this type of review is unlikely to require the total number of patients to be reported. Nazar *et al.*⁴¹ included studies with patients post-discharge from hospital with any clinical condition and Thomas *et al.*⁵⁰ included studies that recruited older people aged 60 years or over with a range of conditions and older people aged 60 years or over with heart failure. Spinewine *et al.*⁴⁸ included studies that recruited patients admitted and discharged from hospital without specifying any clinical condition for the patients.

It is interesting to note that aside from Mekonnen *et al.*,³⁸ none of the remaining four reviews reported included studies that recruited high-risk patients, including elderly patients, patients in receipt of multiple medications, or patients at risk of medication-related events. It can be argued that in order to demonstrate effectiveness of pharmacist-led medication interventions, trials ought to recruit patients that are most likely to benefit from the intervention.

4.4.2.2 Evaluation designs and level of evidence included in the reviews

There is some variation in both the number and design of the studies included in the five reviews; consequently, there is variation in the level of evidence being reported in these reviews. For example, De Oliveira *et al.*²¹ included 13 RCTs and Thomas *et al.*⁵⁰ included 20 RCTs, 16 of which recruited older people aged 60 years or over with a range of conditions and 4 of which recruited older people aged 60 years or over with heart failure. Both of these reviews are graded as evidence Level I. Spinewine *et al.*⁴⁸ report including 14 RCTs and quasi-experimental trials; the level of evidence for studies included by Spinewine *et al.*⁴⁸ is graded as evidence Level II.

Mekonnen *et al.*³⁸ included 17 studies, including 8 RCTs, 3 non-RCTs and 6 before-and-after evaluations, and Nazar *et al.*⁴¹ included 14 studies in their review; however, in their study characteristics table in the review, Nazar *et al.* provide information on only 12 studies. From this information, it would appear that the review included nine RCTs, two non-randomised controlled trials, and one retrospective electronic record review. Both of these reviews are graded as evidence Level III.

4.4.3 Pharmacist-led medication management and hospital outcomes

Three^{21 38 50} of the five reviews undertook a meta-analysis to investigate the effectiveness of pharmacist-led medication interventions; De Oliveira *et al.*²¹ and Mekonnen *et al.*³⁸ assessed the effectiveness of interventions on hospital readmissions and visits to the hospital emergency department, and Thomas *et al.*⁵⁰ assessed the impact on hospital admission and costs. The other two reviews^{41,48} reported a summary of their findings in a narrative format as a meta-analysis was not feasible due to different types and levels of heterogeneity among the primary studies. Both narrative reviews report their findings on interventions to reduce readmissions to hospital.

4.4.3.1 Do pharmacist-led medication interventions reduce admissions/readmissions to hospitals? Evidence from three meta-analyses

De Oliveira *et al.*²¹ report that the overall effect of eight studies evaluating a pharmacist-led intervention on the odds of hospital readmission did not demonstrate a significant benefit to patients receiving the pharmacist intervention compared with patients in the control group (odds ratio 0.73 [95% CI 0.47 to 1.13], I^2 not provided). This means that when the results of the primary studies were combined, pharmacist-led medication management did not differ from usual care for hospital readmission.

Of the 14 studies included in the review by Mekonnen *et al.*³⁸ reporting data on all-cause readmissions, 13 were eligible for meta-analysis. Eight studies (10 datasets) of these 13 reported data on all-cause readmission at 30 days, while 3 reported data on patients in long-term settings and 2 studies reported data for both time frames; 15 interventions (13 studies) were included in the meta-analysis. Six studies showed a significant reduction ($P < 0.05$) in readmissions to hospital; however, two of these six studies had a very small sample size. The remaining nine studies did not demonstrate a significant difference between the intervention and control groups. This means that the summary descriptive analysis of the results of this review on hospital readmissions is mixed. Mekonnen *et al.*³⁸ attempted a meta-analysis but report "...the results of these studies for this end point [outcome] are substantially heterogeneous [I^2 79%]..." (p. 4), and so the HRB has used the descriptive analysis.

Thomas *et al.*⁵⁰ included both hospital admissions and readmissions in their definition of unplanned admissions, which was the primary outcome assessed in their review. According to Thomas *et al.*, "...Unplanned/emergency or unscheduled hospital admissions were defined as 'admission or readmission that was not previously planned or scheduled or 'elective'..." (p 175). Thomas *et al.*⁵⁰ analysed the data from 16 RCTs that recruited older people aged 60 or over by (i) trials using hospital pharmacists ($n=7$) and (ii) trials using community pharmacists ($n=9$). Of the seven trials using hospital-based pharmacists, three trials included post-discharge follow-up. A meta-analysis of these three trials showed there were no significant differences between the intervention and control groups in the number of unplanned admissions (three trials, pooled relative risk: 1.01; [95% CI: 0.89 to 1.15,] $I^2=0\%$). The level of intensity with which the interventions were delivered varied greatly among the three trials using hospital-based pharmacists, which detected no significant difference in admissions or readmissions between patients receiving the intervention and those receiving usual care. According to Thomas *et al.*,⁵⁰ "...One trial followed up with a telephone call at two months to ensure adequate home management of medications; the second trial used regular follow-up appointments at one week, two to four weeks, two months and three months post discharge and the remaining trial used a hospital pharmacist for patients discharge planning, and community pharmacists for home-based follow-up at 7–14 days, with further discretionary visits arranged." (p 176) In addition to the 16 trials that recruited older people aged 60 and over, Thomas *et al.*⁵⁰ included four trials that recruited older people aged 60 and over and who were diagnosed with heart failure. In three of these four trials, the intervention was initiated by pharmacists in the hospital and followed up when the patients were discharged. There was a significant reduction in unplanned hospital admissions demonstrated by pooling the three heart failure trials which took place crossing the hospital and community (relative risk 0.75 [95% CI: 0.59 to 0.95]), suggesting a 25% (5% to 41%) reduction in unplanned admissions for older people with heart failure who received the pharmacist-led intervention. However, Thomas *et al.*⁵⁰ do not report the I^2 . Regarding the quality of the three trials that recruited older people aged 60 and over with heart failure, there was variation in the intensity and duration of follow-up and questions about the role of bias; two had a 12-month follow-up and one had a 6-month follow-up. Two trials were rated as low risk of bias and one trial showed a high risk of bias; the trial with the high risk of bias, which was published in 1999, showed the greatest effect on reducing admissions. Thomas *et al.* point out that "...If only the data from the two low risk of bias studies were combined in a sensitivity analysis, there was no difference between the intervention and control group (relative risk 0.81 [95% CI: 0.62 to 1.05]..." (p. 184). The negative effect in the three-study heart failure analysis must be interpreted with caution.

Overall, the meta-analysis of studies with low levels of bias shows that pharmacist-led interventions, when compared to usual care, do not appear to reduce hospital readmissions.

4.4.3.2 Do pharmacist-led medication interventions reduce visits to hospital emergency departments? Results from two meta-analyses

De Oliveira *et al.*²¹ reported that the overall effect of four studies evaluating a pharmacist-led medication intervention on the odds of emergency department visits compared with the control group favoured the pharmacist intervention, with an odds ratio of 0.42 (95% CI 0.22 to 0.78) indicating a statistically significant difference. The number needed to treat was 6.2 (95% CI 3.4 to 31.4) for one successful outcome; however, the confidence intervals were very wide. Heterogeneity among the four studies was high ($I^2=75$). All four studies used a post-discharge intervention; therefore, heterogeneity could not be explained by the presence or absence of a post-discharge intervention. The removal of the only study that conducted a post-discharge intervention through an in-person visit rather than a telephone-based pharmacist intervention did not change the results (odds ratio 0.50 [95% CI 0.27 to 0.92]). However, the I^2 is not reported, so the HRB does not know the proportion of heterogeneity across these three studies.

Mekonnen *et al.*³⁸ assessed all-cause emergency department contacts and undertook a meta-analysis on seven of eight studies that measured emergency department visits as an outcome. Considering studies that gave two sets of data, nine primary studies were included in the meta-analysis. The pooled effect across all nine primary studies showed that all-cause emergency department visits were significantly reduced, by 28%, in the pharmacist-led intervention group compared to the usual care group (relative risk 0.72 [95% CI 0.57 to 0.92]). However, Mekonnen *et al.*³⁸ report that the data around the assessment of all-cause emergency department visits displayed substantial heterogeneity ($I^2=81\%$). When the authors undertook a sensitivity analysis and removed one study from the analysis, the findings were still significantly different, with an 11% reduction in the incidence of emergency department visits, and there was low heterogeneity (relative risk 0.89 [95% CI 0.79 to 0.99], $I^2=22\%$, eight trials).

Overall, there is some evidence to suggest that pharmacist-led interventions may reduce emergency department visits.

4.4.3.3 Do pharmacist-led medication interventions reduce hospital admissions/readmissions and emergency department visits? Evidence from two narrative reviews

Spinewine *et al.*⁴⁸ summarised the results of two studies that evaluated pharmacist-led patient education and counselling before and after hospital discharge and assessed rates of hospital readmission; the authors report mixed findings across the two studies.

Spinewine *et al.*⁴⁸ also examined four trials that evaluated interventions targeting both patient and primary care providers and reported mixed findings across the four studies. For example, a trial performed in the UK with elderly patients found no impact from a comprehensive intervention on hospital readmission which was the primary outcome measured in the trial. In a second trial summarised by Spinewine *et al.*,⁴⁸ the effect of a pharmacist transition coordinator was evaluated. The study reported significant reductions in hospital use (emergency department visits and readmissions to hospital) in the intervention group at eight weeks follow-up. A third trial summarised by Spinewine *et al.*⁴⁸ evaluated the impact of a multilevel and multidisciplinary intervention comprising patient education and comprehensive discharge planning by a discharge nurse, summaries faxed to primary care providers, and telephone reinforcement two to four days after discharge by a clinical pharmacist. The study reported significantly lower rates of hospital utilisation 30 days (proxy for readmissions and emergency department visits) after discharge. Finally, in a fourth trial summarised by Spinewine *et al.*⁴⁸ undertaken in the USA, Spinewine *et al.* report no effect of a pharmacist-facilitated discharge programme on hospital readmission 14 and 30 days after discharge or on emergency department visits, despite lower rates of medication discrepancies in the intervention group.

Nazar *et al.*⁴¹ summarised the findings from six studies that assessed hospital readmissions as an outcome. The authors report that pharmacist involvement in transition of care reduced hospital readmissions in two studies, was associated with increased readmissions in two studies, and had no

effect on readmissions in two studies, therefore demonstrating mixed findings on pharmacist involvement in transition of care to reduce hospital readmissions. Nazar *et al.*⁴¹ reported that the primary focus in most of these studies was to effect the identification and rectification of problems relating to the medication regime, and reducing readmission to hospitals was evaluated as a secondary focus.

Overall, the narrative reviews provide mixed results with respect to hospital readmissions and emergency department visits.

4.4.3.4 Do pharmacist-led medication interventions reduce costs related to healthcare resource utilisation?

According to Thomas *et al.*,⁵⁰ of the three RCTs that recruited patients diagnosed with heart failure and evaluated hospital pharmacist-led medication interventions, there were mixed findings regarding costs related to the utilisation of healthcare resources. For example, one trial suggests that costs were equitable between the intervention and the usual care group, whereas the second trial showed that, taking all costs into account, the intervention group was more cost-effective than the usual care group, reducing hospital costs by €578 per patient. In the third trial, Thomas *et al.*⁵⁰ observed that the only statement relating to costs in the study was “the average daily cost (1996–1997) on a general medical ward is much higher than the average cost of an emergency room visit (£175.38 and £35.27 respectively) therefore by having fewer hospital admissions it costs less to treat patients in the intervention group than the control group...” (p. 184). In their review, Nazar *et al.*⁴¹ included two studies that examined costs and these studies showed no difference between the intervention and control groups.

Overall, the review of costs found mixed results and, in some cases, an inadequate assessment of costs.

4.4.4 HRB conclusion – Pharmacist-led medication management

The transition of care experience from the hospital to the community can carry numerous risks for patients and their families and/or carers. Central to these risks is the potential miscommunication around changes to the patients’ medication regime which can often lead to adverse related events and a return to the hospital. Nazar *et al.*⁴¹ succinctly encapsulate the nature of this experience and provide some insight into the rate of change that can arise within a patient’s medication regime when they are being discharged from hospital. According to Nazar *et al.*,⁴¹ “...patients are often departing from a confusing and hectic discharge environment, supplied with messages about medicines management, follow-up appointments, and other post-discharge information. The discharge process is susceptible to misunderstanding and miscommunication, often leaving the patient, carers and families ill-prepared to manage care appropriately during the transition home. Only 10% of elderly patients will be discharged on the same medication that they were admitted to hospital on. Sixty per cent of patients will have three or more medicines changed during their hospital stay, 28-40% of medications are stopped within hospital and 45% of medicines prescribed at discharge are new...” (p. 936).

As part of the HRB’s examination of interventions to relieve pressure on acute hospitals, it identified five high-quality systematic reviews that examined the evidence for pharmacist-led interventions that manage the medication regimes of patients during the transition of care from hospital to the community. In particular, the HRB was interested in examining the effect, if any, of these interventions on unplanned admission and readmission to hospital, the length of stay in the hospital, visits to the emergency department, and the costs associated with the use of these healthcare resources. The HRB recognises that in most cases, the primary objective of pharmacist-led medication management interventions is to reduce medication error and potential adverse drug events among patients, and in most of the five reviews the HRB identified, the modifications of the outcomes of interest were often secondary objectives. Indeed, the review by Thomas *et al.*⁵⁰ is the only one of the five reviews the HRB identified that examined the effect of pharmacist-led interventions on hospitalisation (and re-hospitalisation) as the primary outcome of interest. Nonetheless, as Thomas *et*

*al.*⁵⁰ point out, "...medication-related problems are thought to cause between 10 and 30% of all hospital admissions in older people..." (p. 175).

It would appear from the HRB's analysis that the various definitions and operationalisations of pharmacist-led medication reconciliation interventions being used in the five reviews are contributing to the inconclusive findings regarding the effectiveness of interventions on hospital admissions and readmissions. According to Aronson (2017),⁵⁶ "...the process of medication reconciliation has five steps: list the patient's current medications; list the medications currently needed; compare the lists; make a new list based on the comparison; communicate the new list to the patient and caregivers..." (p. 1). However, in the five reviews the HRB analysed, these five steps were not consistently reported in any of the reviews. In addition, variations in the nature and extent of the information provided to patients and caregivers, the intensity and duration of the interventions, and the competing components from other interventions in the transition of care make the evaluation of medication reconciliation a complex process. One potential remedy to unravelling some of this complexity may be to heed the advice of Nazar *et al.*,⁴¹ who refer to transfer-of-care interventions (including pharmacist-led medication interventions) as complex interventions and suggest that future evaluations should include an examination of how the intervention might work. According to Nazar *et al.*⁴¹ "...a more descriptive analysis of the context would facilitate the identification of the key active ingredients of an intervention allowing for a better understanding of the causal mechanisms. Hence, a process evaluation should complement an evaluation of effectiveness of any complex intervention..." (p. 946).

Three high-quality systematic reviews examining multi-component pharmacist-led medication management interventions for patients discharged from hospital were identified. Three review teams completed meta-analyses to identify the effect of pharmacist-led medication management on hospital readmissions (Table 6). Two of these reviews completed their meta-analyses using RCTs and reported low levels of bias. The meta-analyses from these two reviews found that pharmacist-led medication management, when compared to usual care, does not appear to reduce hospital readmissions among adults. There is some evidence from meta-analyses of control trials and observational studies to suggest that pharmacist-led interventions may reduce emergency department visits, but levels of heterogeneity in both meta-analyses were high. The lack of randomisation and the presence of heterogeneity reduce the certainty of the evidence for pharmacist-led medication management reducing emergency department visits. Overall, the review of costs found mixed results and, in some cases, an inadequate assessment of costs.

It is important to note that some primary studies were included in more than one review, and when the overlap was calculated employing Pieper *et al.*'s¹⁶ methodology it was 8.1, which indicates that there is moderate overlap between the primary studies included in the five reviews. This indicates that the five individual reviews are not providing five independent results, but rather are reaffirming each other's results.

Table 6: Summary of effectiveness for each outcome for medication management by review

Intervention by study	Target population	Hospital admissions	Hospital readmissions	Length of stay in hospital	Emergency department visits	Cost
De Oliveira <i>et al.</i> 2017 ²¹	Adults discharged from hospital (n=3,503) 13 studies	Not measured	No association* Not specified – 8 studies	Not measured	Negative association* Not specified – 4 studies	Not measured
Mekonnen <i>et al.</i> 2016 ³⁸	Adults at discharge from hospital	Not measured	Mixed findings (n=21,969)	No association (n=803)	Negative association* (n=10,375)	Not measured
Nazar <i>et al.</i> 2015 ⁴¹	People at discharge with any diagnosis	Not measured	Mixed findings (sample size not specified)	Mixed findings (sample size not specified)	Not measured	No association (sample size not specified)
Spinewine <i>et al.</i> 2013 ⁴⁸	Patient education and counselling before and after discharge	Not measured	Negative association (n=464)	Negative association (n=464)	Negative association (n=464)	Not tested
	Interventions targeting both patients and primary care providers	Not measured	Mixed findings (n=251)	Mixed findings (n=251)	Negative association (n=251)	Not tested
	Interventions focusing on both admission and discharge	Not measured	No association (n=322)	No association (n=322)	No association (n=322)	Not measured
Thomas <i>et al.</i> 2014 ⁵⁰	Older people with medical conditions	No association (n=541)	Not measured	Not measured	Not measured	Not measured
	Older people with heart failure	No association (n=153)	Not measured	Not measured	Not measured	Mixed findings

*Meta-analysis

4.5 Chronic care

4.5.1 Chronic care model

The chronic care model comprises six modifiable elements of healthcare systems (Figure 6):

1. Organisational support which addresses organisational culture and leadership
2. Clinical information systems that organise patient, population and provider data
3. Delivery system design which addresses composition and function of the care team and follow-up management
4. Decision support which increases provider access to evidence-based guidelines and specialists for collaboration
5. Self-management support which provides tailored education, skills training, psychosocial support, and goal-setting, and
6. Community resources which provide peer support, care coordination, and community-based interventions.

Chronic care model	Organisational support
	Clinical information systems
	Delivery system design
	Decision support
	Self-management support
	Community resources

Figure 6: Components of chronic care model

Damery *et al.*⁸ identified nine moderate- or strong-quality reviews that examined the effectiveness of a chronic care model for chronic diseases on hospital system outcomes and/or costs. Hospital system outcomes measured included admissions to hospital, readmissions to hospital, length of stay in hospital, and emergency department visits. The control intervention could be usual care, no intervention, or comparison to one or more other interventions. Damery *et al.*⁸ reported that six of nine reviews focusing on interventions comprising one or more components of the chronic care model reported positive findings for at least one of the hospital or cost outcomes. All chronic care model reviews reported that interventions with two or more of the six components were significantly more effective than single-component interventions at reducing hospital admission rates, with reductions of 22% to 32% observed in reviews that performed meta-analyses (Appendix E). Multicomponent interventions (when compared to usual care) were also successful in reducing readmissions to hospital by 15% to 30%, length of hospital stay by two to four days, and emergency department visits by 42%. Three of the six reviews of the chronic care model that measured costs reported significant reductions, one reported equal costs, and the other two reported mixed findings.

4.5.2 Chronic disease management for asthma

Peytremann-Bridevaux *et al.* (2015)⁴³ investigated the effect of chronic disease management programmes for adults with asthma. As already mentioned, asthma was not one of Damery *et al.*'s 11 chronic diseases. The chronic disease management programmes had to satisfy at least one of the following five criteria: (i) an organisational component targeting patients; (ii & iii) an organisational component targeting healthcare professionals or the healthcare system, or both; (iv) patient education or self-management support, or both; and (v) active involvement of two or more healthcare professionals in patient care. The chronic disease management programme has a number of components that are named in the definition used by Damery *et al.*⁸ including organisation support, delivery system design, and self-management. However, there are some components which are named in the chronic care

model used by Damery *et al.*,⁸ but not in the chronic disease programme used by Peytremann-Bridevaux *et al.*⁴³ These are shared clinical information systems, evidence-based decision support, and employment of specific community resources. Therefore, the chronic disease management programme definition is not as comprehensive as the chronic care model investigated by Damery *et al.*,⁸ and the fact that, according to Peytremann-Bridevaux *et al.*'s⁴³ inclusion criteria, primary studies had to satisfy only one of five criteria in the chronic disease management programme may have diluted the effectiveness of this intervention.

The HRB identified one strong-quality review that examined the effectiveness of chronic disease management for asthma on hospital system outcomes and costs.⁴³ Hospital system outcomes measured were admissions to hospital and emergency department use. The control intervention was usual care. Peytremann-Bridevaux *et al.*⁴³ identified 20 studies testing the effect of chronic disease management for asthma, half of which were completed in North America, six in Europe, three in Asia, and one in Australia.

Peytremann-Bridevaux *et al.*⁴³ reported that nine studies reported hospitalisation data. The mean number of hospitalisations per patient across intervention groups ranged from 0.02 to 0.4, while the mean number of hospitalisations per patient across control groups ranged from 0.06 to 1.23. However, the authors could not perform a meta-analysis because the data were skewed and heterogeneous, with wide variability in terms of measurement time points (within the last 1, 6, 8, or 12 months) and reasons for hospitalisation (due to asthma or any cause). Three trials reported a reduction in hospitalisations for asthma in the intervention group compared with the control group. In contrast, two RCTs and one quasi-RCT did not report any differences between groups. Overall, the findings on hospitalisation were mixed. Two trials and two control before-and-after studies reported the number of hospitalisations and emergency department visits as one outcome and did not report significant differences between groups in the number or percentage of hospitalisations or emergency department visits during the study follow-up. The HRB did not use these four studies in its summary conclusions as we could not identify the direction of the association for the individual outcomes. Nine studies reported the number of emergency department or unscheduled visits. Again, the authors could not perform a meta-analysis because the data were skewed and heterogeneous, with wide variability in means and time points for follow-up, varying from 1 to 12 months. The mean number of emergency department or unscheduled visits per patient across intervention groups ranged from 0.02 to 1.9, while the mean number of emergency department or unscheduled visits per patient across control groups ranged from 0.02 to 1.4. The findings overlap and very likely demonstrate similar experiences between the intervention and control groups. Overall, there is no association between emergency department visits between the intervention and control groups. This section is based on one review and so there is no overlap.

Table 7: Summary of effectiveness for each outcome for chronic disease management by review

Intervention by study	Target population	Hospital admissions	Hospital readmissions	Length of stay in hospital	Emergency department visits	Cost
Peytremann-Bridevaux <i>et al.</i> 2015 ⁴³	Patients with asthma	Mixed findings (n=825)	Not measured	Not measured	No association (n=825)	Not measured

4.5.3 HRB conclusion – Chronic disease management and chronic care models

Damery *et al.* concluded that chronic care models based on multiple components were effective overall. For example, use of the chronic care model reduced hospital admissions, hospital length of stay, and emergency department visits. However, it is not clear which individual components contribute the greatest effect to reducing hospital use and cost outcomes, or if individual components interacted with one another to enhance the overall effect.

The HRB concludes that the chronic disease management programme for asthma was less effective than the chronic care model for other chronic diseases based on Damery *et al.*'s reported conclusions. The review authors, Peytremann-Bridevaux *et al.* highlighted that intervention fidelity varied across the studies on asthma. The review authors also reported that the data in the nine primary studies that measured admissions to hospital were skewed and too heterogeneous to combine. Peytremann-Bridevaux *et al.*'s narrative conclusion is that the evidence that chronic disease management for asthma reduced the number of admissions to hospital is inconclusive. Chronic disease management did not appear to reduce the number of emergency department visits, but once again the data are skewed and heterogeneous. The lack of similarity between the study methods reduces the certainty of the systematic review findings.

4.6 Complex interventions for chronic disease patients

Complex interventions are less clearly defined in the literature and appear to comprise a range of interventions rather than focusing on a single intervention or service model. Damery *et al.*⁸ identified three moderate- or strong-quality reviews that examined the effectiveness of complex interventions for chronic diseases on hospital system outcomes and/or costs. The control intervention could be usual care, no intervention, or comparison to one or more other interventions. Hospital system outcomes measured were admissions to hospital, readmissions to hospital, length of stay in hospital, and emergency department visits. Damery *et al.*⁸ reported that one of the three reviews that assessed complex interventions demonstrated a 32% reduction in emergency department use, another reported a 43% reduction in heart failure-related readmissions, and a review of reviews reported positive findings for admissions, readmissions, length of stay, and emergency department use, though Damery *et al.*⁸ note that no effect sizes were provided in the review (Appendix E).

4.6.1 Damery *et al.*'s conclusion on complex interventions for chronic disease patients

Damery *et al.* concluded that complex interventions for chronic diseases reduced hospital admissions, readmissions, hospital length of stay, and emergency department visits, but again, it is not clear which individual interventions contribute the greatest effect to the positive hospital system outcomes reported or if individual interventions interacted with one another to enhance the desired outcomes.

4.7 Multidisciplinary teams for chronic disease patients

Multidisciplinary teams are interventions comprising teams composed of multiple health and/or social care professionals working together to provide care for people with complex needs. Teams typically condition-specific expertise (doctors, nurses, occupational therapists, and/or physiotherapists) and community-based or social care expertise (general practitioners, and occasionally pharmacists or case managers) (Figure 7).

Multidisciplinary teams																
Condition-specific expertise					Primary or community care expertise					Social care expertise						
Doctors	Nurses	Nutritionists	Pharmacists	Occupational therapists	Physiotherapists	Other therapists	General practitioners	Community Nurses	Community Nutritionists	Pharmacists	Community Occupational therapists	Community Physiotherapists	Other therapists	Social workers	Care assistants	Home help

Figure 7: Components of a multidisciplinary team

Damery *et al.*⁸ identified 10 moderate- or strong-quality reviews that examined the effectiveness of multidisciplinary teams for chronic diseases on hospital system outcomes and/or costs. Hospital system outcomes measured were admissions to hospital, readmissions to hospital, length of stay in hospital, and emergency department visits. The control intervention could be usual care, no intervention, or comparison to one or more other interventions. Damery *et al.*⁸ reported that the team composition varied in the 10 reviews that assessed multidisciplinary team interventions. Nevertheless, the authors reported that multidisciplinary teams were generally effective when used for patients with single conditions rather than multiple conditions, showing a 26% to 31% reduction in admission rates for heart failure in three reviews and a 33% relative risk reduction for admissions in patients with chronic obstructive pulmonary disease in one review (Appendix E). Damery *et al.*⁸ also found that multidisciplinary teams were associated with a 42% reduction in heart failure readmissions in one review, a two-day reduction in length of stay in three reviews, significantly reduced emergency department use in one review, and significantly lower healthcare costs in one review. Conversely, Damery *et al.*⁸ reported that multidisciplinary teams for general chronic disease management showed mixed effectiveness or no significant association with any outcomes in three reviews; Damery *et al.*⁸ suggest that the crucial component of an effective multidisciplinary team is the inclusion of condition-specific specialist expertise in the team skill mix. One of the three reviews that examined the costs of multidisciplinary teams compared to usual care reported some evidence for cost-effectiveness (though provided little detail) while the other two reported mixed findings with respect to costs.

4.7.1 Damery *et al.*'s conclusion on multidisciplinary teams for chronic disease patients

Damery *et al.* concluded that multidisciplinary team care for chronic diseases, particularly when condition-specific specialists, specialist nurses, or pharmacists were part of the team, showed promising evidence of effectiveness. There is evidence that sometimes they reduce hospital admissions, while all reviews show that they reduce length of stay in hospital.

4.8 Self-management

4.8.1 Self-management by chronic disease patients

Self-management interventions are designed to provide patient support, typically via tailored education to inform the patient about their condition(s), inform the patient about recognising the signs and symptoms of disease exacerbation, provide dietary and lifestyle advice, and/or provide condition-specific education supporting medication adherence (Figure 8).

Self-management interventions	Personal action plan
	Tailored condition-specific education
	Able to recognise signs and symptoms of disease exacerbation
	Tailored dietary and lifestyle advice
	Supports for medication adherence

Figure 8: Components of self-management

Damery *et al.*⁸ identified five moderate- or strong-quality reviews that examined the effectiveness of self-management for chronic diseases on hospital system outcomes and/or costs. Hospital system outcomes measured were admissions to hospital, readmissions to hospital, length of stay in hospital, and emergency department visits. The control intervention could be usual care, no intervention, or comparison to one or more other interventions. Damery *et al.*⁸ reported that three of the five reviews of self-management interventions showed either mixed findings or no association between self-management and the hospital and cost outcomes assessed; two of these included any patients with chronic diseases and one included patients with chronic obstructive pulmonary disease (Appendix E). Damery *et al.*⁸ also reported that one of the remaining two reviews demonstrated significant reductions in readmission rates and healthcare costs for patients with heart failure, while the other found significantly lower admission rates for patients with chronic obstructive pulmonary disease.

Damery *et al.*⁸ concluded that self-management showed the most promise when incorporated into the chronic care model or multidisciplinary team care or when tailored patient education was included in a discharge planning intervention.

4.8.2 Self-management or education for asthma

The HRB found two strong-quality reviews examining self-management⁴⁹ or education⁴⁹ for asthma. Asthma was not one of Damery *et al.*'s⁸ chronic diseases. Both reviews examined the effect of asthma self-management or education on hospital admissions, emergency department visits, and costs. The control group for both studies was defined by the authors as either usual care or less intense self-management or education interventions.

Tapp *et al.* (2007)⁴⁹ found 10 trials from four countries (Australia, Switzerland, the UK, and the USA) and another three trials where the country of origin was not specified and found that educational interventions led to a 50% reduction in the relative risk of subsequent hospital admission in the five trials that measured this outcome (relative risk 0.50; 95% CI 0.27 to 0.91, n=572). Tapp *et al.*⁴⁹ reported that this result was based on high-quality evidence. Based on an assumed risk of admission of 27% in untreated populations, risk of admission would fall to 13% due to educational interventions. Overall, the average number needed to treat to prevent one admission was nine (95% CI 6 to 27). Most of the evidence comes from studies measuring the outcome at 24 weeks. There was a moderate level of statistical heterogeneity for this outcome ($I^2=51\%$). From eight trials involving 946 participants, there was no significant difference in the number of people who re-presented at an emergency department setting between the education and control groups (relative risk 0.72 [95% CI 0.47 to 1.11]). The authors reported a moderate level of statistical heterogeneity for this outcome ($I^2=51\%$). This was low-quality evidence due to statistical imprecision and risk of bias. One USA study published in 1991 reported estimated costs of treatment. These were significantly lower in favour of education in terms of cost of emergency department visits per person per year (US\$638). The differences were not significant for physician visits, hospital admissions, and total costs. A 2009 trial

reported that patients allocated to educational interventions incurred lower costs as represented by emergency department visits and cost of hospitalisation.

Pinnock *et al.*⁴⁴ reviewed the effect of an intervention titled Reducing Care Utilisation through Self-management Interventions (RECURSIVE). Twenty-four trials were included in the review; half were from either the UK or the USA. The authors stated that best practice documents advise that “people with asthma should be provided with self-management education reinforced by a personalised asthma action plan and supported by regular review, though mode of delivery, personnel delivering the support, the targeted group and the intensity of the intervention vary” (p. 2). Pinnock *et al.*⁴⁴ reported significant small decreases in hospitalisation rate (standardised mean difference -0.21 [95% CI -0.40 to -0.01], I^2 =not available), significant small decreases in emergency department visits (standardised mean difference -0.25 [95% CI -0.49 to -0.01], I^2 =not available), and non-significant small increases in total healthcare costs (standardised mean difference 0.13 [95% CI -0.09 to 0.34], I^2 =not available).

Overall, the two reviews based on meta-analysis reported that self-management or education reduced hospital readmissions when compared to usual care (Table 8). One meta-analysis reported that self-management or education reduced emergency department visits while the other meta-analysis reported no effect; therefore, findings are mixed. The narrative analysis on costs reported reduced costs for emergency department visits but not for any other costs.

It is important to note that three primary studies were included in both reviews, and when the overlap was calculated employing Pieper *et al.*'s¹⁶ methodology, it was 8.6, which indicates that there is moderate overlap between the primary studies included in the two reviews. This indicates that the two individual reviews are not providing independent results, but rather they are reaffirming the main result that self-management can prevent hospital readmissions.

Table 8: Summary of effectiveness for each outcome for self-management of asthma by review

Intervention by study	Target population	Hospital admissions	Emergency department visits	Cost
Pinnock <i>et al.</i> 2017 ⁴⁴	Asthma	Negative association* (n=10,470)	Negative association* (n=9,197)	No association (n=1,802)
Tapp <i>et al.</i> 2007 ⁴⁹	Acute asthma	Negative association* (n=572)	No association (n=946)	Negative association for emergency department (n=465)

*Meta-analysis

4.8.3 HRB conclusion – Self-management

Damery *et al.* concluded that self-management for chronic diseases showed most promise when incorporated into the chronic care model or multidisciplinary team care or when tailored patient education was included in a discharge-planning intervention. When integrated into a multicomponent intervention, self-management may reduce hospital admissions and readmissions.

The HRB found two strong-quality reviews of RCTs examining self-management or education for asthma. The findings from two meta-analyses found that asthma self-management or education interventions may be effective in reducing hospital admissions, but the level of heterogeneity, where measured, was moderate. The asthma self-management intervention may be effective in reducing the number of emergency department visits, but heterogeneity was not measured. The education intervention was not effective in reducing the number of emergency department visits. The narrative findings on costs are mixed. The authors of one of these reviews, Pinnock *et al.*, noted that “effective self-management for asthma should be tailored to cultural, clinical and demographic characteristics and is most effective when delivered in the context of proactive long-term care management” and these authors’ comments are similar to those of Damery *et al.*

4.9 Hospital at home

Hospital at home is a service that provides active treatment by healthcare professionals in the patient's home for a condition that otherwise would require acute hospital inpatient care. It is always provided for a limited time period. In particular, hospital at home has to offer a specific service to patients in their home requiring healthcare professionals to take an active part in the patients' care. If hospital at home were not available, then the patient would be in hospital and would remain on an acute hospital ward. Hospital at home intervention can be delivered by hospital outreach services or community-based services, or it can be coordinated by a hospital-based team or physician in conjunction with community-based services.

Hospital at home can be used to avoid hospital admission⁴⁷ or permit early discharge.²⁶ It can also be used to provide end-of-life care.⁴⁶ Damery *et al.*⁸ did not cover hospital at home.

4.9.1 Hospital at home to avoid hospital admission

People are accepted to admission-avoidance hospital at home after assessment in the community by their primary care physician, in the emergency department, or a medical admissions unit. One aim of admission-avoidance hospital at home is to reduce the demand for acute hospitals beds. A second aim is to lower the risk of functional decline from limited mobility that can occur during an admission to hospital, particularly in frail older people, by providing coordinated healthcare in a less restrictive environment, thereby giving patients the opportunity for continued involvement in activities of daily living.

The HRB identified one strong-quality review⁴⁷ that examined the effectiveness of hospital at home to avoid hospital admission on hospital system outcomes and/or costs. Hospital system outcomes measured were admissions to hospital, length of stay in hospital, combined length of stay in hospital and home, and emergency department visits. The comparison intervention in all trials was acute hospital inpatient care. Shepperd *et al.* (2016b)⁴⁷ identified 16 trials conducted in seven countries (Australia, Italy, New Zealand, Romania, Spain, the UK, and the USA) aiming to avoid hospital admission among adults age 18 years or over. Three trials recruited participants with chronic obstructive pulmonary disease, two trials recruited participants recovering from a moderately severe stroke who were clinically stable, and six trials recruited participants with an acute medical condition who were mainly elderly. In addition, there was one trial each for participants with cellulitis, community-acquired pneumonia, fever and neutropenia, frail elderly participants with dementia, and participants with neuromuscular disease.

Shepperd *et al.*⁴⁷ analysed the effect of hospital at home on admission avoidance using data on hospital readmission at three months from seven trials. Results indicated that admission-avoidance hospital at home did not increase or decrease the likelihood of hospital readmission (relative risk 0.98 [95% CI 0.77 to 1.23], $P=0.84$, $I^2=28\%$). This indicates that hospital at home is possibly as safe as inpatient care. Seven trials reported the effect of admission-avoidance hospital at home on combined length of hospital stay and hospital at home stay, which Shepperd *et al.*⁴⁷ judged unsuitable for meta-analysis. Four trials reported a significantly higher total length of stay for hospital at home, while two reported a significantly lower length of stay and one reported no difference in the length of stay. Total length of stay varied from a mean reduction of -8.09 days [95% CI -14.34 to -1.85] in a trial recruiting older people with varied health problems, to a mean increase of 15.9 days [95% CI 8.10 to 23.70] in a study that recruited patients recovering from a stroke. While eight trials reported costs of health services, only four of them tested the difference between costs; of these, three trials reported significantly lower costs and the remaining trial reported significantly higher costs for one aspect of care. One other study examined cost of informal care inputs and found that there was no significant difference for five of six measures. One measure was significantly higher for hospital at home; people who lived with the ill person spent a higher average number of hours caring for them. This section is based on one review and so there is no overlap.

4.9.2 Hospital at home to permit early discharge

The HRB identified one strong-quality review²⁶ that examined the effectiveness of hospital at home to permit early discharge on hospital system outcomes and/or costs. Hospital system outcomes measured were readmissions to hospital, length of stay in hospital, combined length of stay in hospital and home, and emergency department visits. The comparison intervention in all trials was acute hospital inpatient care. Gonçalves-Bradley *et al.*²⁶ identified 32 trials that comprised adults aged 18 years or over. Half of the trials were conducted in the UK and the remaining 16 in Australia, Canada, Chile, Italy, New Zealand, Norway, Spain, Sweden, Thailand, the Netherlands, and Turkey. The trials comprised three distinct populations: people recovering from stroke, people aged 65 or over with a mix of medical conditions, and people undergoing elective surgery. This section is based on one review and so there is no overlap.

4.9.2.1 Stroke

Gonçalves-Bradley *et al.*²⁶ combined data from five trials that reported hospital readmission for stroke indicating that early discharge to hospital at home did not increase or decrease the number of readmissions to hospital required at three to six months follow-up (relative risk 1.09 [95% CI 0.71 to 1.66], $I^2=0\%$) or at 12 months follow-up (both primary studies showed no significant difference in readmission rates between the intervention and control groups). This indicates that hospital at home is possibly as safe as inpatient acute hospital care. Ten trials reported hospital length of stay for stroke. Gonçalves-Bradley *et al.*²⁶ combined data from four trials for meta-analysis and found that early discharge hospital at home was likely to significantly reduce hospital length of stay for stroke patients (mean difference -6.68 days [95% CI -10.19 to -3.17], $I^2=0\%$). Gonçalves-Bradley *et al.*²⁶ reported that the remaining six trials (which were not suitable for meta-analysis) reported a median reduction in hospital length of stay ranging from -8 days to -15 days for those with a diagnosis of stroke allocated to hospital at home, which is consistent with the findings of the meta-analysis. Four trials reported inpatient, outpatient, and total healthcare costs for stroke, with different healthcare resources measured and valued. Two trials reported similar costs for stroke to the health service for early discharge hospital at home and inpatient care. Two trials found that early discharge hospital at home may reduce hospital costs of stroke; one was conducted in Canada (mean difference -CA\$3,280.95, $P<0.0001$) and the other in Australia (mean difference AU\$4,678 [95% CI -AU\$6,680 to -AU\$2,676]), although the difference in the Australian study was offset when community costs were included (mean difference -AU\$2,013 [95% CI -AU\$4,696 to -AU\$669]). This indicates that hospital at home is unlikely to save money for the health system but may reduce pressure on acute beds and allow them to be used for other urgent cases.

4.9.2.2 Older people with chronic obstructive pulmonary disease or a mix of conditions

Fifteen trials reported data on hospital readmission for older people with a mix of conditions. Gonçalves-Bradley *et al.*²⁶ pooled data for nine trials recruiting older people with a mix of conditions which had a median follow-up of three months, and five trials for participants with chronic obstructive pulmonary disease with two to three months follow-up. Their analysis demonstrated that early discharge to hospital at home does not significantly increase the risk of readmissions for older people with a mix of conditions (relative risk 1.25 [95% CI 0.98 to 1.58], $I^2=0\%$), nor does it significantly increase the risk of readmissions for people with chronic obstructive pulmonary disease (relative risk 0.86 [95% CI 0.66 to 1.13], $I^2=0\%$). Gonçalves-Bradley *et al.*²⁶ did not combine all data on hospital length of stay for older people with a mix of conditions, due to variation among study populations and because some of the trials did not provide standard deviations. The authors combined data for four trials only and found that early discharge to hospital at home probably reduces hospital length of stay (mean difference -6.76 days [95% CI -10.60 to -2.92]), but there was significant heterogeneity ($I^2=79\%$) and the analysis should be interpreted with caution. Of these four trials, one trial had a negative association in favour of the hospital at home group and three trials had no association. Gonçalves-Bradley *et al.*²⁶ pooled data from three trials that reported both length of stay in hospital and hospital at home combined and found that early discharge hospital at home may increase the total number of days of healthcare received (mean difference 6.43 [95% CI 2.84 to

10.03], $I^2=0\%$). Seven trials reported the costs associated with the intervention for older people with a mix of medical conditions, with variation in estimates partly reflecting the different healthcare resources that were measured and how these were valued. Five trials reported significantly lower costs for the health service, one trial reported a significantly higher cost, and one trial did not do a test of significance. Overall, this indicates that costs of hospital at home for older people may possibly be lowered, but this conclusion is based on very little evidence.

4.9.2.3 People who had elective surgery

Gonçalves-Bradley *et al.*²⁶ identified five trials that reported hospital readmission for people who had elective surgery, and the rate of readmission was equal in both groups. Gonçalves-Bradley *et al.*²⁶ identified six trials reported on hospital length of stay following elective surgery. Early discharge to hospital at home probably reduces hospital length of stay for patients recovering from orthopaedic surgery (mean difference -4.44 days [95% CI -6.37 to -2.51], $I^2=0\%$) and for patients recovering from coronary artery bypass surgery (mean difference -2.7 days, $P<0.001$). Gonçalves-Bradley *et al.*²⁶ did not include one trial recruiting participants recovering from hip surgery in the analysis, as it did not report usable data. Two trials reported on total length of stay following elective surgery. Early discharge hospital at home probably increases total length of stay for patients recovering from surgery (mean difference 2.79 days [95% CI 0.77 to 4.81], $I^2=0\%$). It is uncertain if early discharge hospital at home leads to a reduction in costs to the health service following elective surgery, based on the evidence from five trials. Three trials did not test the difference in costs, but two did and found that there was no difference in costs between the intervention and usual care groups. One primary study that recruited a mix of medical and surgical patients reported that hospital at home may be less costly than hospital care when using average costs for hospital length of stay (mean cost per patient over three months GB£2,516 versus GB£3,292). Another trial that accounted for the marginal costs incurred during a patient's episode of hospital care (and hence the marginal savings of early discharge) reported that early discharge hospital at home may make little or no difference to healthcare costs for patients recovering from a hip or knee replacement or hysterectomy. Another trial also reported little or no difference at 12 months follow-up for patients recovering from bypass surgery. Two trials reported cost data from 40 years ago.

4.9.3 Hospital at home to provide end-of-life care

The HRB identified one strong-quality review⁴⁶ that examined the effect of hospital at home to provide end-of-life home-based care on unplanned admissions to hospital. Shepperd *et al.* (2016a)⁴⁶ reported that the comparison intervention differed in the four trials and was one of the following: home care (though not specialised end-of-life care), acute inpatient care, primary care services, and inpatient hospice care. The review authors identified four trials conducted in three countries (Norway, the UK, and the USA) to avoid unplanned hospital admission among adults who required end-of-life care.

Shepperd *et al.*⁴⁶ reported that the individual relative risks ranged from 0.62 to 2.61. Two trials reported no association or effect on unplanned hospital admissions between home-based end-of-life care and the control group, while the third reported a negative association and the fourth a positive association (four trials; $n=823$; moderate-quality evidence; overall mixed findings). Two trials reported data for healthcare costs and two reported on number of inpatient days. Home-based end-of-life care may slightly reduce healthcare cost (two trials; low-quality evidence; negative association). None of the studies reported costs incurred by the participants or the caregivers. One of the studies cited, the Veterans Administration study, reported data on the use of healthcare services. Those receiving end-of-life home-based care made fewer visits to outpatient clinics (mean difference -1.86 [95% CI -3.2 to -0.53], $P=0.01$), and the use of Veterans Administration hospital beds was lower for participants allocated to end-of-life home-based care compared with those allocated to hospital care (mean difference -5.9 days [95% CI 0.78 to 11.00]). A study from Norway reported a small non-significant reduction in the number of inpatient days for participants receiving end-of-life home-based care (mean difference -4.30 [95% CI -13.88 to 5.28]). This section is based on one review, so there is no overlap.

4.9.4 HRB conclusion – Hospital at home

Hospital at home can be used to avoid hospital admission for older people and people with stroke or chronic obstructive pulmonary disease, or to permit early discharge for elective surgery cases, older people, and people following a stroke. There is some low-level evidence in the reviews that hospital at home may reduce institutionalisation, but this is not an outcome that the HRB examined systematically. The HRB notes that three recent reviews of RCTs of hospital at home indicate that these interventions may be as safe as care in an acute hospital, use fewer hospital bed days (though the data were heterogeneous in one of the two meta-analyses), and may be provided at equal or lower costs (though the comparability of the costings is questioned by the authors of the respective reviews). However, total length of stay, including days in the home, is longer than total conventional length of stay in hospital and this requires investigation. Hospital at home can also be used to provide end-of-life care, but in this case, using data from four trials, the findings for this intervention preventing hospital readmissions is mixed and the authors classify the certainty of the evidence as moderate. However, there is low certainty of evidence from two trials that hospital at home for terminally ill people may lower costs by using fewer hospital bed days. The authors in three reviews recommend that hospital at home may be useful to relieve pressure on acute hospital beds, but that it is not a replacement for acute hospitals. The reviews' authors also noted that better planned multi-centred trials (including agreement upon clinical, hospital, and cost measures) are required. The role of advanced portable medical devices and communication technologies in admission avoidance among those using hospital at home could also be investigated in future studies.

Table 9: Summary of effectiveness for each outcome for hospital at home by review

Intervention by study	Target population	Hospital admissions	Hospital readmissions	Length of stay in hospital	Emergency department visits	Cost
Gonçalves-Bradley <i>et al.</i> 2017 ²⁶	Stroke	Not measured	No association* (n=346)	Negative association (n=528)	Not measured	Mixed findings (n=664)
Gonçalves-Bradley <i>et al.</i> 2017 ²⁶	Older people with medical condition(s)	Not measured	No association* (n=1,267)	Negative association (n=613)	Not measured	Negative association not reported
Gonçalves-Bradley <i>et al.</i> 2017 ²⁶	Elective surgery patients	Not measured	No association (n=1,229)	Negative association* (n=411)	Not measured	No association Sample size not reported
Shepperd <i>et al.</i> 2016b ⁴⁷	Acute medical conditions or exacerbation of chronic conditions	Not measured	No association* (n=834)	Measure total home and hospital (n=714) Measure not comparable	Not measured	Negative association (n=287)
Shepperd <i>et al.</i> 2016a ⁴⁶	End-of-life care	Mixed findings (n=823)	Not measured	No association (n=168)	Not measured	Negative association (n=113)

*Meta-analysis

4.10 Non-traditional emergency department interventions to reduce emergency department use

The HRB identified three strong-quality reviews^{32,40 52} that examined the effect of seven non-traditional emergency department interventions on emergency department use and costs. As each of the seven interventions was only identified in a single review, there is no overlap.

4.10.1 Primary care professionals in hospital emergency departments to provide care for patients with non-urgent health problems

Khangura *et al.* (2012)³² assessed the effects of locating primary care professionals in hospital emergency departments to provide care for patients with non-urgent health problems, compared to care provided by regular emergency physicians. The review was rated as strong quality and included three trials from Ireland and the UK. The authors measured admissions to hospital, reattendances at emergency department, and costs. Khangura *et al.*³² found that general practitioners admitted significantly fewer non-urgent patients to hospital than emergency practitioners in two studies (relative risk 0.33 [95% CI 0.19 to 0.58]; relative risk 0.45 [95% CI 0.36 to 0.56]). In the third study, the proportion of admissions made by each type of physician was not statistically significantly different (relative risk 1.11 [95% CI 0.70 to 1.76]). One primary study found no statistically significant difference in emergency department reattendance rates by patients seen by general practitioners versus emergency physicians, with 17% of patients seen by a general practitioner (95% CI 15.7% to 18.8%) and 18% of patients seen by an emergency department physician (95% CI 16.3% to 19.5%) reattending the emergency department for the same problem within 30 days of index visit. With respect to costs, one study in the UK reported that employing general practitioners to attend to primary care patients in the emergency department between 10am and 9pm saved a total of GB£60,876 in 1991 costs when admission costs were excluded and GB£150,000 when the cost of admissions was included. One study in Ireland provided a limited cost comparison for process variables used by general practitioners versus regular emergency physicians and estimated a total savings of IRL£95,125 by employing general practitioners. It is unclear whether this study included the cost of admissions. Overall, the cost of treatment by general practitioners is lower than that by emergency physicians, but this is based on tenuous calculations.

4.10.2 Non-emergency department interventions to reduce emergency department use

Morgan *et al.*⁴⁰ examined the effectiveness and costs of five categories of interventions to reduce emergency department use in 39 studies (5 trials and 34 observational studies) from four countries (with 75% of the studies completed in the USA). The five categories of interventions were:

1. Patient education on medical conditions and appropriate medical care use for low-acuity conditions (5 studies)
2. Creation of additional capacity in non-emergency department settings (expanded hours or same-day access) (10 studies)
3. Managed care (primary care physician capitation or gatekeeping) (12 studies)
4. Prehospital diversion (2 studies), and
5. Patient financial incentives (co-payments or deductibles) (10 studies).

The comparison intervention in all studies was standard care for emergency department visits.

4.10.2.1 Patient education on medical conditions and healthcare use

Three out of five studies found significant reductions in the use of the emergency department after interventions while the other two had non-significant reductions (mixed findings). Reductions for the five studies ranged from 21% to 80% of emergency department use for time frames of between 6 and 12 months.

4.10.2.2 Capacity increase in non-emergency department settings

Of 10 studies, three examined interventions that expanded capacity through new community clinics, while the remainder involved existing physician practices expanding appointments and/or hours of care. Four studies found significant decreases in the use of the emergency department after increases in non-emergency department capacity and five found non-significant reductions. The reductions in emergency department use ranged from 9% to 54% for nine studies for time frames of between 3 and 12 months. The 10th study reported a 21% increase in emergency department use. Three of the 10 studies examining the effect of capacity increase in non-emergency department settings reported cost data showing 10% to 20% savings with the intervention.

4.10.2.3 Managed care

Of the 12 studies examining the effects of managed care on emergency department use, six had interventions with capitated payment of primary care physician, five had a requirement of primary care physician approval or gatekeeping, and one was a hybrid of these two interventions. Overall, nine studies found significant decreases in the use of the emergency department after managed care interventions, with reductions ranging from 1% to 46% between a one- and three-year time frame, whereas two did not find significant reductions in the intervention group. Two studies reported cost data, with both showing decreases in costs with the use of capitation in the intervention group.

4.10.2.4 Prehospital diversion of low-acuity patients

Both studies examining the effects of emergency medical services diversion of low-acuity patients away from the emergency department found significant decreases in emergency department use after the interventions, with reductions ranging from 3% to 7% over a six-month time frame.

4.10.2.5 Patient financial incentives

Of the 10 studies using costs to influence patients to use certain sites for care or to use care efficiently, nine studies found significant decreases in the use of the emergency department after implementation of the intervention, with reductions ranging from 3% to 50% over a two- to four-year time frame. The remaining study found a significant relative increase of 34% in emergency department visits.

4.10.3 Disease-specific emergency department educational interventions

The HRB identified another strong-quality review that examined the effect of emergency department educational interventions.⁵² The review was specific to asthma and encouraged primary care practitioner and patient contact. The outcome measured was admissions to hospital. This review included five trials from Canada and the USA.

Villa-Roel *et al.*⁵² investigated emergency department educational interventions to increase follow-up with a primary care practitioner for adults who were discharged from the emergency department after being treated for acute asthma. Three trials reported the percentage of admissions assessed at 2, 3, and 12 months, respectively. Villa-Roel *et al.*⁵² found that educational interventions targeting either patients or primary care practitioners did not reduce hospital admissions when compared to usual care (relative risk 0.51 [95% CI 0.24 to 1.06], $I^2=0\%$).

4.10.4 HRB conclusion – Non-traditional emergency department interventions

The HRB found that seven different interventions in three systematic reviews were used to reduce emergency department use. However, Morgan *et al.*'s review included 39 studies, 34 of which were observational; such studies are more likely to report effective findings, so the conclusions from this review about managed care, prehospital diversion, and patient financial incentives should be interpreted with caution. The Kangura *et al.* review is based on three non-randomised controlled trials.

Three interventions (managed care, prehospital diversion, and patient financial incentives) reduced emergency department visits, but the evidence is taken from a mix of controlled trials and

observational studies with author-acknowledged heterogeneity, and therefore the level of certainty for this evidence is low. General practitioners providing out-of-hours care located in or beside emergency departments reduced hospital admissions, but this finding is based on three non-randomised controlled trials with heterogeneity across the trials, indicating that this evidence has a very low level of certainty. Three interventions (out-of-hours general practitioners, managed care, and creation of additional capacity in non-emergency department settings) may reduce costs to the health service, but once again, the certainty of the evidence is very low because of the study design used and the differences between studies.

Table 10: Summary of effectiveness for each outcome for non-traditional emergency department interventions by review

Intervention by study	Target population	Hospital admission	Emergency department visits	Cost
<i>Khangura et al. 2012</i> ³²	Primary care professionals providing care in or beside emergency departments	Negative association (n=9,325)	No association (n=4,684)	Negative association (n=9,325)
<i>Morgan et al. 2013</i> ⁴⁰	Patient education on medical conditions and appropriate medical care use for low-acuity conditions	Not measured	Mixed findings (n=3,703) Sample size specified for 4 out of 5 studies	Not measured
	Creation of additional capacity in non-emergency department settings	Not measured	Mixed findings Sample size not possible to calculate, but large geography-based studies	Negative association
	Managed care	Not measured	Negative association (n=3,123,169) for 7 out of 12 studies. No sample size specified for 5 studies	Not measured
	Prehospital diversion	Not measured	Negative association (n=4,467)	Negative association
	Patient financial incentives	Not measured	Negative association (n=223,680) in 6 of 10 studies. No sample size specified for 3 studies	Not measured
<i>Villa-Roel et al. 2016</i> ⁵²	Asthma	No association* (n=826)	Not measured	Not measured

*Meta-analysis

4.11 Case management

4.11.1 Case management for chronic disease patients

Case management, according to Damery *et al.*,⁸ is based on implementation of a collaborative process between one or more care coordinators or case managers and the patient to assess, plan, and facilitate service delivery for patients with chronic diseases, particularly when transitions across healthcare settings are required.

Damery *et al.*⁸ identified eight moderate- or strong-quality reviews that examined the effectiveness of case management for chronic diseases on hospital system outcomes and/or costs. Hospital system outcomes measured were admissions to hospital, readmissions to hospital, length of stay in hospital, and emergency department visits. The control intervention could be usual care, no intervention, or comparison to one or more other interventions. One of the eight reviews showed that case management was associated with significantly reduced healthcare costs when compared to the control group, and another review demonstrated a halving of the number of admissions to hospital for patients with heart failure who were case-managed compared to the number of admissions receiving care in the control group. However, Damery *et al.*⁸ reported that six of the eight case management reviews showed no association between case management for chronic disease and the hospital and cost outcomes assessed (Appendix E).

Damery *et al.*⁸ concluded that case management for chronic disease was the least effective intervention examined in their review.

4.11.2 Case management for older people

Huntley *et al.*³¹ reported that case management is a collaborative practice involving coordination of care by a range of health professionals, both within the community and at the interface of primary and secondary care. The HRB's review inclusion criteria meant that the HRB concentrated on the latter group. The Case Management Society of America's definition was used by Huntley *et al.*,³¹ and it defines case management as "a collaborative process of assessment, planning, facilitation, care coordination, 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" (p267). The main management elements of the definition used by Huntley *et al.*³¹ are similar to those in Damery *et al.*'s⁸ definition. However, Huntley *et al.*³¹ reported an advocacy role where the case manager represents the patient's and carer's needs, whereas Damery *et al.*⁸ concentrated on using case management as a tool for integrating care.

The HRB identified one strong-quality review³¹ that examined the effectiveness of case management for older people requiring care between the hospital and primary care or community health services on hospital system and costs outcomes. Hospital system outcomes measured were readmissions to hospital, length of stay in hospital, and emergency department visits. The control intervention was usual care. Huntley *et al.*³¹ identified 11 trials where case management was used to care for older people; these were completed in Australia, North America, and Europe. However, only six were trials of hospital-initiated case management which was continued in the community, and Huntley *et al.*³¹ reported that only three of the six trials could be combined in a random-model meta-analysis. Individually, one of the three studies showed a reduction in hospital readmissions, and the other two showed no effect on readmissions. When combined in meta-analysis by Huntley *et al.*,³¹ the overall result was that there was no difference in the rate of readmissions between the case management and usual care groups (relative risk 0.81 [95% CI 0.65 to 1.02], P=0.08, I²=not available) (Table 11). The remaining three hospital-initiated trials that were not appropriate for inclusion in the meta-analysis showed no reduction or increase in hospital readmissions. Two trials reported reduced length of stay in hospital for the case management group, one at 12 months (-9.2 days) and one at six months (-3.2 days). In one other study, there was a 36% reduction in visits to the emergency department. Four of the six trials presented partial cost-outcome descriptions. Two showed significant reductions in costs for the case management group compared to the usual care group, while the other two reported lower costs but did not test the differences. In the trials that reported significant cost reductions, the

savings were due to a reduction in length of stay in hospital. This section is based on one review and so there is no overlap.

Table 11: Summary of effectiveness for each outcome for case management for older people by review

Intervention by study	Target population	Hospital admissions	Hospital readmissions	Length of stay in hospital	Emergency department visits	Cost
Huntley <i>et al.</i> 2013 ³¹	Older people	Not measured	No association* (n=1,129)	Negative association (n=1,041)	Negative association (n=199)	Not measured

*Meta-analysis

4.11.3 HRB conclusion – Case management

Damery *et al.* concluded that case management for chronic disease was the least effective integration intervention in their systematic review and that there are more effective integrated interventions for chronic diseases.

The HRB notes that case management for older people being discharged from hospital may reduce length of stay in hospital (based on narrative findings from three RCTs) in one strong-quality systematic review and also reduce the frequency of emergency department visits (based on one trial), but is very unlikely to reduce readmissions to hospital (based on meta-analysis of three trials). The finding on costs of case management for older people, based on narrative analysis of two trials, is that it may save money. Huntley *et al.* note that the included studies are heterogeneous and trials with negative findings may not be published. There is a low level of certainty in the findings of this case management review.

Damery *et al.* concluded that case management for chronic disease was the least effective integration intervention in their systematic review and that there are more effective integrated interventions for chronic diseases.

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4.12 Specialised multidisciplinary rehabilitation for hip fracture

The HRB identified two strong-quality reviews^{19,28} that examined the effectiveness and cost effectiveness of specialised multidisciplinary rehabilitation for hip fracture. Handoll *et al.*²⁸ and Chu *et al.*¹⁹ completed systematic reviews examining intensive rehabilitative exercise interventions led by an interdisciplinary team comprising a geriatrician, physiotherapist, and nurse. The intensive rehabilitative exercises in both reviews began during inpatient care and were continued in the home or at an outpatient clinic. The control intervention was usual care. The outcomes measured were hospital readmissions, length of hospital and rehabilitation stay, and costs.

4.12.1 Specialised multidisciplinary rehabilitation for hip fracture for older adults

Handoll *et al.*'s²⁸ review aimed to examine the effectiveness and cost effectiveness of specialised multidisciplinary rehabilitation supervised by a geriatrician or rehabilitation physician/clinician compared with usual care for older people with hip fracture. The intention of the review was to include older people without cognitive impairment; however, half of the participants included in the majority of the trials suitable for inclusion had cognitive impairment. The 13 trials were completed in seven countries: Australia, Canada, Finland, Sweden, Spain, Taiwan, and the UK. Services were provided in two settings (inpatient and hospital at home) and, due to problems with interpretation of the findings, the authors presented the findings for these settings separately.

4.12.1.1 Inpatient setting

Hospital readmissions, reported in six trials, did not significantly differ between intervention and control groups (relative risk 0.99 [95% CI 0.82 to 1.19], no association). However, there was some heterogeneity between the trial results ($I^2=28%$).²⁸

The reported lengths of stay (all studies considered total length of stay), which included initial treatment in the orthopaedic unit and subsequent stay in the rehabilitation setting, varied considerably.²⁸ The mean lengths of stay were shorter in the intervention groups of seven trials and were longer in three trials. For the remaining three trials, standard deviations were not available for one trial (mean length of stay: 56 days; control: 44 days; no difference reported), and data were presented as medians for the remaining two trials (median 34 versus 42 days, reported $P=0.05$, no difference reported; and median 16 versus 18 days, reported $P=0.06$, no difference reported). Where data were presented showing the distribution of lengths of stay, it was clear that they were not normally distributed. These data were not pooled given the considerable heterogeneity. Overall, the majority of studies reported a reduced length of stay for the intervention group (negative association).

Four trials reported the results from a cost analysis.²⁸ One Australian trial found that costs (defined as cost per recovered patient) were significantly reduced in the intervention group (AU\$10,600 versus AU\$12,800). Costs assessed were direct costs due to treatment and aftercare up to four months after the fracture. One UK trial concluded that the cost of care per patient (GB£2,714 versus GB£2,618 at 1985 prices) was slightly greater in the intervention group due to costs generated by travel to the unit. A Swedish trial also reported increased costs for the intervention group (SEK84,537 versus SEK94,026 at 1989 prices). Though the total direct cost per patient during the first year in the intervention group was estimated at €2,000 more (1999 prices; €17,900 versus €15,900), the Finnish study reported that the costs did not differ remarkably and furthermore suggested that the costs in the control group were underestimated. Overall, it would appear that costs were marginally higher in the intervention group.

4.12.1.2 Ambulatory setting

One trial, published in 2003, compared accelerated discharge within 48 hours and home-based interdisciplinary rehabilitation with usual care, consisting of routine interdisciplinary hospital care and rehabilitation in hospital among patients recovering from hip fracture surgery.²⁸ Participants in the home-based rehabilitation group had a shorter stay in hospital (mean difference –6.5 days [95% CI –11.3 to –1.7 days], negative association) but a longer period of rehabilitation (mean difference 14 days [95% CI 7.8 to 20.2 days], positive association). Therapists visited participants in the home-based group an average of 13.6 times. There was no difference in the number of participants who were readmitted to hospital within four months in the hospital at home group compared to the care in an inpatient facility group (relative risk 1.08 [95% CI 0.44 to 2.62], no association).

4.12.2 Specialised multidisciplinary rehabilitation for hip fracture for cognitively impaired older adults

Chu *et al.*¹⁹ examined the effectiveness of intensive rehabilitative exercise interventions between the hospital and primary care or community health services on hospital system outcomes. Hospital system outcomes measured were readmissions to hospital and length of stay in hospital. The target population was cognitively impaired older adults. Chu *et al.*¹⁹ identified three trials testing the effect of intensive rehabilitative exercises in hospital and continued in the home. The trials were completed in Australia, Finland, and Taiwan. All trials included inpatient and outpatient physiotherapy, with some trials including a cognitive component, family education, and a discharge assessment. Chu *et al.*¹⁹ reported that the physiotherapy component of the trials was not clearly defined, making it difficult to repeat the trial methods. Two trials reported no difference between the intervention and control groups for readmission to hospital at 16 weeks. One trial reported that those in the intervention group were more likely to be readmitted to hospital within a two-year timeframe. The third trial did not measure this outcome. One trial reported that the length of stay for those in the intervention group with mild or moderate dementia was significantly shorter (estimate in days not provided) than for the control group.

It is important to note that two primary studies were included in both reviews and when the overlap was calculated employing Pieper *et al.*'s¹⁶ methodology it was 14.3, which indicates that there is high overlap between the primary studies included in the two reviews. This is because the Handoll *et al.*'s²⁸ paper (index paper) included two of the three papers in Chu *et al.*'s¹⁹ review.

4.12.3 HRB conclusion – Specialised multidisciplinary rehabilitation for hip fracture

The HRB concludes, based on RCTs included in two strong-quality systematic reviews, that intensive rehabilitative exercises for older people with surgical intervention following hip fracture may shorten length of stay in hospital (narrative analysis of 8 out of 11 trials with heterogeneity) but is unlikely to reduce readmissions to hospital (a single meta-analysis of six trials with low heterogeneity between studies). One trial used an early discharge hospital at home approach and reported that hospital at home and acute hospital care had similar outcomes for older people who had surgery for a hip fracture. Only one of the two reviews examined costs, and it reported that specialised multidisciplinary rehabilitation may be marginally more expensive than usual care. However, specialised multidisciplinary rehabilitation is suitable for cognitively impaired older people. It is clear there is a lack of high-quality multi-centre trials investigating what interventions work to improve independence and reduce hospital use among this group. The HRB concludes that there may be an opportunity to relieve hospital pressure through early discharge and intensive rehabilitation for this group, but high-quality, well-organised trials are required.

Table 12: Summary of effectiveness for each outcome for specialised multidisciplinary rehabilitation for hip fracture for older people by review

Intervention by study	Target population	Hospital admissions	Hospital readmissions	Length of stay in hospital	Emergency department visits	Cost
Chu <i>et al.</i> 2016 ¹⁹	Mild or moderate cognitive impairment and hip fracture surgery	Not measured	No association (n=320)	Negative association (n=243)	Not measured (n=160)	Not measured
Handoll <i>et al.</i> 2009 ²⁸	Older people with hip fracture treated predominately in hospital	Not measured	No association* (n=1,269)	Negative association (n=1,663)	Not measured	Positive association (n=998)
	Older people with hip fracture treated predominately at home (early discharge hospital at home)	Not measured	No association (n=66)	Negative association (n=66)	Not measured	Not measured

*Meta-analysis

4.13 Interactive telemedicine

The HRB identified one strong-quality systematic review by Flodgren *et al.* (2015)²⁴ which assessed the effectiveness, acceptability, and costs of telemedicine as an alternative to, or in addition to, usual care (i.e. face-to-face care or telephone consultation). They authors included 93 RCTs comprising 22,047 participants that were published between 1992 and 2013. The 93 trials recruited patients with the following clinical conditions: cardiovascular disease (36 trials), diabetes (21 trials), respiratory conditions (9 trials), mental health or substance abuse conditions (7 trials), conditions requiring a specialist consultation (6 trials), co-morbidities (3 trials), urogenital conditions (3 trials), neurological injuries and conditions (2 trials), gastrointestinal conditions (2 trials), neonatal conditions requiring specialist care (2 trials), solid organ transplantation (1 trial), and cancer (1 trial). Fifty-two studies were based in North America, 35 studies in Europe, 1 in Hong-Kong, 2 in South Korea, 1 study in Israel, and one in China.

The HRB acknowledges that some of the conditions included by Flodgren *et al.*²⁴ are regarded as chronic diseases and that Damery *et al.*⁸ have recently reviewed the evidence on interventions for chronic diseases, an exercise the HRB is not seeking to replicate here. However, the HRB decided to include the Flodgren *et al.*²⁴ review in this review as Damery *et al.*⁸ did not review the evidence on telemedicine, and this review by Flodgren *et al.*²⁴ examines the evidence from trials that recruited a mix of patient populations with general medical and surgical conditions, not just patients with chronic diseases.

4.13.1 Definition of interactive telemedicine and its comparator

Telemedicine is the use of telecommunication systems to deliver healthcare at a distance.

Telemedicine providing remote monitoring was evaluated in 55 trials and via real-time video conferencing in 38 trials.²⁴ The use of telemedicine as an intervention resided in one of the following six categories, with some overlap:

1. monitoring of a chronic condition to detect early signs of deterioration so as to provide prompt treatment and advice (41 trials);
2. provision of treatment or rehabilitation, for example the delivery of cognitive behavioural therapy or incontinence training (12 trials);
3. education and advice for self-management, for example nurses delivering education to patients with diabetes or providing support to parents of very low-birth-weight infants or to patients on parenteral nutrition at home (23 trials);
4. specialist medical consultations for diagnosis and treatment decisions (8 trials);
5. real-time assessment of clinical status, for example post-operative assessment after minor operation or follow-up after solid organ transplantation (8 trials); and vi) screening for angina (1 trial).

Usual care was either face-to-face care or telephone consultation.²⁴ Telemedicine was delivered in addition to (32% of primary studies), as an alternative to (57% of primary studies), or partly substituted for (11% of primary studies) usual care as compared to usual care alone.

4.13.2 Interactive telemedicine and hospital system outcomes

4.13.2.1 Does interactive telemedicine reduce admissions to hospital?

Flodgren *et al.*²⁴ combined data on all-cause hospital admission from 11 RCTs which recruited 4,529 patients diagnosed with heart failure and evaluated interactive telemedicine when implemented in the patient's home in all 11 trials. In six trials, patients were recruited from the hospital, in four trials from a clinic and in one trial from their home. Overall, Flodgren *et al.*²⁴ report that admissions to hospital for patients whose healthcare was associated with the telemedicine intervention compared to patients who received usual care showed mixed findings ranging from a decrease of 64% in

admissions to an increase of 60% at a median 8 months follow-up (range 3 to 26 months). Relative risks ranged from 0.36 to 1.60 (moderate certainty of evidence). The authors did not retain the meta-analysis due to a high level of statistical heterogeneity ($I^2=67\%$, $P=0.0008$).

4.13.2.2 Does interactive telemedicine reduce readmissions to hospital?

Flodgren *et al.*²⁴ report that 16 trials that recruited patients diagnosed with heart failure and/or cardiovascular-related illness report mixed findings on hospital readmission; 3 of the trials reported a reduction in readmission among patients receiving the telemedicine intervention compared to patients receiving usual care. The remaining 13 trials reported no difference in readmission rates between patients exposed to the telemedicine intervention and patients receiving usual care, suggesting the findings on hospital readmissions for patients diagnosed with heart failure and/or cardiovascular-related illness are mixed.

In patients recovering from a cardiac event, cardiac surgery, or procedure, one trial reported no difference in readmission rates at 12 months follow-up between patients exposed to telemedicine and those exposed to usual care. A second trial reported a slightly lower re-hospitalisation rate during the first month after discharge for patients assigned to telemedicine compared to those assigned to usual care, but this was not a statistically significant reduction.²⁴ Overall, there was no difference in readmission rates for patients recovering from a cardiac event, cardiac surgery or procedure in the interactive telemedicine group compared to the usual care group.

4.13.2.3 Does interactive telemedicine reduce the length of stay in hospital?

Flodgren *et al.*²⁴ combined data on length of hospital stay related to any condition (not just heart failure) from five studies and found no difference in hospital length of stay between patients assigned to telemedicine and those receiving usual care (mean difference -0.12 [95% CI -0.79 to 0.55], $P=0.73$, $I^2=24\%$; $n=2,688$, no association) at a median of six months follow-up (range 30 days to median 26 months).

The authors²⁴ also combined data on heart failure-related length of hospital stay from five studies and found no difference between intervention and control groups (mean difference -0.16 [95% CI -0.85 to 0.53], $P=0.64$, $I^2=15\%$; $n=2,920$). The authors also reported that findings were mixed for the remaining 10 studies but they provide no data to support this claim.

In patients recovering from implantation or replacement of a dual chamber pacemaker or an implantable cardioverter defibrillator, two trials reported shorter length of hospital stay in the telemedicine group as compared with the control group, suggesting a negative association in favour of the intervention.²⁴

In patients with urological conditions, two studies reported no difference in the effects of real-time video conferencing as compared to face-to-face consultation on patient length of hospital stay.²⁴

4.13.2.4 Does interactive telemedicine reduce emergency department visits?

Flodgren *et al.*²⁴ combined data on emergency department and urgent care visits from three trials with patients diagnosed with heart failure. There was no difference between patients receiving the intervention and those receiving usual care in the number of participants with at least one visit to the emergency department and urgent care (relative risk 0.93 [95% CI 0.74 to 1.17], $P=0.54$; $n=689$) at a median 4 months follow-up (range 30 days to 6 months). The authors report it was not feasible to combine data from 10 studies on emergency department and urgent care visits due to differences in reporting this outcome; a summary of these studies showed findings were mixed.

In patients recovering from implantation or replacement of a dual chamber pacemaker or an implantable cardioverter defibrillator, two trials reported no difference between telemedicine and usual care in emergency department visits or unscheduled visits at 12 and 15 months follow-up.²⁴

4.13.2.5 Does interactive telemedicine reduce healthcare costs?

Two trials that recruited patients diagnosed with heart failure and evaluated remote monitoring with automated alerts or risk stratification reported lower hospital readmission costs at 3 and 6 months for patients exposed to telemedicine compared with patients receiving usual care; however, this study reported hospital readmission costs to be the same for both groups at 12 months, leading to an overall conclusion of mixed findings at 12 months.²⁴ One trial evaluating telemedicine with video conferencing reported lower hospital readmission costs for telemedicine as compared with usual care, but the follow-up period is not reported. Three trials reported no difference in total health service costs between patients receiving telemedicine compared to patients receiving usual care. Overall, the results on costs of monitoring heart failure patients using remote monitoring compared to usual care were mixed.

In patients with heart failure recovering from implantation or replacement of a dual chamber pacemaker or an implantable cardioverter defibrillator, one trial reported higher mean total healthcare costs per telemedicine patient compared with usual care, and two trials reported lower costs for patients assigned to telemedicine.²⁴ Overall, the results on costs of surgical follow-up for patients using remote monitoring compared to usual care were mixed.

In patients diagnosed with hypertension, one trial reported no difference between patients assigned to the telemedicine group compared to patients assigned to usual care for costs of examinations and overall cost of patient management at six months.²⁴

In patients diagnosed with diabetes,²⁴ one trial reported lower healthcare costs per year for telemedicine patients compared with usual care patients, and one trial reported lower costs for telemedicine patients when care was delivered without technical problems. One trial reported lower costs for telemedicine patients compared with patients using face-to-face clinic visits. A cost analysis in one study reported slightly higher mean annual Medicare payments in the telemedicine group compared with the usual care group. In one trial, costs were increased in the usual care group due to more unscheduled visits. Overall, the results on costs for diabetes patients indicated they were lower for the telemedicine group.

In patients with chronic obstructive pulmonary disease,²⁴ one trial reported no difference in total healthcare costs between patients exposed to telemedicine and those who received usual care.

In patients with co-morbidities receiving home care, one trial reported a lower cost per visit in the patients receiving the video conferencing and monitoring intervention compared to patients receiving usual care. A second trial compared costs six months before the intervention and costs during the six-month intervention and reported a greater decrease in the average healthcare costs per participant in the telemedicine group. Overall, the results on costs for co-morbidities were lower for the telemedicine group.

In patients visiting the emergency department with acute injuries and conditions,²⁴ one trial reported higher overall costs to the NHS at six months for the joint teleconsultations group compared to face-to-face outpatients' consultations. Flodgren *et al.*²⁴ reported that the index consultation accounted for this excess cost. However, the cost savings by patients were greater in the joint teleconsultation group compared to the face-to-face outpatients group.

4.13.3 HRB conclusion – Interactive telemedicine

There is one high-quality systematic review examining the effectiveness of interactive telemedicine. The HRB concludes that telemedicine interventions do not increase or reduce hospital admissions for cardiovascular disease (narrative analysis of 11 RCTs with high heterogeneity), readmissions for heart failure (18 trials), length of stay in hospital (10 studies with low heterogeneity), or emergency department visits, so as an intervention it may be as safe as face-to-face monitoring and consultation

for the specific conditions tested. However, the narrative findings on costs are mixed and depend on the type of technological intervention used and the disease monitored.

Table 13: Summary of effectiveness for each outcome for interactive telemedicine by review

Intervention by study	Target population	Hospital admissions	Hospital readmissions	Length of stay in hospital	Emergency department visits	Cost
Flodgren <i>et al.</i> 2015 ²⁴	Cardiovascular disease	Not measured	Mixed findings (n=3,048)	No association *	No association*	Mixed findings (n= 1,145)
	Heart failure	Mixed findings (n=4,529)	Not measured	No association * (n=2,920)	No association (n=689)	Not measured
	Cardiac event, cardiac surgery, or procedure	Not measured	No association (n=1,700)	No association (n=1,500)	Not measured	Mixed findings (n=2,527)
	Implantation or replacement of a dual chamber pacemaker or an implantable cardioverter defibrillator	No association	Not measured	Not measured	Not measured	No association
	Hypertension	Not measured	Not measured	Not measured	Not measured	No association (n=329)
	Diabetes	Not measured	Not measured	Not measured	Not measured	Negative association (n=1,506)
	Chronic obstructive pulmonary disease	Not measured	Not measured	Not measured	Not measured	No association (n=40)
	Co-morbidities receiving home care	Not measured	Not measured	Not measured	Not measured	Negative association (n=104)
	Non-acute injuries and conditions	Not measured	Not measured	Not measured	Not measured	Positive association (n=2,094)
	Urological conditions	Not measured	Not measured	Not measured	No association (n=326)	Not measured

*Meta-analysis

5 Conclusion

5.1 Summary of the HRB's main findings

Damery *et al.*⁸ and the HRB identified a number of integrated interventions that were tested to determine if they reduced pressure on acute hospital services (emergency and inpatient services). The measures of reduced pressure were reduced number of unplanned hospital admissions or readmissions, reduced length of stay in hospital, reduced emergency department visits, and reduced or equal costs.

The interventions identified were discharge management or quality improvement, medication management, the chronic care model, chronic disease management, complex interventions, multidisciplinary teams, self-management, hospital at home, alternatives or additions to emergency department services, case management, specialised multidisciplinary rehabilitation for hip fracture, and interactive telemedicine. It is important to note that only health system outcomes in studies testing these interventions were examined in this umbrella review, and not clinical outcomes.

Some interventions demonstrated promising results in relieving pressure on hospitals. Discharge management for patients with chronic diseases and patients admitted to hospital with general medical and surgical needs was the most promising of the interventions for these populations. For example, Damery *et al.*⁸ reported an overall reduction in hospital readmissions and hospital length of stay for patients diagnosed with chronic disease conditions. A subsequent systematic review by Le Berre *et al.*³³ also reports an overall reduction in readmission to hospital and length of stay in hospital for chronic disease patients; however, Le Berre *et al.*³³ found substantial heterogeneity for the hospital readmissions outcome. In addition, the HRB's analysis of the data from four high-quality meta-analyses suggests that there is promising evidence that discharge management is effective at reducing readmission to hospital for patients with general medical and surgical conditions. However, the HRB examined data from five high-quality meta analyses and one narrative review and found that discharge management failed to demonstrate effectiveness on hospital outcomes for older patients. In four of the reviews, older patients were defined as 65 years and older; in one review, patients were aged 60 years and older; and another review did not report the specific age of the older patients. The HRB notes that discharge planning for older patients leaving hospital is an area currently receiving some attention in an umbrella review protocol in the UK (O'Connell Francischetto *et al.* [2016]).¹⁰

Other promising interventions were the chronic care model; complex interventions for chronic diseases; multidisciplinary care for single chronic diseases; and hospital at home for a number of target populations. Hospital at home can be used to avoid hospital admission for older people and people with stroke or chronic obstructive pulmonary disease, and also to permit early discharge for elective surgery cases, older people, and people following a stroke. There is some low-level evidence that hospital at home may reduce institutionalisation, but this is not an outcome the HRB examined systematically. Managed care and prehospital diversion in or beside emergency departments may also be useful, but these interventions need a higher level of evidence.

There is a suggestion that some interventions have been shown to be more effective when combined with other effective interventions. For example, self-management when combined with discharge management, or the chronic care model or multidisciplinary care and likewise medication management when combined with the three aforementioned interventions may be more effective. Interactive telemedicine may have potential when combined with the chronic care model, multidisciplinary teams, or hospital at home, but more research is required, as telemedicine is an evolving set of interventions. There are also suggestions from other authors of umbrella reviews that combining interventions may be beneficial in reducing pressure on hospitals. For example, Miani *et al.* (2014)⁵⁷ report that "...individual or discrete interventions such as discharge planning or post-discharge medication review on their own may convey little beneficial effect in relation to length of stay or readmissions...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..." (p. 53). Van

den Heede and Van de Voorde (2016)⁹ conclude that “...reducing emergency department use will require a broad approach that integrates several interventions adopted to the country’s healthcare system and funding system...” (p. 1348). The HRB concurs with the sentiments expressed by Van den Heede and Van de Voode⁹ and Miani *et al.*⁵⁷ that a combination of interventions, combining effective active components and delivered across the patient’s journey from hospital to the community, are more likely to relieve pressure on the acute hospital system.

The HRB bases the combined intervention argument on a recognition that there appears to be an array of ubiquitous interventions already delivered across different healthcare systems, including approaches to discharge management, hospital at home, pharmacist- or nurse-led medication management, self-management, and case management. Most of the work around early or timely discharge from hospital is based mainly on communication and monitoring between providers and patients. Such communication and monitoring involves providing useful information, recording observations, giving reassurance, and ensuring a three-way link between the patient, hospital, and community health service. The HRB also recognises that these interventions work for some people; however, the HRB needs more information on who the interventions work for, under what conditions they work, and why they work for some people some of the time and not all of the time.

More research is required to determine the effect of specialised multidisciplinary rehabilitation for hip fracture in patients with different degrees of cognitive impairment in terms of reduced length of stay in hospital and preventing institutionalisation in the short term. Case management is not useful for chronic diseases but may have some potential for older people being discharged from hospital, as it may improve some but not all hospital system outcomes.

The HRB summarises, in table format (Table 14), the integrated interventions by whether they apply to people with chronic diseases, patients following medical or surgical conditions, or older people, and by which hospital system outcome the intervention improves. Table 14 indicates that there are a number of integrated interventions for people with chronic diseases that reduce systems outcomes with moderate certainty, and there are also a four integrated interventions for the general medical and surgical populations that reduce systems outcomes with moderate certainty. Table 14 indicates there some integrated interventions for older people may work, but the certainty is low, and more work is needed in this area.

Table 14: Summary of evidence on integrated interventions by population

Chronic disease population – Low evidence of reduction in system outcomes, moderate, or good

Chronic disease	Discharge management	Chronic care model	Complex intervention	Multi-disciplinary team	Self-management	Hospital at home (stroke)	Interactive telemedicine (diabetes)
Hospital admission		Moderate	Moderate		Good		No effect
Hospital readmission	Moderate		Moderate				No effect
Length of stay in hospital	Moderate	Moderate	Moderate	Moderate		Moderate	
Emergency department visits		Moderate	Moderate				
Cost							No effect

For patient populations with medical and/or surgical conditions – Low evidence of reduction in system outcomes or moderate

Medical and/or surgical conditions	Discharge management	Medication management	Hospital at home	Primary care professionals in or beside emergency departments	Additional capacity in non-emergency facilities	Managed care	Prehospital diversion	Patient financial incentives
Hospital admission				Moderate				
Hospital readmission	Moderate	No effect	No effect					
Length of stay in hospital	No effect		Moderate					
Emergency department visits		Moderate				Low	Low	Low
Cost				Low	Low			

For the older patient population – Low evidence of reduction in system outcomes

Older people	Hospital at home	Case management	Specialised rehabilitation for hip fracture
Hospital readmission	No effect	No effect	No effect
Length of stay in hospital	Low	Low	Low
Emergency department visits		Low	
Cost	Low		

*Meta-analysis

5.2 Comparing the HRB's work with similar umbrella reviews

During the HRB's work on this umbrella review, the HRB identified six umbrella reviews that speak to some parts of the DOH's question: Ouwens *et al.* (2005),⁵⁸ Mistiaen *et al.* (2007),⁵⁹ Martínez-González *et al.* (2014),⁶⁰ McBain *et al.* (2015),⁶¹ and Van den Heede and Van de Voorde.⁹ Although the focus of these reviews and their reported findings are not directly comparable to the HRB's work, they do share some closely related features with some of the HRB's work, particularly their focus on integrated interventions to relieve pressure on hospitals. The purpose of this section is to highlight some of the conceptual and methodological shortcomings related to the systematic reviews included in these six umbrella reviews, in particular the poor descriptions of integrated interventions and their components reported in the included reviews. The HRB identified similar shortcomings during this umbrella review. The HRB argues that these shortcomings contribute to incomplete conclusions on the effectiveness of integrated interventions and how the interventions work in a healthcare system.

5.2.1 Integrated interventions and their components

Ouwens *et al.*⁵⁸ undertook an analysis of 13 systematic reviews to investigate the effectiveness, definitions, and components of integrated care programmes for chronic disease patients. Ouwens *et al.*⁵⁸ concluded that "...integrated care programmes have widely varying definitions and components. Failure to recognize these differences leads to inappropriate conclusions about the effectiveness of these programmes and to inappropriate application of research results..." (p. 145). The HRB also found that the integrated interventions examined often varied in definition and components. The HRB acknowledges that the variation in definitions across the integrated interventions is perhaps inevitable, given that Ouwens *et al.* identified 12 different interventions. What concerns us most is the variation in the reporting of the components included in the interventions. For example, the number and type of components reported in an intervention varied in the primary studies that were included in the systematic reviews the HRB analysed. These inconsistencies were particularly prominent in the reviews on discharge planning, pharmacist-led medication management, interactive telemedicine, and chronic disease management. As Braet *et al.*¹⁸ note, "...discharge management interventions can comprise of a single action, for instance a telephone call after discharge, or a variety of interventions..." (p. 7).

Furthermore, according to Ouwens *et al.*⁵⁸ "The most common components of integrated care programmes were self-management support and patient education, often combined with structured clinical follow-up and case management; a multidisciplinary patient care team; multidisciplinary clinical pathways and feedback, reminders, and education for professionals..." (p. 141). These components also featured prominently in the integrated interventions examined by the HRB in this umbrella review, which included not only patients with chronic diseases but also patients with acute conditions and older people. This begs the question: Are these components ubiquitous parts of most healthcare systems or should they be, and if so, what is the purpose of undertaking so many experimental studies on healthcare practices that appear to be commonly used across most healthcare systems for different patient groups?

A further implication arises when authors such as Ouwens *et al.*⁵⁸ tend to report the common components of interventions in this way; little attention is paid to identifying the key components that an intervention may require to work effectively. In addition, little attention is given to examining the potential interrelationship between different components for an intervention to work effectively.

In this HRB umbrella review, the HRB identifies discharge management interventions as showing the most promise for reducing hospitalisation for patients with both chronic and acute conditions, as well as surgical conditions. However, the HRB findings are reported with caution, as the reviews analysed contained sufficient heterogeneity to temper confidence in the results. A large part of this heterogeneity relates to the incomplete reporting on the interventions and components within discharge management, a scenario also identified in a 2007 umbrella review. Mistiaen *et al.*⁵⁹ undertook an umbrella review to examine the effectiveness of integrated interventions to reduce post-discharge problems in adults discharged home from an acute general hospital. They included 15

systematic reviews and report that "...The interventions included in a particular review showed considerable heterogeneity in terms of what exactly was done, by whom it was done, the way it was done, the frequency with which it was done, and the duration of the intervention..." (p. 8).

Seeking to build on and update the earlier work of Ouwens *et al.*,⁵⁸ Martínez-González *et al.*⁶⁰ undertook an umbrella review of integrated care programmes for patients with a chronic disease, with a focus on assessing methodological quality, elements of integration assessed, and effects reported. Martínez-González *et al.*⁶⁰ included 27 reviews published from 1997 to 2012. According to Martínez-González *et al.*,⁶⁰ they too found that interventions to manage chronic diseases were poorly described in the reviews they analysed. They report that "...the description of the programmes and interventions was often superficial and incomplete, hampering a detailed assessment of the different components and interventions..." (p. 564).

It would appear thus far that despite numerous evaluations of integrated interventions using both primary experimental studies and meta-analysis to combine the findings from primary studies dating back to at least the year 2000, the HRB and other authors seem to continually encounter an incomplete picture of the interventions and their components that are being evaluated. The continuing longevity of this type of incomplete reporting means that when there is evidence that some integrated programmes work, the HRB has little understanding of what components make them work, how components relate to other components, and what type of intervention is effective for whom and under what conditions. As Martínez-González *et al.*⁶⁰ point out, "...integrated care programmes can improve patient-centred outcomes, process quality and reduce the use of some healthcare resources in patients with chronic diseases.... However, it is unclear which components or interventions should be prioritized in integrated care programmes to maximize their benefit..." (p. 568).

So far, the HRB has drawn on three umbrella reviews of integrated interventions published in 2005,⁵⁸ 2007,⁵⁹ and 2014⁶⁰ to illustrate the longevity of the incomplete reporting of integrated interventions and their components, which the HRB also found in its analysis of 36 systematic reviews in this umbrella review. The HRB also draws on another umbrella review undertaken by McBain *et al.*⁶¹ which suggests that the longevity of incomplete reporting of integrated interventions is continuing, even where a relatively 'new' intervention is being evaluated. The consequence of this inadequate reporting is that authors are unable to draw meaningful conclusions about the intervention or the components that appear to be showing effectiveness. McBain *et al.*⁶¹ undertook an assessment of the impact of self-monitoring interventions on healthcare utilisation across a range of chronic diseases. They included 17 systematic reviews that examined interventions for heart failure, hypertension, and chronic obstructive pulmonary disease. McBain *et al.*⁶¹ report that "Both human-to-human structured telephone support and tele-monitoring interventions accompanied by medical support during office hours were found to be particularly advantageous in reducing hospitalization and readmission rates in the short- and long-term..." (p. 7). However, McBain *et al.*⁶¹ go further and highlight the incomplete reporting of the nature of the intervention being evaluated, which again has implications for transferring the learning from these evaluations into generic healthcare practice. According to McBain *et al.*,⁶¹ "...It is unlikely that self-monitoring was implemented in isolation within these interventions, however, information on the inclusion of other behaviour change techniques was missing. Lack of detail is common in the description of complex interventions, constraining scientific replication and limiting the subsequent introduction of successful interventions." (p. 7). McBain *et al.*'s⁶¹ review has assumed that self-monitoring was an important component of all of the interventions; however, without a detailed description of the other behaviour change techniques used, the authors say "it is not possible to say unequivocally that self-monitoring was the key behavioural component..." (p. 8).

A further example of inadequate reporting on the interventions being evaluated arises from the work of Van den Heede and Van de Voorde,⁹ who undertook an umbrella review to examine the evidence on the effectiveness of interventions to reduce (the rise in) emergency department visits. Van den Heede and Van de Voorde⁹ included 23 reviews which were rated moderate or strong quality using

the AMSTAR quality appraisal instrument for systematic reviews. Van den Heede and Van de Voorde⁹ point out that “...most of the included reviews (especially the more generic reviews) included remarks on the large encountered heterogeneity of included interventions (and lack of clear definitions)...” (p. 1345). It must be noted that the observations by Van den Heede and Van de Voorde⁹ relating to the heterogeneity of interventions was nested within their overall assessment of heterogeneity of other characteristics of the primary studies included in the reviews they examined, e.g. heterogeneity in populations studied and outcomes measured. Nonetheless, their observations do appear to point to an inadequate rendition of the description of the interventions under evaluation and appears to some extent consistent with the reports of other umbrella reviews and of the work of the HRB in this umbrella review.

The HRB’s observations about the poor quality of reporting on interventions in the literature do not arise in a vacuum and the HRB is conscious that reviewers are frequently confronted with inadequate descriptions of interventions that are evaluated in primary studies. For example, Hoffmann *et al.* (2013)⁶² analysed reports of randomised trials of 137 non-pharmacological interventions published in six leading medical journals in 2009. According to Hoffmann *et al.*,⁶² “...more than half (61%) of the interventions assessed in the study were not described in sufficient detail in the published primary report to enable replication of the intervention in practice...”(p. 3).

The HRB acknowledges that one of the main implications arising from the incomplete reporting of interventions and their key components is the difficulty in transferring these interventions into practice, particularly when the interventions are demonstrating effectiveness in reducing hospitalisation among some patient populations. This incomplete reporting limits the confidence with which the HRB can provide evidence-based, policy-relevant assessments to the DOH.

In addition, this incomplete reporting of the interventions, and specifically the failure to identify the key components of interventions, has implications for drawing conclusions about the observed effectiveness of interventions. For example, across many of the 36 systematic reviews the HRB examined in this umbrella review, it was often unclear what specific components working within an intervention were attributed to causing the observed outcomes. When the HRB speaks of key components, it means those programme strategies that are included in an intervention because there is theoretical and empirical evidence that these components will substantively contribute to achieving the desired outcome and their absence is likely to render the intervention less effective.

For example, discharge management is an intervention, i.e. a planned approach to intervening in the patient journey; however, under this intervention many components are tried and tested, e.g. medication reconciliation, post-discharge home visits, and/or phone calls, and some are more important than others within certain contextual conditions. Policy-makers in the health sector charged with reconfiguring scarce resources often need to make decisions quickly and having evidence that some components are more effective at achieving desired outcomes is an important resource to strengthen the evidence–policy interface. The HRB believes that the key components of an intervention are the ‘active ingredient’; they are often the difference between success and failure. In essence, the HRB concurs with the conclusions by Kühne *et al.* (2015),⁶³ who recently undertook a comprehensive review of the literature to examine how authors of evidence syntheses tend to conceptualise key components within multi-component interventions. Kühne *et al.*⁶³ conclude that “...In general, [intervention] components are those active, content-related ingredients of an intervention that have the potential to causally influence outcomes...” (p 821).

The HRB believes it is of paramount importance for the future credibility of the evidence–policy interface that future evaluations of interventions prioritise the identification and evaluation of the active ingredients of interventions as an important step in building a more complete evaluation infrastructure to determine causality in complex healthcare interventions. The HRB acknowledges that other authors have expressed similar sentiments. For example, Kühne *et al.* point out that several authors “...highlighted that components have the potential to causally influence outcomes and are essential for treatment effects. The most often used synonym was ‘active ingredient’. Some

authors defined active ingredients as the components that have the capacity to bring about change; the defining characteristics of interventions..." (p. 820).

Finally, the HRB would argue that the evaluation of what appear to be complex multicomponent interventions perhaps needs a different approach to the one adopted via the experimental trial methods. The HRB would argue that a theory-driven approach based on an evaluation of the key components may be more appropriate to determine what works for whom, within what context, and why these components work. The HRB premises its argument on the following observations that this review team observed in its analysis of the literature on integrated multicomponent interventions to alleviate pressure on acute hospitals.

5.2.2 Methods for investigating complex or multicomponent interventions

The introduction of integrated interventions between hospitals and the community is a complex endeavour that is essentially expected to engender a process of change in patient and/or provider behaviour, sometimes resulting in an observed change in healthcare resource utilisation. However, the effectiveness of interventions that tend to be multicomponent and complex in nature is likely to be sensitive to an array of influences, including the profiles of the provider and the recipient, changing environments, variation in implementation, organisational history, and much more. Moreover, these interventions are likely to be implemented into healthcare systems that contain an array of pre-existing interventions, likely with consequent adaptations to both the new intervention and the existing interventions when they begin to act on each other. Therefore, perhaps it is unrealistic for RCTs and subsequent meta-analyses to account for all these influences. As Berwick⁶⁴ points out, "...the RCT is a powerful, perhaps unequaled, research design to explore the efficacy of conceptually neat components of clinical practice—tests, drugs, and procedures. For other crucially important learning purposes, however, it serves less well..." (p. 1182). In particular, Berwick is critical of the incomplete learning that is often derived from using experimental designs to evaluate complex interventions implemented in healthcare systems. According to Berwick,⁶⁴ "...the assertion either that nothing works or that the results are inconsistent and more research is needed is a typical conclusion from classical [experimental] evaluations of quality-improvement efforts in health care, such as rapid response teams, chronic disease management projects, or improvement collaboratives..." (p. 1183).

To offset this deficit in learning, Berwick⁶⁴ suggests an alternative evaluation model, pioneered by Pawson and Tilley,⁶⁵ called the realist evaluation. The realist approach, cited in Berwick,⁶⁴ seeks to explain why an intervention works, for whom, and under what conditions by elucidating the configuration of context, mechanism, and outcome. For example, according to Pawson and Tilley (1997),⁶⁵ "...programs work (have successful 'outcomes') only insofar as they introduce the appropriate ideas and opportunities ('mechanisms') to groups in the appropriate social and cultural conditions ('contexts')..." (p. 56–7).

Towards the end of work on this umbrella review, the HRB identified one recently published realist review of integrated care programmes targeting older adults with complex needs. This realist review by Kirst *et al.* (2017) included a total of 65 articles, representing 28 integrated care programmes. According to Kirst *et al.*,⁶⁶ "...This is the first realist review to identify key processes that lead to the success or failure of [integrated care programmes] in achieving outcomes, such as reduced healthcare utilisation, improved patient health, and improved patient and caregiver experience..." (p. 613). Kirst *et al.*⁶⁶ undertook this work to identify, test, and refine the theory of why integrated care programmes achieve certain specified outcomes and what contextual conditions constrain or enable the programmes to succeed. In essence, they sought to identify the mechanisms (M), i.e. the reasoning of individuals involved in the programme (for example, providers and/or clients) and the contexts (C), that is the setting in which a programme operates (for example, geographical location, programme infrastructure) that can trigger or modify the behaviour of a mechanism.

Kirst *et al.*⁶⁶ identified two context-mechanism-outcome configurations: (i) trusting multidisciplinary team relationships, and (ii) provider commitment to and understanding of the programme model. In the first context-mechanism-outcome Kirst *et al.*⁶⁶ reported on, the development of a trusting

relationship within and between the multidisciplinary team delivering the integrated care programmes was the key mechanism that led to reductions in healthcare utilisation and/or improved patient health and this mechanism was triggered when strong leadership was present within the context of service delivery.

According to Kirst *et al.*,⁶⁶ “...in programs that were successful, cross-sector multidisciplinary teams, that span different organizations, trusted each other, were clear in their roles, and could rely on each other to perform their respective roles. These teams collaborated closely and communicated effectively, shared knowledge about their work and patient information more effectively, which allowed for continuity of care and better coordination of care. These factors were related to better management of patient conditions resulting in reductions in healthcare utilization and/or improved patient health...and, in some cases, patient and/or caregiver experience.... strong leadership to guide teams in their work was a contextual factor that helped to build trust and support team collaboration...” (p. 615).

In the second context-mechanism-outcome Kirst *et al.*⁶⁶ report on, the key mechanism was the commitment to and belief in the model of care that led to successful outcomes; this mechanism was triggered within the context of making financial incentives available to providers to assist them in implementing the integrated care programmes. According to Kirst *et al.*, “...provider understanding of and belief in this model...were also found to be important for program success. Providers’ commitment to and belief in the model as a means to improve patient health was particularly important to motivate providers to make the effort to change their work practices and to work multidisciplinary.... Contextual factors that facilitated provider commitment and understanding included funding models that involved incentives for providers to implement IC [information and communication programs]. GPs [general practitioners] in capitated programs and programs with salaried staff had more flexibility and resources to implement IC, while GPs working under a fee-for-service model were less likely to become engaged and commit to the model because they were not compensated for time involved in multidisciplinary team meetings and other program activities...” (p. 616).

The second context-mechanism-outcome reported by Kirst *et al.*⁶⁶ suggests that healthcare providers are more likely to invest resources in the implementation of integrated care when they perceive it to deliver an advantage to their patients and to their status as healthcare providers. In addition, when the system recognises the changes to their practice with financial incentives, this improves the contextual conditions for implementation. This latter point about financial incentives requires further attention when considering implementing similar programmes in an Irish context, as previous research has demonstrated that the absence of financial incentives is often a key barrier to the implementation of integrated care programmes in Ireland.⁶⁷ For example, Mc Hugh *et al.* (2013)⁶⁷ undertook 31 in-depth interviews with a purposive sample of 29 general practitioners and two practice nurses in Ireland around the management of diabetes. Mc Hugh *et al.*⁶⁷ report on the barriers to and facilitators of integrated diabetes care from the general practice perspective. According to Mc Hugh *et al.*,⁶⁷ “The main barriers identified in this study were system-level deficiencies including the lack of remuneration for chronic disease management, poor coordination at the primary–secondary care interface and insufficient services, particularly in the community, which forced [general practitioners] to rely on the hospital as a doorway to other healthcare professionals. These challenges have a ripple effect throughout the system at an organisational, social, professional and patient level...” (p. 7).

5.3 Strengths and limitations

The main strength of this umbrella review is that it provides a comprehensive overview of evidence on a wide array of integrated interventions that can inform policy-makers to make decisions on effective strategies to reduce pressure on the acute hospital system. It permits a broad overview of the evidence base on the effectiveness of a number of alternative or complementary interventions that would not be possible with a single systematic review of one intervention. However, umbrella reviews do not permit conclusions about the detailed contexts in which interventions were implemented. This umbrella review included the work of Damery *et al.*,⁸ who provided evidence from strong- and moderate-quality reviews on integrated interventions that focused on chronic diseases. Damery *et al.*'s⁸ umbrella review was published in the peer-reviewed journal *BMJ Open* in 2016, and it examined reviews published since 2000. Due to the fact that the work of Damery *et al.*⁸ included research published up to December 2015 and the fact that the HRB team had five months to complete the current umbrella review, the HRB did not update Damery *et al.*'s⁸ search for integrated interventions to manage chronic diseases, but did add four reviews that focused on patients with chronic asthma and two reviews of discharge management for patients with chronic diseases which were not covered by Damery *et al.*⁸

Another key strength of the HRB review is that it included only strong-quality reviews and followed a rigorous and transparent approach which included clear inclusion and exclusion criteria, quality assessment by two authors, and systematic extraction checked by a second author. Following Damery *et al.*,⁸ the HRB's primary unit of analysis was integrated intervention and the secondary unit of analysis was hospital system outcome. Where feasible, the HRB has tried to explain heterogeneity found in testing the interventions. The HRB attempted to analyse only recent, high-quality evidence to capture the current state of the evidence.

This study was completed in a five-month time frame and most of the limitations were introduced because of time pressures. One limitation of the HRB's review was that the search was quite focused, was based on two major databases, and included English-language papers only. Therefore, the search may have missed a small number of reviews. Another limitation of this review was that some of the systematic reviews included primary papers that were rated as Level-III evidence, which means they included primary before-and-after studies and are at high risk of bias leading to more positive results. The inclusion of such study designs was particularly evident in reviews on discharge management for older people and in some of the emergency department interventions. A further limitation of this review was that there was overlap between primary papers included in reviews on disease management, pharmacy-led medication management, self-management, and specialised multidisciplinary rehabilitation for hip fracture. A limitation of all umbrella reviews is that they usually do not include newer interventions, because such interventions typically have yet to be included in published systematic reviews.

The comparator 'usual care' was not standardised for each of the interventions, but includes the routine care received by patients; this will vary from country to country and reflect the general quality of the health system. In a weak health system, interventions may appear more effective because usual care is weak, whereas in a strong health system, interventions may appear less effective as usual care is provided in a more comprehensive manner.

The length of time over which studies examined outcomes varied in the reviews the HRB examined. In some reviews, the length of time over which studies examined outcomes was not reported.

The HRB focused only on health-system-level outcomes: unplanned hospital admissions, readmissions, length of stay, emergency department use, and costs related to using acute and emergency hospital services. Focusing on health-system-level outcomes conveys only a partial picture of the effectiveness of interventions and does not include clinical effectiveness or patient experiences with services.

The HRB only included reviews that evaluated integrated interventions; it excluded reviews when the intervention was only implemented in one setting, that is, either in the hospital or in the community. This means that the HRB has excluded reviews that focused on interventions delivered in one setting, which could be effective in reducing hospitalisation for any of the three population groups we identified in the literature.

The HRB has not formally applied the GRADE approach¹⁵ to rating the quality and certainty of the evidence, but it has applied its principles of bias (considering study design and publication bias where reported), inconsistency (considering heterogeneity), and imprecision (considering meta-analysis and confidence intervals) in its conclusions on each intervention.⁶⁸ GRADE was developed for systematic reviews rather than umbrella reviews, and some experienced authors note that to apply it consistently for umbrella reviews, one would need to review the primary studies or use recent Cochrane reviews where GRADE was systematically applied.⁶⁸

5.4 Implications for policy-makers

Damery *et al.*⁸ and the HRB identified a number of integrated interventions that were tested to determine if they reduced pressure on acute hospital services (emergency and inpatient services).

Some interventions demonstrated promising results in relieving pressure on hospitals. Discharge management for patients with chronic diseases and patients admitted to hospital with general medical and surgical needs was the most promising of the interventions. However, the HRB examined data from five high-quality meta-analyses and one narrative review, and found that discharge management for older patients failed to demonstrate effectiveness on hospital outcomes. The HRB notes that discharge planning for older patients leaving hospital is an area currently receiving some attention in an umbrella review protocol in the UK. In addition, two protocols have been published to undertake a realist review on the role of context in care transition interventions for medically complex older adults, and on supporting shared decision-making for older people with multiple health and social care needs, respectively.

Other promising interventions the HRB identified in the literature reviewed were the chronic care model; complex interventions for chronic diseases; multidisciplinary care for single chronic diseases; and hospital at home for a number of target populations. Managed care and prehospital diversion in or beside emergency departments may also be useful but need higher-level evidence.

Some interventions have been shown to be more effective when combined with other effective interventions. For example, self-management when combined with discharge management, or the chronic care model or multidisciplinary care and likewise medication management when combined with the three aforementioned interventions may be more effective. Interactive telemedicine may have potential when combined with the chronic care model, multidisciplinary teams, or hospital at home, but more research is required as telemedicine is an evolving set of interventions. There is also evidence from other umbrella reviews that combining interventions may be beneficial in reducing pressure on hospitals. The HRB concurs with other umbrella review authors that a combination of interventions, combining effective active components and delivered across each patient's journey from hospital to the community, is more likely to relieve pressure on the acute hospital system.

The HRB bases the combined intervention argument on a recognition that there appears to be an array of ubiquitous interventions already delivered across different healthcare systems, including approaches to discharge management, hospital at home, pharmacist- or nurse-led medication management, self-management, and case management. Early or timely discharge from hospital consists of communication and monitoring between providers and patients. Such communication and monitoring involves providing useful information, recording observations, giving reassurance, and ensuring a three-way link between the patient, hospital, and community health service. The HRB recognises that these interventions work for some people; however, the HRB needs more information on who the interventions work for, under what conditions they work, and why they work for some people some of the time and not all of the time. The HRB would argue that the evaluation of what appear to be complex multicomponent interventions may need a different approach to the one adopted via the experimental trial methods. Berwick⁶⁴ suggests an alternative evaluation model, namely the realist evaluation pioneered by Pawson and Tilley.⁶⁵ The realist approach seeks to explain why an intervention works, for whom, and under what conditions by elucidating the configuration of context (C), mechanism (M), and outcome (O). For example, according to Pawson and Tilley⁶⁵, programmes that work have successful 'outcomes' only insofar as the programmes introduce the appropriate ideas and opportunities, known as mechanisms, to groups in the appropriate social and cultural conditions, known as contexts. Towards the end of the HRB's work on this umbrella review, the team identified one recently published realist review of integrated care programmes targeting older adults with complex needs, by Kirst *et al.* (2017).⁶⁶

Kirst *et al.*⁶⁶ undertook this work to identify, test, and refine the theory of why integrated care programmes achieve certain specified outcomes, and what contextual conditions constrain or enable

the programmes to succeed. Kirst *et al.*⁶⁶ identified two context-mechanism-outcome configurations: (i) trusting multidisciplinary team relationships (M) within a context of strong leadership to establish a shared vision, time to build trusting team relationships, and an organisational culture of team participation (C), and (ii) provider commitment to and understanding of the integrated care model (M) within the context of strong leadership/organisational culture, the time to build infrastructure, provider expertise and training, flexibility in implementation, and provider incentives (C). These mechanisms were triggered within the contextual conditions outlined to achieve the outcomes of reduced health system utilisation, improved patient health, and improved patient/caregiver experience (O).

On a separate but related topic, more research is required to determine the effect of specialised multidisciplinary rehabilitation for hip fracture in patients with different degrees of cognitive impairment in terms of reduced length of stay in hospital and preventing institutionalisation in the short term. Case management is not useful for chronic diseases but may have some potential for older people being discharged from hospital, as it may improve some but not all hospital system outcomes, and this requires more research.

Damery *et al.*⁸ and the HRB present a number of promising integrated interventions to help reduce pressure on acute hospitals and provide more specialised support to patients living at home. However, if the Irish healthcare system decides that some of these interventions are appropriate to implement, then perhaps these interventions need to be adapted to the context of the Irish healthcare system and evaluated for their effectiveness within the Irish context. On the other hand, it is likely that some of these interventions, either in a partial format or in a comprehensive format, may already be implemented in some parts of the Irish healthcare system. In this case, it may be useful to undertake a mapping exercise to identify the interventions that are currently used and how their implementation may be improved within the Irish context.

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Appendix A Search strategies

MEDLINE search

	Search string	Results
1	exp *Hospitalization/	74,510
2	*"continuity of patient care"/ or *aftercare/ or *patient discharge/ or *patient handoff/ or *patient transfer/ or *transitional care/	28,245
3	(hospital adj (admission or readmission or discharge or avoidance or length of stay)).ti,ab.	51,850
4	*cost-benefit analysis/ or *"cost of illness"/ or *health expenditures/	26,372
5	1 or 2 or 3 or 4	152,078
6	(umbrella review or review of reviews or systematic review or meta- analysis or meta-analysis).ti.	127,803
7	5 and 6	1,885
8	Limit 7 to English language	1,845
9	Limit 8 to yr="2000–Current"	1,810

Cochrane search

	Search string	Results
1	MeSH descriptor: [Patient Admission] explode all trees	661
2	MeSH descriptor: [Length of Stay] explode all trees	8,011
3	MeSH descriptor: [Cost-Benefit Analysis] explode all trees	18,438
4	MeSH descriptor: [Patient Readmission] explode all trees	1,048
5	MeSH descriptor: [Continuity of Patient Care] explode all trees	18,576
6	MeSH descriptor: [Aftercare] explode all trees	16,746
7	MeSH descriptor: [Patient Discharge] explode all trees	1,420
8	MeSH descriptor: [Patient Handoff] explode all trees	24
9	MeSH descriptor: [Patient Transfer] explode all trees	153
10	MeSH descriptor: [Transitional Care] explode all trees	14
11	MeSH descriptor: [Cost of Illness] explode all trees	1,341
12	MeSH descriptor: [Health Expenditures] explode all trees	340
13	MeSH descriptor: [Hospitalization] explode all trees	14,904
14	(hospital near (admission or readmission or discharge or avoidance or length of stay)).ti,ab.	1,320
15	(or #1–#14)	49,402
16	(reduc* or decrease or prevent* intervention).ti,ab	3,286
17	(#15 and #16)	1,341
18	Limit 17 to reviews	1,130

Appendix B Health Evidence Quality Assessment Tool

Adaptation of Health Evidence's Quality Assessment Tool for Review Articles

Instructions for completion:

Please refer to the attached dictionary for definitions of terms and instructions for completing each section. For each criterion, score by placing a check mark in the appropriate box.

First Author's Surname: _____

Year of Publication: _____

Journal: _____

Reviewer: _____

CRITERION	YES	NO	
Q1 Did the authors have a clearly focused question [population, intervention (strategy), and outcome(s)] for this review?			
Q2 Were appropriate inclusion and/or exclusion criteria used to select or exclude primary studies in this review?			
Q3 Did the authors describe the review search strategy comprehensively? <ul style="list-style-type: none"> Two or more appropriate databases were used Search terms based on question and inclusion criteria Limits to search stated 			
Q4 Did the search strategy cover an adequate number of years, and if less than 10 years, was the number of years justified?			
Q5 Did the review describe the level of evidence in the primary studies included in the review? Circle one: Level I RCTs only Level II non-randomised, cohort, case-control Level III uncontrolled studies (surveys, case series)			
Q6 Did two review authors independently assess the methodological quality of the primary studies (with a method of conflict resolution identified) using an appropriate tool? The tool may include the following criteria: <ol style="list-style-type: none"> Study sample (size, effect size) Participation or response rates Sources of bias (identify confounders, respondent bias) Data collection (justify measures of independent/dependent variables) Follow-up/attrition rates (and effects) Data analysis (Estimates, risk measures, or ratios with confidence intervals) 			
Q7 Are the results of the quality assessment in the review presented in a table or detailed in text?			
Q8 Was a standardised data extraction tool used, and if it was appropriate to combine findings using meta-analysis was this used, if it was appropriate to combine findings using narrative analysis, was this used?			
Q9 Were appropriate methods used for combining or comparing results across studies such as using weighting, fixed or random effects, sensitivity analysis, coding, or appropriate narrative or qualitative synthesis?			
Q10 Do the data support the authors' interpretation of the findings (consider extraction sheet, other authors' findings, search limitations, and analysis limitations)?			
TOTAL SCORE:			
Quality Assessment Rating: (circle one)	Strong (total score 8–10)	Moderate (total score 5–7)	Weak (total score 4 or less)

Health Evidence Quality Assessment Tool Dictionary

A systematic review is a research approach to accessing, acquiring, quality assessing, and synthesising a body of research on a particular topic. All phases of systematic review development should be well-described such that the process is transparent and replicable by others.

Q1 Clearly focused research question

The review should have a clearly focused research question that contains the following components: **Population**, **Intervention**, and **Outcomes**. Any part of these that are not addressed in a review's main research question should be clearly stated in the inclusion criteria to receive a **Yes** for criterion #1. **Outcomes can be general in the research question (e.g. to allow for a broader search strategy, especially if the topic at hand has a limited body of literature available), and then be addressed more specifically in the evidence tables and/or highlighted through the process of data extraction.** For example, a general question may read: "The aim of this study,

therefore, was to systematically review evidence from controlled trials on the efficacy of motor development interventions in young children.”

Overall Coding for Q1:

If the answer to each of population, intervention, and outcome is **Yes**, then place a check mark in the **Yes** column. Otherwise, place a check mark in the **No** column.

Q2 Provision of inclusion and/or exclusion criteria

The review should clearly describe the criteria that were used to select primary studies. This includes decisions related to the target population, intervention, and outcome(s), as well as the research design (i.e. RCT, cohort, participatory, etc.). Using the descriptions “peer-reviewed” and/or “measurement of a quantitative outcome” in the inclusion criteria are NOT sufficient descriptions to count for study design. Mark a **No** for this criterion.

If authors mention in their exclusion criteria that they rejected reviews, letters, editorials, and case reports, but do not specifically address what they chose to include, mark a **No** for this criterion.

Overall Coding for Q2:

Place a check mark in the **Yes** column if selection criteria were clearly outlined.

Q3 Comprehensive search strategy

A well-described comprehensive search strategy will include multiple database searches (two or more) and may also include a variety of other search strategies. Relevant databases, chosen based on the key concepts in the research question, could include those from health databases (MEDLINE, CINAHL, BIOSIS, Embase, etc.), psychological databases (PsycINFO), social science databases (sociological abstracts), and/or educational databases (ERIC).

The search terms need to have been based on the research question and the inclusion criteria.

Search limits are clearly stated.

Overall Coding for Q3:

To answer **Yes**, the author(s) should have used at least two appropriate databases, the search terms should be appropriate, and the limit should be clearly stated.

Q4 Search strategy covers an adequate number of years

In order to ensure that the entire body of relevant research is included in the review, the search strategy should cover a sufficient time period. The number of years that are adequate to search for primary studies will vary depending on the topic and the amount of literature being developed in that field. Generally, at least 10 years should be used as a minimum length of time; however, this may be increased if there has been little published in that time frame, or may be shortened if there has been a large amount of literature published in the recent past. The duration may also be shortened if the review is an update; however, the original search must have covered a sufficient number of years, and if less than 10 years, the number of years must be justified.

Overall Coding for Q4:

Answer **Yes** if the search strategy covered enough years that it is unlikely that important studies were missed and if the search period covers less than 10 years the number of years must be justified.

Q5 Level of evidence of studies included in review is described

Select the level of evidence based on the types of primary studies that appeared in the systematic reviews/meta-analyses under assessment. If more than one level of evidence was included, only circle the lowest level (Level III is the lowest of the three).

Should the author(s) describe the studies as 'observational', please consider these studies to be a Level III as they may include cross-sectional studies.

Overall Coding for Q5:

Place a check mark in the **Yes** column if the level of evidence for the primary studies is clearly identified in the review and circle the appropriate level of evidence.

Q6 Quality assessment of primary studies

The methodological quality of primary studies is powerful in helping to explain variations in results from study to study. Therefore, the methodological rigour of primary studies in the relevant topic area should be identified and clearly described.

Each primary study should be assessed for methodological quality using a standardised assessment tool/scale.

These criteria apply to meta-analyses as well. Review authors need to do more than just state quality-related data that was extracted. The implication of this data on a review's findings must be addressed. For example, just because review authors list sample sizes of the primary studies does not mean they have assessed study sample.

*You should not have to conduct the quality appraisal, based on study characteristics provided.

For Cochrane Reviews, authors are required to conduct a standardised 'Risk of Bias' assessment (see <http://www.cochrane-handbook.org/> Figure 8.6a). Their results are typically included in the Characteristics of Included Studies table. These characteristics translate to the Health Evidence Quality Assessment Tool as follows:

If Cochrane authors assess...	On the Health Evidence QA tool select...
Sequence generation →	Research design
Allocation concealment →	Research design
Blinding →	Source of bias
Free of selective reporting →	Data collection
Incomplete long-term/short-term outcome data	Data analysis

**Authors describe assessing intention-to-treat analysis and whether incomplete data was dealt with correctly.*

The **JADAD** and **EPOC** tools are well-reputed and typically code **Yes**.

In some instances, different quality assessment criteria may be used for different study designs included in the same review. For example, the EPOC tool has different criteria for interrupted time series studies, compared to randomised controlled trials.

For reviews of **qualitative primary studies**, the following should be assessed and described for each included primary study:

1. Suitability of methodology/paradigm to the research question
2. Clear description of sampling strategy
3. Clear description of data collection and data analysis methods
4. Context sufficiently described so that relevance of findings to other contexts can be established
5. Rigour:

- a. Audit trail (rationale for the research steps taken throughout the research process)
 - b. Coding agreed on by two or more authors
 - c. Deviant case analysis
6. Reflexivity (regarding researcher and the research process – the researcher’s reflections on their effect on the research and research process, and the effect of the research on them and how both of these may have affected the outcome/findings)

Overall Coding for Q6:

For a review of quantitative studies, place a check mark in the **Yes** column if an appropriate quality appraisal tool was assessed by two authors independently. For a review of qualitative studies, place a check mark in the **Yes** column if all six criteria were assessed by two authors independently.

Q7 Are quality assessments transparent?

For quality assessments to be transparent they must be presented in a table or detailed in text.

Overall Coding for Q7:

Place a check mark in the **Yes** column if two (or more) independent reviewers assessed each primary study for methodological quality, with a method of conflict resolution identified and the results presented.

Q8 Quantitative: Was a standardised data extraction tool used, and was it appropriate to combine the findings of results across studies considering outcomes, study design, and heterogeneity? / Qualitative: Was a standardised data extraction tool used, and did the reviewers describe the similarities and differences across studies in sufficient detail to make the results meaningful?

It is important that primary study results be assessed for similarity prior to combining them (both statistically and/or non-statistically). The completion of a data extraction tool helps to ensure that data are extracted consistently from each study.

If a **meta-analysis** is conducted, a test for homogeneity or heterogeneity is the minimum requirement that should be assessed across studies prior to determining the overall effect size. If significant heterogeneity is detected, the author(s) should indicate use of a Random Effects Model, as opposed to a Fixed Effects Model.

On occasion, an author may indicate the presence of significant heterogeneity and still combine data using a Fixed Effects Model. This IS appropriate if analyses have been conducted with both the inclusion and exclusion of data sets that may notably skew results. The results of these separate analyses, however, **MUST** be reviewed for the reader’s consideration. This process, often called ‘sensitivity analysis’, assesses the moderators that may have contributed to the heterogeneity.

If a **systematic review** or a **narrative review** is conducted for which statistical analysis is not appropriate, the results of each study should be depicted in graph/table format in order to assess similarity across the primary studies. Often the results will be in the form of a table, but in the case of a narrative review the results of each study will be described at length within the body of the review.

In some cases, confidence intervals/effect sizes are NOT required. For a **review of reviews**, a narrative presentation is appropriate (e.g. “the intervention had a positive effect on 20% of participants”), ideally with a table listing main features of each of the systematic reviews under review, or thorough, **CONSISTENT** discussion of the main features in the body of the review. If the review of reviews doesn’t consistently present the actual

numerical (or other qualitative) results (e.g. effect sizes from the original reviews) in the text, then it should score a **No**.

In general, trust the review author(s)' judgment of what is significant heterogeneity. A declaration of the specific number that was calculated (e.g. Chi-square score) is not mandatory.

NOTE: Despite extensive search strategies, some Cochrane reviews are unable to retrieve any applicable studies. In this case, a priori methodologies are often described. Subheadings alone, however, are sufficient to score a **Yes**, as Cochrane requires that they are filled in adequately before publication. Without a **Yes** for these criteria, these types of reviews will be of only Moderate quality, which may result in them being missed by users who are looking only for Strong reviews.

Overall Coding for Q8:

Place a check mark in the **Yes** column if data was extracted using a consistent approach and a test of homo/heterogeneity has been conducted if required and the corresponding model applied, or if the individual study results have been described graphically or narratively in a consistent manner. Please note that if study results are listed narratively, the information must have been provided consistently for all studies within the review text.

Q9 Were appropriate methods used for combining or comparing results across studies such as using weighting, fixed or random effects analytic model as appropriate, sensitivity analysis as appropriate, coding, or appropriate qualitative synthesis?

Whether a meta-analysis or a systematic/narrative review, the overall measure of effect should be determined by assigning those studies of highest methodological quality greater weight. In the case of meta-analyses, weighting may also be based on sample size, which is also acceptable.

If review authors have named a specific statistical software package (e.g. RevMan) they have used to combine data, this is sufficient for weighting, as the vast majority of this software incorporates the weighting of studies by a number of participants. Review authors may describe using the DerSimonian and Laird approach to random-effects meta-analysis which also incorporate weighting. Higgins and Green (2009) explain that:

“The random-effects method (DerSimonian 1986) incorporates an assumption that the different studies are estimating different, yet related, intervention effects [...] The method is based on the inverse-variance approach, making an adjustment to the study weights according to the extent of variation, or heterogeneity, among the varying intervention effects.”

Cochrane Handbook for Systematic Reviews of Interventions Version 5.0.2., The Cochrane Collaboration, 2009. Available from <http://www.cochrane-handbook.org>

One may notice the inclusion of sensitivity analyses and/or funnel plot diagrams. These are useful for assessing the effect of study quality on results in the case of the former, and potential for publication bias in the case of the latter. While useful, these particular analyses are **not mandatory** for a review to acquire a **Yes** coding.

In a **narrative synthesis**, quality of EACH of the included studies must be discussed consistently throughout the conclusions/discussion section to receive a **Yes** for this criterion.

In some cases, review authors disclose the QA scores of primary studies – in table format, for example – and discuss those scores, but do not actually ‘weigh’ them, essentially allowing the readers to determine which ones have the most weight. This is NOT sufficient to score a **Yes** for this criterion, as the review authors should be doing all summative work. It IS appropriate, however, for review authors to state, for example: “Only the studies with a quality score of 5 or above are included in the analysis.”

Reviews that weight conclusions/discussion by primary study quality still receive a **Yes** even if <3 quality parameters were assessed (as per QA criterion #6).

Overall Coding for Q9:

Place a check mark in the **Yes** column if a weighting system has been used in determining the overall impact. Also include the appropriate use of **fixed or random effects model, sensitivity analysis, coding, or appropriate qualitative synthesis**.

Q10 Do the data support the author(s)’ interpretation of the findings (consider quality assessment, contents of extraction sheet, other authors’ findings, search limitations, analysis limitations)?

Consider the reported data and assess whether the review author(s)’ interpretation of the results of the primary studies is supported by the data. If no numerical values or p values/confidence intervals are given, then the reviewer cannot determine whether any conclusions are supported by the data and should respond **No** to criterion #10. In addition, if review author(s) failed to adequately assess methodological quality of the primary studies (i.e. criterion #6 is **No**), and also failed to weight the studies by quality or sample size (for meta-analyses) in their synthesis of results (i.e. criterion #9 is **No**), then the response to #10 should also be **No**, since it is difficult to determine agreement with review author(s)’ conclusion(s) if no quality assessment has taken place, since it is possible that agreement with author(s)’ overall conclusion(s) would differ if studies were of weak quality compared to very strong quality.

Overall Coding for Q10:

Place a check mark in the **Yes** column if the data for the primary studies supports the interpretations outlined in the review.

Overall Coding for the Review

An overall assessment of the methodological quality of the review will be determined based on the results from each question. The total score is out of 10. Add all the check marks in the **Yes** column and add to the **Total** column under **Yes**. Do the same for the **No** column. Use the following decision rule to determine the overall assessment for the review based on the numbers in the **Total** columns.

- Reviews with a score of **8 or higher** in the **Yes** column will be rated as Strong
- Reviews with a score between **5 and 7** in the **Yes** column will be rated as Moderate
- Reviews with a score of **4 or less** in the **Yes** column will be rated as Weak

In the case that a score does not necessarily reflect your impression of the actual quality of a review (i.e. Strong/Moderate/Weak), consider revisiting some of the criteria and Yes and/or No scores, or discuss with a second reviewer, so that the corresponding quality category is a reflection of the review’s overall methods and the score will be an accurate reflection for use by public health decision-makers.

Appendix C List of studies excluded following full-text screening and quality assessment

Review	Reason for exclusion	Quality score
Bahr <i>et al.</i> 2014. Integrated literature review of postdischarge telephone calls. ⁶⁹	Study was rated as weak (score 2) using an adapted version of the Health Evidence Quality Assessment Tool for systematic reviews.	2
Blakemore <i>et al.</i> 2015. Complex interventions reduce use of urgent healthcare in adults with asthma: systematic review with meta-regression. ⁷⁰	Study was rated as moderate	7
Branowicki <i>et al.</i> 2017. Meta-analysis of clinical trials that evaluate the effectiveness of hospital-initiated post-discharge interventions on hospital readmission. ⁷¹	Study was rated as moderate	6
Bryant-Lukosius <i>et al.</i> 2015. The clinical effectiveness and cost-effectiveness of clinical nurse specialist-led hospital to home transitional care: a systematic review. ⁷²	Study was rated as moderate	7
Caplan 2013. A meta-analysis of "hospital in the home". ⁷³	Study was rated as moderate	6
Chhabra <i>et al.</i> 2012. Medication reconciliation during the transition to and from long-term care settings: a systematic review. ⁷⁴	Study was rated as moderate	6
Chiu and Newcomer 2007. A systematic review of nurse-assisted case management to improve hospital discharge transition outcomes for the elderly. ⁷⁵	Study was rated as weak	4
Couturier <i>et al.</i> 2016. A systematic review on the effect of the organisation of hospital discharge on patient health outcomes. ⁷⁶	Study was rated as moderate	7
Credé <i>et al.</i> 2017. What is the evidence for the management of patients along the pathway from the emergency department to acute admission to reduce	Study was rated as moderate	6

Review	Reason for exclusion	Quality score
unplanned attendance and admission? An evidence synthesis. ⁷⁷		
Desai <i>et al.</i> 2015. The effectiveness of family-centered transition processes from hospital settings to home: a review of the literature. ⁷⁸	Study was rated as moderate	5
Dy <i>et al.</i> 2013. Continuity, coordination, and transitions of care for patients with serious and advanced illness: a systematic review of interventions. ⁷⁹	Study was rated as moderate	6
Fox <i>et al.</i> 2013. Acute care for elders components of acute geriatric unit care: systematic descriptive review. ⁸⁰	Study was rated as weak	2
Graverholt <i>et al.</i> 2014. Reducing hospital admissions from nursing homes: a systematic review. ⁸¹	Study was rated as moderate	7
Guerin <i>et al.</i> 2013. Community services' involvement in the discharge of older adults from hospital into the community. ⁸²	Study was rated as moderate	7
Halpern <i>et al.</i> 2003. The economic impact of acute exacerbations of chronic bronchitis in the United States and Canada: a literature review. ⁸³	Study was rated as weak	3
Hastings and Heflin 2005. A systematic review of interventions to improve outcomes for elders discharged from the emergency department. ⁸⁴	Study was rated as moderate	6
Hickman <i>et al.</i> 2007. Best practice interventions to improve the management of older people in acute care settings: a literature review. ⁸⁵	Study was rated as moderate	5
Hickman <i>et al.</i> 2015. Multidisciplinary team interventions to optimise health outcomes for older people in acute care settings: A systematic review. ⁸⁶	Study was rated as moderate	7
Hoff <i>et al.</i> 2012. The patient-centered medical home: a review of recent research. ⁸⁷	Study was rated as weak	3
Holland <i>et al.</i> 2008. Does pharmacist-led medication review help to reduce hospital admissions and deaths in older people? A systematic review and meta-analysis. ⁸⁸	Study did not cross two settings	
Huntley <i>et al.</i> 2017. A systematic review to identify and assess the effectiveness of alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission. ⁸⁹	Study was rated as moderate	6
Jayakody <i>et al.</i> 2016. Effectiveness of interventions utilising telephone follow up in reducing hospital readmission within 30 days for individuals with chronic	Included studies only focused on chronic diseases	

Review	Reason for exclusion	Quality score
disease: a systematic review. ⁹⁰		
Jones <i>et al.</i> 2016. Transitional care interventions and hospital readmissions in surgical populations: a systematic review. ⁹¹	Study was rated as moderate	7
Joseph <i>et al.</i> 2016. The effectiveness of structured interdisciplinary collaboration for adult home hospice patients on patient satisfaction and hospital admissions and re-admissions: a systematic review. ⁹²	No studies met their criteria, so there were no results	
Kalankesh <i>et al.</i> 2016. Effect of telehealth interventions on hospitalization indicators: a systematic review. ⁹³	Study was rated as weak	3
Karam <i>et al.</i> 2015. Efficacy of emergency department-based interventions designed to reduce repeat visits and other adverse outcomes for older patients after discharge: A systematic review. ⁹⁴	Study was rated as moderate	6
Katz <i>et al.</i> 2012. Comparative effectiveness of care coordination interventions in the emergency department: a systematic review. ⁹⁵	Study was rated as moderate	5
Lehnbom <i>et al.</i> 2014. Impact of medication reconciliation and review on clinical outcomes. ⁹⁶	Study was rated as weak	4
Linertová <i>et al.</i> 2011. Interventions to reduce hospital readmissions in the elderly: in-hospital or home care. A systematic review. ⁹⁷	Study was rated as moderate	7
McNeill and Bryden 2013. Do either early warning systems or emergency response teams improve hospital patient survival? A systematic review. ⁹⁸	Study was rated as moderate	7
Motamedi <i>et al.</i> 2011. The efficacy of computer-enabled discharge communication interventions: a systematic review. ⁹⁹	Study was rated as moderate	7
Naylor <i>et al.</i> 2011. The care span: The importance of transitional care in achieving health reform. ⁵⁵	Study was rated as moderate	6
O'Connor <i>et al.</i> 2014. Frontloading and intensity of skilled home health visits: a state of the science. ¹⁰⁰	Study was rated as weak	2
Parker <i>et al.</i> 2002. A systematic review of discharge arrangements for older people. ¹⁰¹	Study was rated as moderate	5
Poulos and Eagar 2007. Determining appropriateness for rehabilitation or other subacute care: is there a role for utilisation review? ¹⁰²	Study was rated as weak	0

Review	Reason for exclusion	Quality score
Reddy <i>et al.</i> 2017. A systematic review of the impact of healthcare reforms on access to emergency department and elective surgery services: 1994-2014. ¹⁰³	Study was rated as moderate	7
Resnick <i>et al.</i> 2016. Rehabilitation interventions for older individuals with cognitive impairment post-hip fracture: a systematic review. ¹⁰⁴	Study was rated as weak	4
Richards and Coast 2003. Interventions to improve access to health and social care after discharge from hospital: a systematic review. ¹⁰⁵	Study was rated as moderate	5
Richardson <i>et al.</i> 2005. Cost-effectiveness of interventions to support self-care: a systematic review. ¹⁰⁶	Study was rated as moderate	6
Santomassino <i>et al.</i> 2012. A systematic review on the effectiveness of continuity of care and its role in patient satisfaction and decreased hospital readmissions in the adult patient receiving home care services. ¹⁰⁷	Study was rated as moderate	7
Sibbald <i>et al.</i> 2007. Shifting care from hospitals to the community: a review of the evidence on quality and efficiency. ¹⁰⁸	Study was rated as moderate	5
Smith <i>et al.</i> 2017. Shared care across the interface between primary and specialty care in management of long term conditions. ¹⁰⁹	Study did not include our outcomes	
Yoo <i>et al.</i> 2015. Hospital readmission of skilled nursing facility residents: a systematic review. ¹¹⁰	Study was rated as moderate	5

Appendix D Review characteristics

See excel attachment on website

Appendix E Damery *et al.*'s summary findings

Summary statistical associations for the systematic reviews in Damery *et al.*,⁸ by integrated care chronic disease intervention type, for each outcome of interest

Review/intervention type	Hospital admissions	Hospital readmissions	Hospital length of stay	Emergency department attendances	Costs
Discharge management					
Bettger <i>et al.</i> (2012)		Mixed findings***			
Brady <i>et al.</i> (2005)					Mixed findings***
Fearon <i>et al.</i> (2012)		No association****	Negative association**		Mixed findings***
Feltner <i>et al.</i> (2014)		Negative association**			
Jeppesen <i>et al.</i> (2012)		Negative association**			Negative association**
Lambrinou <i>et al.</i> (2012)		Negative association**			
Langhorne <i>et al.</i> (2005)		No association****	Negative association**		Mixed findings***
McMartin (2013)		Negative association**	Negative association**		
Olson <i>et al.</i> (2011)		No association****			
Phillips <i>et al.</i> (2004)		Negative association**	No association****		Negative association**
Phillips <i>et al.</i> (2005)		Negative association**	No association****		No association****
Prieto-Centurion <i>et al.</i> (2014)		Mixed findings***			
Tummers <i>et al.</i> (2012)					Mixed findings***
Winkel <i>et al.</i> (2008)		No association****			Negative association**
Yu <i>et al.</i> (2006)		Mixed findings***			Negative association**
Chronic care model					
Adams <i>et al.</i> (2007)	Negative association**		Negative association**	Negative association**	Negative association**
de Bruin <i>et al.</i> (2012)	Mixed findings***				Negative association**
Gonseth <i>et al.</i> (2004)		Negative association**			Negative association**
Hisashige (2013)	Negative association**				Mixed findings***
Kruis <i>et al.</i> (2013)	Negative association**		Negative association**		
Lemmens <i>et al.</i> (2009)		Mixed findings***			
Peytremann-Bridevaux <i>et al.</i> (2008)	Negative association**				
Steuten <i>et al.</i> (2009)		Mixed findings***			No association****
Woltmann <i>et al.</i> (2012)					No association****
Complex interventions					
Dickens <i>et al.</i> (2014)				Negative association**	
Martínez-González <i>et al.</i> (2014)	Negative association**	Negative association**	Negative association**	Negative association**	Mixed findings***

Review/intervention type	Hospital admissions	Hospital readmissions	Hospital length of stay	Emergency department attendances	Costs
Takeda <i>et al.</i> (2012)		Negative association**			
Multidisciplinary teams					
Health Quality Ontario (2012)	Negative association**				
Health Quality Ontario (2013)	Negative association**				
Holland <i>et al.</i> (2005)	Negative association**		Negative association**		Negative association**
Koshman <i>et al.</i> (2008)		Mixed findings***		Negative association**	
McAlister <i>et al.</i> (2004)	Mixed findings***				
Medical Advisory Secretariat (2009)	No association****		Negative association**		
Roccaforte <i>et al.</i> (2005)		Negative association**	Negative association**		
Sikich (2012)	Negative association**			Mixed findings***	
Smith <i>et al.</i> (2007)	Mixed findings***				Mixed findings***
Smith <i>et al.</i> (2012)	Mixed findings***				Mixed findings***
Self-management					
Franeck (2013)	No association****		No association****	No association****	
Harrison <i>et al.</i> (2015)		No association****			
Jovicic <i>et al.</i> (2006)		Negative association**			Negative association**
Smith <i>et al.</i> (2012)	Mixed findings***				Mixed findings***
Zwerink <i>et al.</i> (2014)	Negative association**		No association****		
Case management					
Hickam <i>et al.</i> (2013)	Mixed findings*****				Mixed findings***
Hutt <i>et al.</i> (2004)	Mixed findings***		Mixed findings***	Mixed findings***	Mixed findings***
Latour <i>et al.</i> (2007)		Mixed findings***	Mixed findings***		No association*****
Manderson <i>et al.</i> (2012)					Negative association**
Oeseburg <i>et al.</i> (2009)	Mixed findings***		Mixed findings***	Mixed findings***	Mixed findings***
Stokes <i>et al.</i> (2015)					No association****
Taylor <i>et al.</i> (2005)		Mixed findings***			
Thomas <i>et al.</i> (2013)	Negative association**				

*Positive association: more than half of the primary studies in the review reported an increase in the outcome of interest

**Negative association: more than half of the primary studies in the review reported a decrease in outcome of interest

***Mixed findings: about half of the primary studies in the review reported positive findings for the outcome of interest and/or half reported negative or no association; or about one-third of the studies report each association type

****No association: no significant associations for any of the primary studies in the review for the outcome of interest

