The effectiveness of the Nurse Care Coordinator role on patient-reported and health

service outcomes: A systematic review

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Abstract

This systematic review examined the effectiveness of nurse care coordinator roles on patient-reported and health service outcomes. Multiple electronic databases (Medline, CINAHL, EMBASE) were searched and the Cochrane Risk of Bias Assessment Tool was applied by two independent reviewers. The GRADE system was used to assess the quality of evidence. A total of 45 articles (reporting on 36 studies) were included. The majority of studies (n=28; 78%) were conducted in the United States and published after 2009 (n=24; 67%). Thirteen studies (36%) used a randomised controlled trial design. A total of 17 studies evaluated patient-reported outcomes and 29 studies reported health service outcomes. The individual components of nurse care coordinator roles that were evaluated ranged considerably. The impact of nurse care coordination on patient-reported and health service outcomes was inconsistent. There was an indication from higher quality studies that nurse care coordination roles were more likely to result in improved patient and health service outcomes where they involved frequent, in-person interactions, had on-going follow-up with monitoring of disease status, and involved transition care and the application of behavior change principles.

Introduction

The fragmented process in which healthcare is typically delivered is failing people who have complex needs, potentially resulting needlessly in increased morbidity and distress as well as increased overall costs to the system. Improving the coordination of healthcare is one solution to this issue. Care coordination refers to a "person-centred, assessment based, interdisciplinary approach to integrating health care and social support services in a cost-effective manner in which an individual's needs and preferences are assessed, a comprehensive care plan is developed and services are managed and monitored by an evidence-based process which typically involves a designated lead care coordinator" (National Coalition on Care Coordination, 2011, p. 1). Internationally, an increasing number of health services are employing nurses into dedicated care coordinator positions as a strategy to improve coordination of care (Nutt & Hungerford, 2010). This systematic review examined the literature with regard to care coordinator roles performed by nurses to assist future development and implementation. The review was structured according to the following specific aims:

1. To describe the various components of the care coordinator role within the health system; and
2. To examine the impact of the care coordinator role and its various components on patient outcomes, and service delivery, from the perspective of patients, clinicians, and those working in the role;

Methods

Criteria for including studies in the review

Types of studies

Studies that used randomised controlled trial, non-randomised controlled trial, quasi-experimental and pre-post test designs were included.

Types of clinical settings

Studies that included participants who received health care in hospital and/or community settings were included.

Types of participants

Studies that included participants of any age (adults and/or children) receiving treatment for a health condition (acute or chronic) were included. Obstetric care was not considered as a treatment in this review so any studies that addressed pregnancy care were not included.

Types of interventions

Studies that included a group of participants who were allocated a nurse who provided them with a dedicated care coordination service were included. Studies that included a group of participants who were allocated a dedicated care coordinator to manage cancer were excluded because this was the subject of a recent comprehensive systematic review (Langbecker, Hunt, & Yates, 2014). Although it is acknowledged that coordination functions are an important part of the role for all health professionals, this review is focused solely on literature relating to the effectiveness of dedicated care coordinator roles. This review is not focused on examining the impact of other roles that have significant coordination functions, such as community mental health nurses or practice nurses. It is also not focusing on studies that examined replacing care usually delivered by medical practitioners by nurses or nurse practitioners that have significant coordination functions.

Types of comparisons

Studies with a comparison group of participants who were not allocated a care coordinator (historical or prospective) were included. Studies that did not have a comparison group (i.e. cohort studies reporting outcomes of participants who were allocated a care coordinator) were also included.

Types of outcomes

The types of patient-reported outcomes considered for inclusion in this review were: Quality of life; Symptom severity (physical and psychological); Concerns and problems; Self-efficacy; Knowledge (disease/self management); Continuity of care; Satisfaction with care (patient and family). The types of health service outcomes considered for inclusion were: Resource use (hospitalisation, length of stay, emergency department use, outpatient/clinic use, home visit use, hospice use, doctor visits, allied health service use, community service use, other health service use); Receiving appropriate care; Treatment time/delay; Treatment adherence; Follow-up adherence; Survival; Throughput; Costs; Coordinator satisfaction; Staff-reported understanding of the care coordinator role; and Staff-reported effectiveness of care coordinator role.

Search methods

Our review of the literature was limited to articles published in English from January 1, 1990 to November 2015. We searched Medline, CINAHL and Embase. Reference lists of all included articles and articles excluded following full-text screening (including reviews) were reviewed to identify additional literature not identified through database and web based searches. Search terms are listed in the supplementary file.

Screening and selection

Title and abstract screening was conducted by two reviewers independently. After the removal of articles which did not meet the initial title/abstract screening, the full text of

remaining articles was obtained and screened. Some included longitudinal studies involved more than one published article where results from the same outcomes were reported at different follow-up time points. Only the report with the longest follow-up was included in this review. Some care coordination programs had also been tested using multiple research designs (e.g. a pilot study followed up by a fully powered randomised controlled trial). In these circumstances, only outcomes from better designed studies were considered in this review.

Data abstraction and critical appraisal

Data were extracted from each article, including country, year of publication, study design, sample characteristics, key features of the care coordinator role, outcome measures and key findings. Randomised controlled trial, non-randomised controlled trial, quasi-experimental and pre-post test designs were evaluated for risk of bias using domains of the Cochrane Risk of Bias tool. Quality of evidence for outcomes was not downgraded due to performance bias because personnel could not be blinded for this form of intervention. An additional domain to assess risk of bias due to confounding was assessed for the non-randomised studies included in the review. Non-randomised studies included in this review were considered at high risk of bias due to confounding if the study did not (i) restrict participant selection so that all groups had the same value for the confounder; (ii) demonstrate balance between groups for the confounder; (iii) match on the confounder; or (iv) adjust for the confounder in statistical analyses to quantify the effect size. The quality of evidence from non-randomised studies was assigned low quality or downgraded to very low quality if concerns regarding risk of bias or imprecision were detected. We used the principles of the GRADE (Grades of Recommendation, Assessment, Development and Evaluation) system (Guyatt et al., 2008) to assess the quality of the body of evidence associated with the outcomes.

Data synthesis

Results are presented in two sections: 1) A description of the care coordinator roles used. Information about the individual components of care coordinator roles were extracted and summarized in a table included in the Supplementary Information; and 2) An analysis of the impact of care coordinators on outcomes. For consistency, results refer to 'care coordinator (CC)' and 'non-care coordinator (non-CC)' patients, regardless of the terminology used in the original study. It was not possible to conduct meta-analyses due to clinical heterogeneity and inconsistent reporting of outcomes. A narrative synthesis of the results from the included studies was performed.

Results

Search results

Results of the literature search are presented in Figure 1. A total of 45 articles, which reported outcomes from 36 studies, were included in this review.

Study characteristics

The majority of studies (n=28; 78%) were conducted in the United States and published after 2009 (n=24; 67%).Thirteen studies (36%) used a randomised controlled trial design. One study reported results from the Medicare Care Coordination Demonstration project, which involved 18309 participants randomised to receive care from a dedicated CC or control group in 15 separate sites (Peikes, Chen, Schore, & Brown, 2009). Although results from the sites were reported separately in this study, the research design used in each site was the same apart from slightly different implementation of the CC role. For this reason, risk of bias assessment was applied to the whole MCCD program evaluation. It should also be noted that an additional study where results from one individual MCCD site (Health Quality Partners)

was reported separately was included in this review (Coburn, Marcantonio, Lazansky, Keller, & Davis, 2012).

There was a high or unclear risk of selection bias for 6 RCTs (46%) and detection bias for 26 studies (72%). We found no clear evidence of selective reporting or other biases in the studies. Several non-randomised studies included in this review were considered at high risk of bias due to confounding (n=10; 43%).

A description of the study design, populations, outcomes reported and results of risk of bias assessments for each included study are presented in Table 1. More detailed summaries of the features of the care coordinator roles, populations they were targeted towards and results of outcomes included in this review is provided in Supplementary File Table 1.

Individual components of care coordinator roles

Care coordinator roles targeted towards populations defined as 'high risk' were common among the included studies (n=18; 50%) (Aiken et al., 2006; Aldeen, Courtney, Lindquist, Dresden, & Gravenor, 2014; Boult et al., 2013; Ciccone et al., 2010; Coburn et al., 2012; Coleman, Parry, Chalmers, & Min, 2006; Dajczman et al., 2013; Gravelle et al., 2007; Hajewski & Shirey, 2014; Hawkins et al., 2015; Kind et al., 2012; Koehler et al., 2009; Marek et al., 2013; Parsons et al., 2012; Peikes et al., 2009; Plant et al., 2015; Sidorov, Fisher, Girolami, & Wolke, 2002a; Sidorov et al., 2002b). Patients with diabetes were targeted in five studies (14%) (Barnett et al., 2006; Gabbay et al., 2013; Kogut, Johnson, Higgins, & Quilliam, 2012; Price, 1996; Sidorov et al., 2002b). People with dementia (Eloniemi-Sulkava, Notkola, & Hentinen, 2001; Engelhardt et al., 2008), with a terminal illness (Aiken et al., 2006; Sweeney, Halpert, & Waranoff, 2007) and children with special care needs (Berry et al., 2011; Taylor et al., 2013) were the target populations in two studies each. Other studies focused on people recovering from a stroke (Fens et al., 2015; Fens et al.,

2014), patients with COPD (Dajczman et al., 2013), people with bipolar disorder (Bauer et al., 2006), disabled with functional impairments (Jingping, Goehring, & Mancuso, 2015) and people either residing in (Boyd et al., 2014) or at high risk of requiring care in a residential aged care facility (Parsons et al., 2012).

A variety of different components were included in each care coordinator role. It was noted that advanced practice registered nurses were employed as CC in seven studies (19%) (Barnett et al., 2006; Gravelle et al., 2007; Koehler et al., 2009; Kruse et al., 2010; Marek, Adams, Stetzer, Popejoy, & Rantz, 2010; Marek et al., 2013; Parsons et al., 2012). Other studies simply noted that the care coordinators were Registered Nurses or nurses without stating their experience or qualifications for performing this role.

A frequent component of the CC roles was 'transition care', which was applied in some form in 11 studies (31%) (Boult et al., 2013; Coburn et al., 2012; Coleman et al., 2006; Dajczman et al., 2013; Hawkins et al., 2015; Kind et al., 2012; Koehler et al., 2009; Marek et al., 2013; Peikes et al., 2009; Plant et al., 2015; Taylor et al., 2013; White, Carney, Flynn, Marino, & Fields, 2014). Inclusion of an action plan for situations of clinical deterioration was a component of transition care for three of these CC roles (Coleman et al., 2006; Kind et al., 2012; Koehler et al., 2009). Three studies (9%), which all evaluated care coordination programs based in the primary care setting, used a 'Reach in' model of transition care that involved the CC working with in-patient teams when participants were hospitalised (Hawkins et al., 2015; Marek et al., 2013; White et al., 2014).

Development of a care plan was also a component of 11 studies (31%) (Aldeen et al., 2014; Berry et al., 2011; Boult et al., 2013; Ciccone et al., 2010; Coburn et al., 2012; Engelhardt et al., 2008; Gravelle et al., 2007; Hawkins et al., 2015; Peikes et al., 2009; Sweeney et al., 2007; Taylor et al., 2013). Arranging consultations with healthcare or community service

providers was a feature of the CC role used in 12 studies (33%) (Aldeen et al., 2014; Boult et al., 2013; Ciccone et al., 2010; Coburn et al., 2012; Eloniemi-Sulkava et al., 2001; Gabbay et al., 2013; Gravelle et al., 2007; Hajewski & Shirey, 2014; Kruse et al., 2010; Parsons et al., 2012; Plant et al., 2015; Sidorov et al., 2002a). The CC delivered services for patients for a defined time-period in eight studies (22%) (Fens et al., 2014; Gabbay et al., 2013; Kind et al., 2012; Koehler et al., 2009; Plant et al., 2015; Sidorov et al., 2002a; Sweeney et al., 2007; White et al., 2014).

Education about disease and self management was a component of the CC role evaluated in 11 studies (31%) (Aiken et al., 2006; Barnett et al., 2006; Boult et al., 2013; Dajczman et al., 2013; Engelhardt et al., 2008; Koehler et al., 2009; Kruse et al., 2010; Peikes et al., 2009; Price, 1996; Sidorov et al., 2002a).Five studies (14%) (Ciccone et al., 2010; Coburn et al., 2012; Gabbay et al., 2013; Gravelle et al., 2007; Kogut et al., 2012) used behaviour change or health coaching principles to promote the uptake of recommended health maintenance practices. Interventions targeted at medication management or adherence were included in nine (25%) of the CC roles (Coburn et al., 2012; Coleman et al., 2006; Engelhardt et al., 2008; Gabbay et al., 2013; Hawkins et al., 2015; Kogut et al., 2012; Kruse et al., 2010; Marek et al., 2013; Price, 1996).

Contact with participants was made using in-home visits in eight (22%) of the CC roles included in this review (Coburn et al., 2012; Eloniemi-Sulkava et al., 2001; Engelhardt et al., 2008; Fens et al., 2014; Hawkins et al., 2015; Kind et al., 2012; Marek et al., 2013; Sweeney et al., 2007). Participants visited the CC in a clinic in four studies (11%) (Bauer et al., 2006; Coburn et al., 2012; Gabbay et al., 2013; Kruse et al., 2010). Telephone follow-up was common, being used in 13 studies (36%) (Barnett et al., 2006; Bauer et al., 2006; Coburn et al., 2012; Coleman et al., 2006; Eloniemi-Sulkava et al., 2001; Gabbay et al., 2013; Hawkins et al., 2015; Kind et al., 2012; Koehler et al., 2009; Kruse et al., 2010; Peikes et al., 2009;

Sweeney et al., 2007; White et al., 2014). Health status of patients was monitored by the CC in eight (22%) studies (Barnett et al., 2006; Boult et al., 2013; Gabbay et al., 2013; Gravelle et al., 2007; Hawkins et al., 2015; Marek et al., 2013; Price, 1996; Sweeney et al., 2007), including one study that utilised daily telemonitoring(Barnett et al., 2006). It was noted in five studies (14%) that the CC was the designated key contact person for patients or that they were available to be contacted (Dajczman et al., 2013; Eloniemi-Sulkava et al., 2001; Gabbay et al., 2013; Kruse et al., 2010; Taylor et al., 2013).

Physician collaboration was a core feature of the CC role employed in six studies (17%), (Bauer et al., 2006; Boyd et al., 2014; Coburn et al., 2012; Dajczman et al., 2013; Hajewski & Shirey, 2014; Parsons et al., 2012) whereas the CC provided education to patients about how to communicate with health care team in three further studies (9%) (Engelhardt et al., 2008; Peikes et al., 2009; Taylor et al., 2013). One study reported that the CC would communicate with members of the health care team on the patient's behalf if it was required (Sweeney et al., 2007).

Impact of the care coordinator role on patient-reported outcomes

Quality of life

Twelve studies reported about the effect of care coordination on health-related quality of life (Supplementary File Table 2). Moderate and high quality evidence from four RCTs, in addition to the report of outcomes from the 15 MCCD sites, indicated that receiving care from a CC did not have an impact on health-related quality of life for elderly patients or those with chronic disease (Boult et al., 2013; Gabbay et al., 2013; Parsons et al., 2012; Peikes et al., 2009; Plant et al., 2015). In contrast, high quality evidence from a trial that enrolled elderly patients who had impaired ability to manage medications, identified that intervention participants had better quality of life than the control group (Marek et al., 2013). It should be

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noted that CC in this trial involved more frequent contact with participants compared with the other trials (CC provided bi-weekly in-home visits for the duration of follow-up). Bauer et al., (2006) reported that the participants with bipolar disorder who received care from the CC had better scores in the mental component summary score of the SF-36 but not the physical component score. Although greater quality of life was reported by the CC group in a trial that enrolled patients with a terminal illness (Aiken et al., 2006), the evidence rating was downgraded to low quality due to attrition bias (only 45% of the 190 participants included in analysis).

Psychological morbidity

Six studies reported outcomes that were grouped under the term psychological morbidity (Supplementary File Table 3). High quality evidence from a trial of a care coordination role that involved bi-weekly home visits from an Advanced Practice Nurse for elderly patients with impaired ability to manage medications reported that depression scores were significantly better than the control group (Marek et al., 2013). Moderate quality evidence from a randomised controlled trial of nurse case management of diabetes that involved care coordination found that this intervention reduced depression symptoms at the 2 year follow-up time-point (Gabbay et al., 2013). In contrast, no effect of CC on depression was observed in any of the 15 programs included in the MCCD (Peikes et al., 2009). Only three of the 15 MCCD programs produced a moderate improvement in emotional distress (Peikes et al., 2009). However, it should be noted that a validated tool to measure severity of depressive symptoms or emotional distress was not used in this study and we downgraded the quality of evidence to moderate quality for this reason. The other included studies that reported on psychological morbidity were non-randomised comparisons and the evidence was rated as low or very low quality.

Physical Symptoms

Four studies reported on the effect of CC roles on physical symptoms (Supplementary File Table 4). Two of the 12 programs from the MCCD identified moderate improvement in sleep (defined as a rating of being bothered by poor sleep most or all of the time) and pain (defined as pain interfering with usual activities) (Peikes et al., 2009). However, it should be noted that a validated tool to measure these symptoms was not used in this study and we downgraded the quality of evidence to moderate quality for this reason.

Evidence regarding the effect of a CC on physical symptoms from another RCT was also downgraded to moderate due to risk of attrition bias and imprecision (Aiken et al., 2006). The effect of a CC on physical symptoms was inconsistent. Participants randomised to a CC who had a diagnosis of COPD reported lower symptom distress than the control group while participants randomised to CC who had a diagnosis of CHF reported higher symptom distress. The authors noted that the criteria used for study entry resulted in one-third of the sample dying or being transferred to a hospice within the first three months (Aiken et al., 2006).

Satisfaction with care and care coordinator

High quality evidence from two RCTs was identified regarding the effect of CC on satisfaction with care (Supplementary File Table 5). In a trial of CC for bipolar disorder, participants who were randomised to the CC reported greater satisfaction with care (measured using the Patient Satisfaction Index) than the control group (p<0.001) (Bauer et al., 2006). Likewise, elderly patients at high risk of readmission who were randomised to a CC also reported greater satisfaction with care (measured with the Patient assessment of chronic illness care) (Boult et al., 2013). In contrast, no difference in Diabetes Treatment Satisfaction Questionnaire scores were observed in a randomised trial at 2 year follow-up (Gabbay et al.,

2013). There was also low quality evidence identified that nearly all patients (>97%) recovering from a stroke who received care from a CC were satisfied both with their care in general as well as care provided by the CC in particular (Fens et al., 2014).

Only low or very low quality evidence from either single group or non-randomised comparisons was identified for the outcomes of family-reported and staff-reported satisfaction with care and care coordinators (Supplementary File Tables 6-9). All studies reported positive satisfaction with care and care coordinators, including the two that enrolled children (Berry et al., 2011; Engelhardt et al., 2008; Fens et al., 2015; Fens et al., 2014; Taylor et al., 2013).

Impact of the care coordinator role on health service outcomes

Hospitalisations

The effect of a CC on hospitalisations was reported by 18 studies (Supplementary File Table 10) (Boyd et al., 2014; Hajewski & Shirey, 2014). High quality evidence was identified from the MCCD program that CCs did not impact hospitalisations (Peikes et al., 2009). A statistically significant reduction in average annualized rate of hospitalisations was observed in the CC group for only one of the 15 programs included in the evaluation (Peikes et al., 2009). One additional program, Health Quality Partners, resulted in 11% (not statistically significant) reductions in hospitalisations for the CC group (Peikes et al., 2009). The differences between CC and usual care in this program were concentrated in the 'high-risk' group, suggesting that targeting this sub-population for CC intervention may be most appropriate and requires further investigations (Peikes et al., 2009).

Further high quality evidence from a trial conducted within an emergency department in Australia also identified that rates of hospitalisations were not different between groups over two years follow-up (Plant et al., 2015). Evidence from a matched pair cluster RCT

conducted with elderly patients identified to be at high risk of readmission was downgraded to moderate quality due to imprecision (Boult et al., 2013). Reductions in the rate of overall hospital admissions (6% less in CC group) and 30-day readmissions (13% less in CC group) were identified but the difference between groups was not statistically significant (Boult et al., 2013).

In contrast, the majority (n=9; 69%) of the low quality evidence derived from studies that utilised non-randomised comparison group and single group pre-post designs reported that significant reductions in hospitalisations were associated with CCs (Barnett et al., 2006; Boyd et al., 2014; Dajczman et al., 2013; Engelhardt et al., 2008; Hawkins et al., 2015; Jingping et al., 2015; Sweeney et al., 2007).

Length of stay

There were 12 studies that reported on the effect of a CC on length of stay included in this review (Supplementary File Table 11). Moderate quality evidence from the two RCTs indicated that there was no difference in hospital length of stay (Bauer et al., 2006; Plant et al., 2015). Low and very low quality evidence from several non-randomised studies was inconsistent (Aldeen et al., 2014; Barnett et al., 2006; Dajczman et al., 2013; Engelhardt et al., 2008; Hajewski & Shirey, 2014; Kind et al., 2012; Koehler et al., 2009; Kruse et al., 2010; Sidorov et al., 2002b; Sweeney et al., 2007)

Emergency department use

A total of 11 studies reported on the effect of a CC on emergency department utilisation (Supplementary File Table 12). There were no statistically significant differences identified between CC and non-CC groups in the three RCTs that reported on this outcome (Aiken et al., 2006; Boult et al., 2013; Plant et al., 2015). However, the quality of evidence was

downgraded to moderate quality due to imprecision (Boult et al., 2013; Plant et al., 2015) or attrition bias (Aiken et al., 2006).

The low and very low quality evidence was less consistent. The non-randomised studies with small sample sizes tended to produce more positive results for CC on emergency department use (Dajczman et al., 2013; Kruse et al., 2010; Sweeney et al., 2007). By contrast, a propensity score matched study of the implementation of the Evercare care coordination program into 9 NHS primary care trusts in the UK identified that CC did not reduce the likelihood of an admission to the ED (Gravelle et al., 2007). Another large non-randomised study, which was focused on patients with chronic disease failed to detect a statistically different difference between CC and non-CC groups in the mean number of emergency department visits over 2 years follow-up (Sidorov et al., 2002a).

Other health service use

Two non-randomised studies reported on outpatient/clinic use (Supplementary File Table 13) (Barnett et al., 2006; Kruse et al., 2010). No statistically significant differences between groups were identified. One RCT reported a 29% reduction in home healthcare use for the group of participants who were randomised to CC (Supplementary File Table 14) (Boult et al., 2013). Five studies reported on the effect of CC on use of primary care services (Supplementary File Table 15 & 16). One used a RCT design (Boult et al., 2013). No difference between groups was identified downgraded to moderate quality due to imprecision (Boult et al., 2013). The low quality evidence from three studies that used non-randomised comparison groups was inconsistent.

Receipt of appropriate care and treatment adherence

Two studies reported on the effect of CCs on receipt of appropriate care for diabetes (Supplementary File Table 16). In one study, CC patients were similarly likely to have all 5

recommended processes of care performed (40.1% vs 38.9%; p = 0.543) as propensity score matched controls (graded as low quality evidence) (Kogut et al., 2012). Screening for diabetic complications was more likely to be carried out for participants randomised to receive nurse case management, which involved care coordination (Gabbay et al., 2013). One RCT reported that the average percent of correct doses per month was 98.8% in the CC group who received a medication dispenser and 97.4% in the CC group who received a pill organizer (Supplementary File Table 17) (Marek et al., 2013).

<u>Survival</u>

A total of 13 studies reported on the effect of CC on survival (Supplementary File Table 18). High quality evidence from a large RCT identified that CC improved survival over a 6-year follow-up period (adjusted HR 0.73; 95% CI=0.55-0.98) (Coburn et al., 2012). This study reported results from the Health Quality Partners program, which was one of the MCCD sites. It involved care coordination by a nurse with frequent telephone follow-up. The evidence from the five other RCTs that reported on survival was downgraded to moderate quality due to imprecision (Bauer et al., 2006; Boult et al., 2013; Eloniemi-Sulkava et al., 2001; Parsons et al., 2012; Plant et al., 2015).

Large scale observational studies, which used propensity score matching to control confounding, did not identify differences in survival between CC and non-CC groups. For example, the implementation of the Evercare program into 62 primary care practices in the UK was found to have no effect on survival (mortality increased 5.5%; 95% CI=-3.5% to 14.5%) (Gravelle et al., 2007). The Evercare program involved development of individualized care plans followed by monitoring by a nurse CC for people aged over 65 with a previous admission to an emergency department (Gravelle et al., 2007). There was no difference in the likelihood of 12-month all-cause mortality between patients with a disability

who received in-person education and self-management support using behaviour management principles from a nurse CC and non-CC groups (OR 0.82; p=0.39) (Jingping et al., 2015). In contrast, diabetic veterans who received a home telehealth care coordination intervention survived longer than a propensity score matched control group (adjusted HR 0.7; 95% CI=0.5-0.9) (Chumbler et al., 2009).

Health service costs

There were 14 studies included in this review that reported on the effect of CC on health care costs (Supplementary File Table 19). Most of the studies compared total health care costs between CC and non-CC groups. A cost-utility analysis was undertaken for one program (Barnett et al., 2007). There was considerable uncertainty regarding the cost-effectiveness of the program under evaluation (CC involving home telehealth care using disease management protocols for diabetics) (Barnett et al., 2007). The mean ICER was more than $60000 and the program was considered cost-effective for only one-third of the participants (Barnett et al., 2007).

A noteworthy finding is that none of the programs in the MCCD evaluation generated savings in health care costs (calculated from Medicare claims) (Peikes et al., 2009). In contrast, high quality evidence from two other RCTs included in this review did identify that CC interventions with frequent follow-up and transition care reduced health care costs (Coleman et al., 2006; Marek et al., 2014). The Care Transitions program, which involved in-person contact with inpatients and a 28-day post-discharge follow-up program involving care coordination, resulted in lower health care costs at 90 and 180 days post-hospitalisation (Coleman et al., 2006). A care coordination intervention targeted at geriatric patients with an impaired ability to manage medications, which involved a program of bi-weekly in-person

contact during which interventions to improve medication adherence and care coordination were provided, resulted in $296 savings per month (Marek et al., 2014).

Discussion

A key finding of this systematic review was that the individual components of nurse care coordinator roles ranged considerably. Not surprisingly, the impact of nurse care coordination on patient-reported and health service outcomes was also inconsistent. There was an indication from higher quality studies that nurse care coordination roles did result in improved patient and health service outcomes where they involved frequent, in-person interactions, had on-going follow-up with monitoring of disease status, and involved transition care and the application of behavior change principles (Coburn et al., 2012; Gabbay et al., 2013; Marek et al., 2013). Our finding that nurse care coordinator roles were more likely to have positive effects on some patient-reported and health service outcomes when they were characterised by more frequent contact over time and based on evidence based principles of behaviour change is consistent with previous systematic reviews of other similar care coordinator roles (Manderson, McMurray, Piraino, & Stolee, 2012; Sutherland & Hayter, 2009). It was reported that nurse case management resulted in positive results on health outcomes such as objective clinical measurements, quality of life, patient satisfaction, adherence to treatment, self-care and service use (Sutherland & Hayter, 2009). Manderson et al. (2012) reported that some evidence was identified in support of a 'navigator' role that involved a variety of interventions including care plans and treatment goals. There is an important methodological difference between the previous and our present review that should be considered though. We assessed the risk of bias for each included study and incorporated the GRADE system for appraising the quality of evidence, as is recommended for systematic reviews (Moher, Liberati, Tetzlaff, & Altman, 2009). A tool to appraise the quality of the evidence was not used in the previous systematic reviews of similar care coordinator roles

(Manderson et al., 2012; Sutherland & Hayter, 2009). As such, it is unclear whether or not the conclusions drawn in the previous systematic reviews about the effects of care coordination may have been different had the quality of research design in the primary studies been assessed.

It should be noted that we limited our review to studies that included a care coordinator role performed by a nurse. In a recently published review of care coordinator roles (defined as navigators), which did not have professional qualification as a nurse as an inclusion criteria, it was identified that nurses were most frequently employed as the care coordinators (Manderson et al., 2012). Lay persons or allied health professionals, such as physiotherapists or social workers, were also commonly employed to fulfil the care coordinator roles (Manderson et al., 2012). In that review, results of individual studies were not compared to determine whether or not the professional qualifications of the care coordinator had an impact on the effectiveness of the model of care. Reassuringly, in a different systematic review, it was identified that successful programs assigned a nurse to be the case manager (Naylor, Aiken, Kurtzman, Olds, & Hirschman, 2011). Therefore, our focus on nurse care coordination was justified.

Our finding that nurse care coordinator roles that included a transitional care component frequently improved a range of patient and health service outcomes is also consistent with results from studies that specifically evaluated transitional care interventions performed by nurses. A systematic review identified that transition care was consistently associated with reduced readmissions in the short-term (typically 30 days) and, subsequently, a reduction in overall health care costs (Naylor et al., 2011). Due to the nature of the research designs of studies included in our review, though, it is unclear whether, or to what extent, the transitional care component of the nurse care coordinator intervention exerted an effect on outcomes. A randomised controlled trial that directly compares a transitional care

intervention in isolation with a care coordination intervention that involves transitional care as one component of care would be required for such clarity.

A high quality study of a nurse care coordinator role produced positive long-term health outcomes (Coburn et al., 2012). Previous randomised controlled trials that did not involve care coordination have identified that disease self-management programs guided by behaviour change principles also improved patient outcomes (Rubak, Sandbæk, Lauritzen, & Christensen, 2005). Therefore, it is possible that that the use of behaviour change principles to guide intervention components focused on disease self-management may have been a mediating factor for the positive impact observed in the care coordinator trial included in our review (Coburn et al., 2012).

Although a key feature of nurse care coordination that produced positive impacts on patient-reported and health service outcomes was targeted at specific populations deemed to be at 'high risk', the actual patient selection strategies employed across this sub-group of studies still differed considerably. As a result of this variation we were unable to determine whether a specific 'high-risk' patient selection strategy was the most effective in recruiting patients who would benefit most from care coordination. It is notable that most studies did not utilise a validated risk-stratification model for patient selection. Instead, participants were selected as 'high risk' based on arbitrarily set cut-offs for age (typically 65), the presence of specific chronic conditions, such as heart failure or diabetes, and recent unplanned hospital admissions (or a combination of these). It may be more appropriate for future evaluations of nurse care coordinator programs to devise a patient selection strategy based upon a risk-stratification model developed using local data in order to target the role towards patients who are most likely to derive the greatest benefit. However, the impact of conducting patient selection using information derived from a risk-stratification model on the operational requirements of participant recruitment for a nurse care coordinator program is unknown. It is

possible that extra resources are required to implement this particular patient selection strategy, which could potentially offset the (already limited) potential for overall cost-savings associated with such programs. For these reasons, we recommend that further research be conducted to explore the issues and challenges associated with particular patient selection strategies.

An alternative patient selection strategy is to identify patients who will benefit from the main target of the particular nurse care coordinator role being employed. Only one study included in our review utilised such a strategy (Marek et al., 2013). A randomised controlled trial of a nurse care coordinator focused on promoting medication adherence appropriately enrolled only elderly patients who had confirmed difficulty managing medications, based on assessment using a validated instrument (Marek et al., 2013).

There are a number of possible explanations for the lack of/inconsistent evidence regarding the impact of nurse care coordinator roles across a broad range of outcomes. One potential reason why some of the nurse care coordinator roles failed to improve health service outcomes, such as hospitalisations and health care costs, could have been their strategy used for patient selection. Some studies relied on clinician referrals for inclusion in the nurse care coordination program. There is a possibility that provider referral identifies patients that are challenging to manage, but not necessarily those at high risk for future health care utilization and costs. In this regard, it should be noted that the general purpose of care coordination is to assist patients to effectively engage with the complex range of health services required to manage complex disease states. However, an actual measure of 'care complexity' was not used to guide patient selection for any of the included studies in this review. Further research into whether measuring care complexity and using this information to inform patient selection would be a feasible and (more) effective strategy for selection of only patients with confirmed complex care needs into nurse care coordinator programs would be worthwhile.

Methodological limitations of the available studies also need to be considered. Some studies produced only low or very low quality evidence, meaning that further research is likely to have an impact on estimates of the impact of the nurse CC role on patient and health service outcomes. For this reason, conducting further research of better quality (i.e. randomised trials adhering to CONSORT recommendations for allocation concealment and blinding of outcomes assessment with larger sample sizes to improve effect estimate precision) would increase confidence in our estimates of the potential clinical benefits for some of the nurse care coordinator roles evaluated.

There was also a considerable degree of inconsistency across the included studies in terms of the outcomes assessed. As the role focused specifically on coordination of care, outcomes relating to health service use and patient experience of care may be a more appropriate target than other patient reported outcomes that are subject to a broader range of other influences that are beyond the scope of the coordinator role.

Many studies provided insufficient detail about the intervention (for example, the expertise and qualifications of the CC). As such, it was difficult to determine how frequently specific elements of care coordinator roles were implemented for participants across different studies. Inadequate descriptions of intervention components is a major problem because without this vital information, other researchers will not be able to replicate as well as build upon research findings and clinicians will be unable to implement the effective intervention that was evaluated. For this reason, we recommend that future research into evaluations of nurse care coordinator roles consider utilising existing tools to improve the reporting of intervention descriptions, such as the TiDIER checklist (Hoffmann et al., 2014).

Selection bias may have impacted the results of the individual studies included in this review. Patients who enrolled into research studies focused on improving care coordination were

likely to have been more motivated to engage in related activities, while the more vulnerable patients that were less motivated to participate in research may not have been as likely to be included. Regarding the generalisability of the evidence identified in this review, it should be noted that the evidence concerning nurse care coordinators identified in this review was almost exclusively derived from an adult population. Only two studies included in the review enrolled children (Berry et al., 2011; Taylor et al., 2013). The outcome reported in these studies was family-reported satisfaction with the care coordinator. Further research into the effectiveness of nurse care coordination on patient and health service outcomes is therefore required.

It should be noted that our review was focused on the effect of nurse care coordinators on patient-reported and health service outcomes, regardless of the terms that were used in the individual studies to define the role. The lack of standardised definitions in this field meant that several terms were used to describe the roles performed by nurses included in this review, such as nurse care coordinator, nurse case manager and nurse navigator. Several studies that used the term 'case management' or 'case manager' that we reviewed in full-text were excluded because care coordination was not a component of the role.

Implications for Practice

The findings of this review confirm the potential that nurse care coordinator roles improve patient and health service outcomes. Suggested actions to support implementation of our findings into a health service's nurse care coordination functions are provided in Table 2. To achieve optimal outcomes for the health system, the findings suggest that care coordinator roles should have some key features, including ongoing contact with the patient over time. However, given the variability in patient needs, the available studies do not provide specific guidance on a particular 'dose' or frequency of contact. Presumably, such decisions need to

be based on a careful assessment of patient need. Furthermore, the findings of this review

also suggest that care coordinators need to be capable of implementing evidence based

principles of behaviour change. Such capabilities reflect a more advanced level of nursing

practice and indicate that nurse care coordinators need specific education in such techniques.

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Figure 1. PRISMA flow diagram

Identification

Records identified through database searching
(n=2529)

Additional records identified through other sources
(n=16)

Records after duplicates removed
(n=2313)

Screening

Records screened
(n=2329)

Records excluded
(n=2106)

Eligibility

Full-text articles assessed for eligibility
(n=222)

Full-text articles excluded, with reasons
(n = 167)
12 no dedicated care coordinator
9 no relevant outcomes
12 did not involve care coordination
1 poor reporting; 1 only abstract available
68 non-nurse care coordinator
1 nurse practitioner replaced care
58 Cancer care
1 Wrong study design
4 Wrong intervention
1 focused on referral
1 maternity
2 Review papers

Included

Studies included
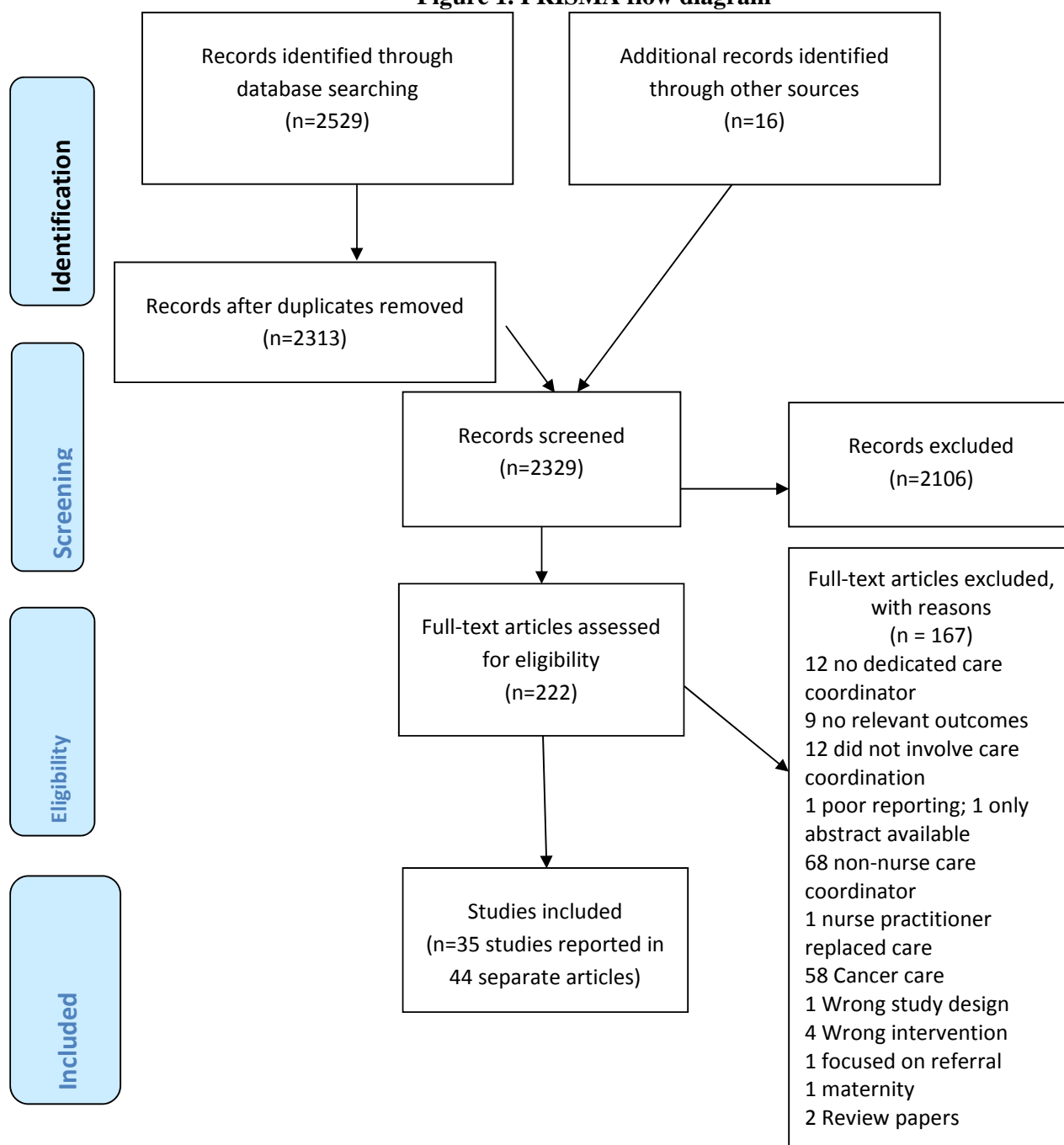(n=35 studies reported in 44 separate articles)

Table 1: Characteristics of included studies

Study, Country	Design	Participants	Care coordinator intervention	Outcome measures	Risk of bias assessment						
					RSG	**AC**	**BO**	**IO**	**SR**	**C**	**O**
Aiken et al. (2006), US	RCT	Chronic heart failure or Chronic Obstructive Pulmonary Disease with a 2-year life expectancy N=62 COPD N=130 CHF	Home-based case management	Physical symptoms, quality of life, ED visits	L	L	L	H	L	NA	L
Aldeen et al. (2014), US	Non-randomised comparison	N=408 CC compared with 6806 non-CC (total 7214) Adult patients older than 65 entering the ED who screened positive on the Identification of Seniors at Risk (ISAR) tool or were referred to	Nurse liaison in the emergency department	Hospitalisations, length of stay, ED visits, survival	NA	NA	H	L	L	H	L

		the care coordinator by an ED physician.									
Atherly and Thorpe (2011), US	Non-randomised comparison	N= 23630 'High-cost (Medicare) beneficiaries with complex diabetes and/or congestive heart failure'	Nurse case manager	Health care costs	NA	NA	U	L	L	L	L
CCHT (Barnett et al., 2006; Chumbler et al., 2005; Neugaard, Kobb, Ryan, Qin, & Joo, 2005), US	Retrospective, concurrent matched cohort study design with qualitative substudy	N=391 patients with diabetes	Home telehealth coordinated by a nurse	Quality of life, hospitalisation, length of stay, ED visits, outpatient clinic visits, survival, qualitative findings, ICER	NA	NA	U	L	L	L	L
Bauer et al. (2006), US	RCT	N=306 patients with bipolar disorder	Nurse care coordinator clinic visits and telephone support	Quality of life, satisfaction with care, length of stay, health care costs, survival	L	U	L	L	L	NA	L
Berry et al. (2011), US	Pre-post test	N=92 received CC and n=81 did not receive CC Children with special health care needs	Nurse care coordinator	Family-reported satisfaction with coordinator	NA	NA	H	H	L	H	L

Study	Design	Participants	Intervention	Outcomes							
Guided Care intervention (Boult et al., 2013; Boult et al., 2008; Boult et al., 2011; Boyd et al., 2010), US	Matched-pair cluster-randomised	Elderly patients at high risk of generating high health expenditures (identified by the 'Hierarchical Condition Category - HCC' predictive model)	Registered nurse guided care providing: comprehensive assessment, evidence-based care planning, proactive monitoring, care coordination, transitional care, coaching for self-management, caregiver support and access to community-based services.	Quality of life, satisfaction with care, hospitalisation, ED visits, home visits, primary care visits, survival	L	L	L	L	L	NA	L
Boyd et al. (2014), NZ	Quality improvement study where facilities were randomly assigned to receive the intervention.	Residents of 29 facilities randomised to care coordination were compared with 25 facilities that did not receive care coordination	Comprehensive geriatric assessment and liaison with primary care and specialist services.	Hospitalisations	U	U	H	H	L	NA	L
Medicare Coordinated Care Demonstration (Brown, Peikes, Chen, & Schore, 2008; Brown, Peikes,	Multi-site RCT	N=18309 Medicare beneficiaries with a chronic condition (site specific exclusion criteria included a hospitalisation within the last 12 months, under 65,	15 programs were included and each varied in care coordination implementation.	Quality of life, psychological morbidity, physical symptoms, hospitalisation, health care costs	L	L	L	L	L	NA	L

Study	Design	Population	Intervention	Outcome							
Peterson, Schore, & Razafindrako to, 2012; Peikes et al., 2009), US		end-stage renal disease)									
Ciccone et al. (2010), Italy	Single group longitudinal study	Heart failure or diabetes	Nurse case management in primary setting	Quality of life	NA	NA	U	H	U	H	L
Health Quality Partners(Coburn et al., 2012), US	RCT	N=1736 patients over 35 with chronic disease	Nurse case management in community	Survival	L	L	L	L	L	NA	L
Care Transitions (Coleman et al., 2006; Coleman et al., 2004), US	RCT	N=750 inpatients with at least 1 of 11 diagnoses, including stroke, congestive heart failure, coronary artery disease, cardiac arrhythmias, chronic obstructive pulmonary disease, diabetes mellitus, spinal stenosis, hip fracture, peripheral	Care transition after discharge from acute care	Hospitalisations, health care costs	L	U	L	L	L	NA	L

		vascular disease, deep venous thrombosis, and pulmonary embolism.									
Dajczman et al. (2013), France	Pre-post test	n=202 with COPD	Nurse navigator	Hospitalisations, length of stay, ED visits	NA	NA	U	L	L	H	L
Eloniemi-Sulkava et al. (2001), Finland	RCT	N=100 demented patients and their families	Nurse case manager	Survival	U	H	U	U	U	NA	L
Engelhardt et al. (2008), US	Non-randomised comparison	36 patients with Alzheimer's disease and their carers compared with 113 control patients	Telephone case management	Family-reported satisfaction with care, hospitalisations, length of stay, survival, health care costs	NA	NA	L	L	U	H	L
Sweeney et al. (2007), US	Non-randomised controlled trial	N=358 CC and 398 non CC life-limiting diagnosis with multiple comorbid conditions (75% were oncology patients)	Nurse care coordinator	Psychological morbidity, physical symptoms, hospitalisations, length of stay, ED visits, survival, health care costs	NA	NA	L	L	L	H	L

Fens et al. (2015), Holland	Non-randomised controlled trial	N=62 CC and n=55 non-CC Stroke survivors and their caregivers	Home visits by stroke care coordinator	Quality of life, psychological morbidity, satisfaction with care, satisfaction with coordinator, family-reported satisfaction with care, family-reported satisfaction with coordinator	NA	NA	U	H	L	L	L
Evercare (Gravelle et al., 2007), UK	Pre-post comparison with non-randomised propensity-score matched comparison and separate qualitative multiple case study evaluation	9 primary care trusts in the UK including 64 intervention practices compared with 6960-7695 practices (depending on outcome)	Evercare – nurse case manager	ED visits, mortality	NA	NA	U	L	L	L	L
Gabbay et al. (2013), US	Randomised controlled trial	545 participants with diabetes classified as 'high risk' for complications (e.g. high blood pressure, dyslipidaemia)	Nurse case manager	Quality of life, psychological morbidity, satisfaction with care	H	H	U	H	U	H	L
Hajewski and Shirey (2014), US	Pre-post non-randomised control group comparison	Total number of patients included was not reported. One in-patient unit was	Nurse case manager on an in-patient ward	Hospitalisations, length of stay	NA	NA	U	U	U	H	H

					NA	NA	U	L	L	L	L
		compared with another control unit									
High Risk Case Management (Hawkins et al., 2015), US	Non-randomised comparison (propensity score matched control group qualified for program but did not participate)	2015 participants compared with 7626 nonparticipants Medigap insured individuals who had Hierarchical Condition Category (HCC) scores greater than 3.74 (predicts health care costs) or were referred to the program	Nurse case manager	Hospitalisations, health care costs	NA	NA	U	L	L	L	L
Jingping et al. (2015), US	Non-randomised comparison with propensity score matched control group	907 CC group compared with 907 matched controls Disabled (functional limitations who received in-home personal care to assist with activities of daily living)	Nurse case manager	Hospitalisations, ED visits, survival, health care costs	NA	NA	U	L	L	L	L

Kind et al. (2012), US	Pre-post test	605 participants included in intervention period compared with 103 participants in baseline period	Nurse case manager for transition back to community from acute care	Hospitalisations, length of stay, health care costs	NA	NA	U	L	L	L	H
		Hospitalised on medical or surgical ward with dementia, delirium, cognitive impairment or over 65 and living alone or previously hospitalised with 12 months.									
Koehler et al. (2009), US	Pilot RCT	41 medical inpatients predisposed to readmission	Nurse care coordination post-discharge with phone follow-up	Hospitalisations, length of stay	L	L	U	L	L	NA	H
Kogut et al. (2012), US	Retrospective, cross sectional study	CC=649; non-CC=9049	Nurse case manager	Receipt of appropriate care	NA	NA	H	U	U	L	L
Kruse et al. (2010), US	Matched case control	CC= 130; non-CC=249	Nurse practitioner care manager	Hospitalisations, length of stay, ED visits, specialist visits, primary care provider visits, survival	NA	NA	H	L	L	L	L

Study	Design	Sample	Intervention	Outcomes							
Nurse Care Coordination for Elderly with impaired self-management (Marek et al., 2014; Marek et al., 2013), US	RCT	N=414	Nurse care coordinator	Quality of Life, psychological morbidity, treatment adherence, health care costs	L	L	L	L	L	NA	L
Marek, Popejoy, Petroski, and Rantz (2006), US	Quasi-experimental design	CC=55; non-CC=30	Nurse care coordinator	Psychological morbidity, physical symptoms	NA	NA	U	H	L	L	L
Marek et al. (2010), US	Retrospective cohort design with non-randomised comparison group	CC=57; non-CC=80	Nurse care coordinator	Costs	NA	NA	U	L	L	L	L
Parsons et al. (2012), NZ	Cluster RCT	N=351 Older adults assessed as being at high risk of being placed in residential care	Case manager in primary care	Quality of life, survival	L	L	H	L	L	NA	L
Plant et al. (2015), Australia	RCT	N=500 patients with chronic illness admitted to an emergency department	Nurse-led care navigation	Quality of life, hospitalisations, length of stay, ED visits, survival	L	L	L	L	L	NA	L

Study	Design	Sample	Intervention	Outcome	RSG	AC	BO	IO	SR	C	O
Price (1996), US	RCT	N=251 (188 CC) diabetics	Nurse co-ordinated care	Quality of life	U	U	U	L	L	NA	L
Sidorov et al. (2002b), US	Non-randomised comparison	N=3118 CC; n=3681 non-CC diabetics	Disease management coordinated by a nurse	Hospitalisations, length of stay ED visits, primary care visits, health care costs	NA	NA	U	L	L	L	L
Sidorov et al. (2002a), US	Pre-post test	N=396 asthmatics; n=3556 diabetics; n=1795 chronic heart failure	Disease management coordinated by a nurse	Health care costs	NA	NA	U	L	L	H	L
Taylor et al. (2013), US	Cross sectional survey 12 months after implementation of CC position with non-randomised comparison group	N=25 children	Care coordinator	Family-reported satisfaction with care coordination	NA	NA	U	H	L	H	L
White et al. (2014), US	Non-randomised comparison	N=961 (685 CC group)	Care manager	Hospitalisations	NA	NA	U	L	L	H	L

RSG= Randomisation sequence generation; AC=Allocation concealment; BO=Blinded outcome assessment; IO= Incomplete outcome reporting; SR= Selective outcome reporting; C=Confounding; O= Other sources of bias; U=Unclear risk of bias; H=High risk of bias; L=Low risk of bias; NA= Not applicable for the study design.

Table 2. Implementation recommendations
1. *Have a system that facilitates effective targeting of care coordination for high-risk patients (e.g. elderly, with chronic disease, poor health literacy, impaired ability to manage treatment, medications or self-care/self-management)*
a. A target population has been designated
b. A systematic screening process to identify target population has been implemented
c. A recruitment strategy to maximize uptake within the target population has been implemented
d. Data about screening and patient recruitment activities is being captured
e. The effectiveness of screening and recruitment is being evaluated periodically to identify if areas of the process that could be improved
2. *Enable the participants to establish a sense of confidence in the care coordinator by providing regular and in-person contact over the course of the follow-up*
a. Resources to support in-home visits and/or dedicated clinic time have been allocated
b. Communication technologies are available to ensure the patient can contact the care coordinator (voicemail, email, sms, web-based shared care platform)
c. Process designed to facilitate shared/collaborative development of treatment goals and corresponding care plans
d. Patient satisfaction with the care coordinator is being evaluated periodically
3. *Promote the integration of the care coordinator with the health care team (promoting frequent and direct collaboration with physicians who are supportive of the role);*
a. Activities to promote support for/collaboration with the care coordinator from other members of the health care team are being led/actively promoted by the health service
b. Scoping of available services has been undertaken and a list of key contacts for the multidisciplinary team is available for care coordinator
c. Communication technologies are available to ensure the navigator can communicate with the multidisciplinary care team efficiently (voicemail, email, sms, web-based shared care plan platform)
d. Process designed to facilitate shared/collaborative development of treatment goals and corresponding care plans
e. Health care team satisfaction with care coordinator is being evaluated periodically
4. *Apply interventions to promote the uptake of recommended health maintenance practices that are informed by principles from behaviour change theory instead of information provision in isolation (e.g. motivational interviewing)*
a. Training and on-going professional development has been provided to all navigators
b. Designed a process for referral to services to reinforce behaviour change interventions if required (e.g. assistance with smoking cessation, health coaching etc)
c. Progress towards set goals for health maintenance practices are evaluated on an on-going basis using validated tools (e.g. disease-specific self-care/self-management tools)
5. *Provide transition management for patients being discharged from acute care*
a. Organised a system to alert care coordinators that patients are in need of transition care (i.e. have required hospital/emergency department admission)
b. Adopted a model, which has been proven to be effective in reducing readmissions: e.g. Naylor's Transition Care Model (Naylor et al., 2011).

Supplementary file for 'The effectiveness of the Nurse Care Coordinator role on patient-reported and health service outcomes: A systematic review'

This supplementary file (to be included as a link in the text) contains:

Search strategy

* Note: MH refers to MeSH term

MEDLINE via EBSCOhost search strategy

1. (care coordinat*) OR (MH "Patient Navigation") OR (nurse navigat*) OR (MH case manager) OR (MH case management)

2. "patient outcome" OR (MH "Quality of Life") OR (MH "Signs and Symptoms") OR (MH "Needs Assessment") OR (MH "Treatment Outcome") OR "care experience"

3. (MH "Interprofessional Relations") OR (MH "Patient Care Team") OR "multidisciplinary team"

4. (MH "Health Services Accessibility") OR (MH "Health Care Costs") OR (MH "Delivery of Health Care")

5. 2 OR 3 OR 4

6. 1 AND 5 (limited to humans, date of publication 1990-present)

CINAHL via EBSCOhost search strategy

1. (care coordinat*) OR (nurse navigat*) OR (patient navigat*) OR (case manage*)

2. "patient outcome" OR (MH "Quality of Life") OR (MH "Signs and Symptoms") OR (MH "Needs Assessment") OR (MH "Treatment Outcome") OR "care experience"

3. (MH "Interprofessional Relations") OR (MH "Patient Care Team") OR "multidisciplinary team"

4. (MH "Health Services Accessibility") OR (MH "Health Care Costs") OR (MH "Delivery of Health Care")

5. 2 OR 3 OR 4

6. 1 AND 5(limited to humans, date of publication 1990-present)

EMBASE search strategy

1. (care NEXT/2 coordinat*) OR (patient NEXT/1 navigat*) OR (nurse NEXT/1 navigat*) OR (case NEXT/1 manage*)

2. ('treatment outcome'/exp) OR ('quality of life'/exp) OR ('health care need'/exp) OR ('physical disease by body function'/exp)

3. ('multidisciplinary team') OR (interdisciplinary communication'/exp)

4. ('health care delivery'/exp) OR ('health care access'/exp) OR ('health care cost'/exp) OR 'health care utilization'/exp)

5. #3 OR #4 OR #5

6. 1 AND 5 (limited to humans, date of publication 1990-present)

SF Table 1. Characteristics of care coordinator intervention models used in included studies

Study	Characteristics of model	Care coordinator characteristics	Population Characteristics	Location	Pros/Cons highlighted by authors
Aiken et al. (2006)	Home-based case management by nurse case managers (caseload 30-50 patients) that focused on: • Self-management and knowledge • End of life preparation • Enhancing physical and mental functioning • Shifting care from high cost emergency medical and inpatient services to proactive management in the outpatient setting.	Registered Nurse	Terminally ill with chronic heart failure or COPD	C	• Criteria for entry into the study resulted in a one third of the sample dying or being transferred to hospice within the first three months. • Nursing case managers were able to perform roles in palliation (including education and patient empowerment) and an administrative role in coordinating palliative care and active treatment services. • Positive impacts were attributed to the specialised training and experienced registered nurse case managers.
Aldeen, Courtney, Lindquist, Dresden, and Gravenor (2014)	Emergency department based geriatric advanced practice nurse -coordinated care. Components included: • Arranging geriatrics, allied health, palliative care consults as required • Coordinate care plan with ED staff • Discuss care plan with primary care provider	ED RNs (with average 24 years clinical experience) who received training (total 164 hours over 4 months) in geriatric assessment and care coordination	Geriatric at high risk of readmission	I	• Care coordinators may have uncovered underlying problems in older adults than the lower-acuity presenting problem resulting in higher admission rate to hospital.

CCHT (Barnett et al., 2006; Chumbler et al., 2005; Neugaard, Kobb, Ryan, Qin, & Joo, 2005; Young, Foster, Silander, & Wakefield, 2011)	Advanced practice nurse coordinated home telehealth care using disease management protocols	Registered nurses or advanced registered nurse practitioners	Ethnically diverse group of veterans with diabetes	T	Daily monitoring may have assisted care coordinators to detect subtle changes earlier in their clinical course allowing for earlier intervention leading to reduced requirement for primary care provider consultations.
Bauer et al. (2006)	Nurse care coordinator clinic visits and telephone support focused on enhancement of access to care and continuity of care.	No information about qualifications or training provided	Bipolar disorder	I	Potentially psychoeducation was the mechanism for improved outcomes because pharmacotherapy was similar in both groups. Enhancing access to care was another potential mechanism.
Berry et al. (2011)	Nurse care coordinator identified need for care coordination then met with family and physician to develop a care plan	No information about qualifications or training provided	Children with special health care needs	M	A new tool was developed for identification of children with more complex health care needs in order for the CC caseload to be feasible. The entire practice became engaged in care coordination activities by holding meetings and making referral forms more visible. Fee structures didn't completely cover the costs of establishing and maintaining the CC role
Boult et al. (2013); Boult et al. (2008); Boult et al. (2011); Boyd et al. (2010)	Registered nurse guided care providing: comprehensive assessment, evidence-based care planning, proactive monitoring, care coordination, transitional care, coaching for self-management, caregiver support and access to community-based services to 50-60 high risk multi-morbid	RNs with experience in geriatric nursing, interest in counselling patients in self-	Elderly patients at high risk of generating high health expenditures	I	Reasons for lack of effect of guided care on functional health and use of health services may include: • Inadequate 'dosing' of the intervention • Heterogenous implementation of care coordination model across sites

	patients soured from 2-5 primary care practices.	management, and comfort with interdisciplinary team practice and information technology were given preference (average 16 years clinical experience; range 4 to 31). patients.			• Inadequate statistical power (for health service utilisation outcomes) Core features of successful models include: • Systematic identification of high risk patients • Intensive case management (including face to face interaction) • Collaboration with primary care physicians • IT that supports care coordination • Patient and family engagement • Well-coordinated transition from acute care • Medication management • Integration of community-based support services
Boyd et al. (2014)	Comprehensive geriatric assessment and liaison with primary care and specialist services.	Gerontology nurse specialists who had at least 1 year of postgraduate education or a Masters degree in Nursing. All had more than 10 years of clinical experience in gerontology.	Residents at aged care facilities		• The program integrates gerontology specialists across healthcare boundaries. • Higher intensity interventions (e.g. Evercare) may have a greater effect on reducing hospitalisations.
Medicare Coordinated Care Demonstration (MCCD)	All assessed patients' needs and developed care plans. 14/15 provided education to improve medication adherence, diet, exercise and self-care. Most programs sent physician written reports and trained patients in strategies to improve	All except one program required CC registered nurses (4 required CC	Chronic disease	I	• Diversity in care coordination and patient profiles between programs made it difficult to ascertain beneficial effects.

(Brown, Peikes, Chen, & Schore, 2008; Brown, Peikes, Peterson, Schore, & Razafindrakoto, 2012; Peikes, Chen, Schore, & Brown, 2009)	communication. CC caseloads varied from 36 to 86 patients. Most contact was by telephone. 3 programs used telemonitoring.	to be Bachelor's degree prepared RNs and one other program employed RNs or experienced licensed practical nurses)		Features of programs associated with reductions in hospitalisations: • Program with the highest amount of in-person contact had a statistically significant reduction in hospital use. • Physician engagement and cooperation achieved through CC located near physicians, CC attended physician appointments or saw physicians on hospital rounds • CC had communications 'hub' role • Patient education using a behaviour change model instead of only factual information • Transition management (care coordinators had timely notification of admission to hospital/ED, contacted patient during hospitalisation, requested copy of discharge information, used a transition protocol).
Ciccone et al. (2010)	All patients received: (a) initial and follow-up assessments conducted by the care manager in order to establish baseline measures of health measures and behaviors and provide a means for tracking patient progress during the study, (b) an individualized care plan which reflected the treatment recommendations of their doctor and specialists as well as personal health goals chosen by the patient, (c) educational materials matched to their specific conditions or risk factors, (d) assistance with service coordination including easier access to specialist care, and (e) regular, ongoing one-on-one health coaching sessions offering opportunities to	Trained nurses who had been working as hospital or home care nurses in the district in various capacities.	Elderly with chronic illness	C	The project offered an opportunity for primary care provider and CC to directly collaborate by having the CC co-located. CC also provided home visits, which was advantageous in situations of illness, physical or situational barriers to attending meetings at the clinic.

address individual patient concerns and goals.				
Health Quality Partners – one of the MCCD sites (Coburn, Marcantonio, Lazansky, Keller, & Davis, 2012)	• Assessments to identify physical, functional, cognitive, psychological, behavioural, social, and environmental needs • Nurse case manager developed an individualised care plan informed by patient's self-articulated primary concerns and unmet needs, findings from risk assessments and evaluations and the participant's motivational readiness. • Interventions incorporated into care plan included education, symptom monitoring, medication reconciliation and counselling for adherence and assistance with community health and social services. • Group interventions were delivered by nurse case managers. • Case managers collaborated with primary care physicians and specialists as needed to help patients achieve target clinic goals and receive appropriate and timely preventive care according to guidelines. • Contact (in-person, group sessions, telephone) frequency determined by patient need. • Intensified transition follow-up provided upon discharge from hospital.	Registered Nurse	Over 65 with chronic illness (heart failure, coronary artery disease, diabetes, asthma, hypertension, hyperlipidemia)	C	Elements contributing to this program's effectiveness include: • delivering a broad set of services that match the preventive health needs of the targeted population • frequent longitudinal in-person contacts with participants • collaboration with primary care providers • training, management, and performance monitoring capabilities.

	• Caseload was 85-110 once fully trained				
Care Transitions (Coleman, Parry, Chalmers, & Min, 2006; Coleman et al., 2004; Parry, Kramer, & Coleman, 2006)	Nurses visited patients in the hospital, at home and had telephone contact during a 28-day post-hospitalisation discharge period guided by the four pillars: 1. Medication self-management (knowledgeable and has medication management system) 2. Patient-centred record (patient understands and uses record to facilitate communication and continuity of care) 3. Follow-up (scheduled and completed) 4. Red flags (knowledgeable about clinical deterioration)	No information about qualifications or training provided	Inpatients with stroke, congestive heart failure, coronary artery disease, cardiac arrhythmias, chronic obstructive pulmonary disease, diabetes mellitus, spinal stenosis, hip fracture, peripheral vascular disease, deep venous thrombosis, and pulmonary embolism.	I	• Encouraging patients and their caregivers to assert a more active role in their care transitions results in reduced rehospitalization rates. • The transition coach could manage more patients and there was less potential for redundancy with existing health care practitioners such as discharge planners, home health care nurses, and case managers. • The care transitions intervention was designed not only to improve the immediate transitions that patients and their caregivers faced but also to provide them with skills and tools that could be applied to future care transitions. • Having a transition coach to better prepare patients for their ambulatory follow-up visits could enhance overall clinic productivity. • Intervention led to improved self-management knowledge and skills for many patients, primarily in the areas of medication management, condition management, and patient confidence about what was required of them during the transition and beyond
Dajczman et al. (2013)	Components include: • Educating patients and caregivers • Contactable via telephone, email contact • Nurse-physician partnership	Masters prepared clinical nurse specialist with extensive experience with	COPD at the discretion of pulmonary physician, ED or ward personnel	I	The nurse-physician partnership and the presence of a nurse navigator to meet the needs of this patient population are pivotal to the success of this program.

	• Facilitates timely transfers and performs transition care and follow-up	pulmonary disease			
Eloniemi-Sulkava, Notkola, and Hentinen (2001)	• advocacy for patients and their caregivers • comprehensive support for the patients and their caregivers • continuous and systematic counselling • annual training courses for patients and their caregivers • follow-up calls • in-home visits • assistance with arrangements for social and healthcare services • 24-hour-per-day availability by mobile telephone.	RN with public health background who received extensive training, support, and advice in dementia care from dementia specialists	Aged 65 and older with dementia	C	• Family care coordinator should be targeted especially at patients with problems threatening the continuity of community care. • More effective in severe dementia • success of the dementia family care coordinator requires a wide range of knowledge and skills regarding dementia care. • The coordinator not only needs continuous training and support but should also have access to an appointed skilled physician for consultations. • It should be considered how to provide support for demented patients and their caregivers on a 24-hour basis if instant intervention measures are needed outside working hours in problematic situations threatening the continuity of community care.
Engelhardt et al. (2008)	• Nurse provided home assessment visit • Care plan developed based on nursing assessment and home health assessment • Strengths-based telephone counselling to address health literacy, care coordination, caregiver support, financing of care, patient-physician communication, treatment adherence, use of community resources and to address neglect of affective components of illness and avoidance of end of life discussions.	No information about qualifications or training provided	Alzheimer's disease and carers	M, T	• Telephone case manager support useful when in-home support is withdrawn but psychosocial and social supports are still needed.

Sweeney, Halpert, and Waranoff (2007)	• Initial home evaluation to establish goals addressing a care domain weakness (disease knowledge, treatment plan, terminal care planning, benefit plan management, family and living environment, pain and symptom management and provider support) • Patient status reviewed at weekly meetings • Care manager placed telephone calls to patient and providers on behalf of patients • Management ended when goals achieved	Registered nurses with an average of 18 years of nursing experience	Life-limiting illness	C	• Frequent telephone contact (2-3 per week) enabled proactive identification of potential lapses in care • Intervention can change patient behaviours and environments otherwise known to negatively affect care and increase healthcare resource use
Fens et al. (2014)	• 5 home visits over a period of 18 months by a stroke care coordinator using a structured assessment tool to assess activities of daily living, social activity, cognition, communication, psycho-emotion, fatigue, secondary prevention, medical consumption, medical condition, caregiver strain and provision of information. • More home visits offered as required • Written reports sent to general practitioner • CC could consult nursing home multidisciplinary team for advice as needed	Home care service nurses specialised in stroke.	Stroke survivors	C	The intervention may have focussed too much on screening for stroke-related problems and not as much on adequate follow-up care and referral.
Gabbay et al. (2013)	• Met with nurse case manager at baseline and then at 2 and 6 weeks, followed by 3, 6, and 12 months, and then at least every 6 months thereafter. • Intervention group participants could also contact their NCMs by phone and	Registered Nurses	Diabetics with high risk of complications: • HbA1C >8.5%		• Case managers trained in motivational interviewing produced improvements in blood pressure control depression symptoms.

	Email between visits when appropriate. • Case manager visits typically included a review of the patient's clinical laboratory test results, health-related lifestyle behavior relevant to managing T2D, and medication adherence. • Case managers also checked whether the patient was due for complications screening and reminded them of follow-up specialist visits when they were due. Referrals to a certified diabetes nurse educator or a dietitian were made. • Case managers prompted primary care providers for medication titrations.		• Hypertensio n • Dyslipidaem ia		• Case manager prompts for medication titration were not always acted upon by physicians
Hajewski and Shirey (2014)	Nurse case manager assigned for high risk in-patients: • Organise referrals for home care, wound care, diabetes consult • Promote progression of care • Physician relationship building	No information about qualifications or training provided	In-patients on a medical-surgical unit	I	• Case management principles central to effectiveness • Weekly meetings were essential for ongoing evaluation of process changes at the unit level impacting role change for the primary nurse and unit-based case manager. • Evaluation of the balance of patient care requirements between the NCM, primary nurse, and non-licensed staff resulted in redefining the work responsibilities of all members of the unit-based nursing team was complex and time-consuming
High Risk Case Management (Hawkins et al., 2015)	• In-home visit by case manager for comprehensive assessment • Care plan developed and shared with participant, physician and caregivers	No information about qualifications or training provided	Chronic disease	C, T	• ROI of the HRCM program increased with longer duration in the program, particularly evident for participants in the program for less than 10 months (people within last phase of life accrue more expenses and it takes months of the intervention to improve quality of health care)

	• Telephone contact every 3 weeks to discuss plan of care and ongoing health status • If hospitalised, CC assisted hospital with discharge planning and home-care planning if required • Mail-outs with tailored messages regarding gaps in care (medication refill reminders and missed office visits)				• Home visits provide a comprehensive understanding of patient and caregiver needs and environmental issues
Evercare (UK) (Gravelle et al., 2007; Sheaff et al., 2009)	• Evercare model • preventive and responsive care for patients aged over 65 years at high risk of admission to emergency departments • Case managers carried out structured assessments of their patients, planned care, arranged and co-ordinated services, monitored patients at a frequency determined by individual need and arranged ad hoc interventions when incipient deterioration was found.	Advanced practice nurses	Elderly	C	• access to case management added a frequency of contact, regular monitoring, psychosocial support, and a range of referral options that had not previously been provided to frail elderly people. (p. 33) • No significant impact on ED admissions and mortality • did not collect data on a range of other important outcomes, especially on any direct measures of the health of the target population (p. 33) • CC implementation did not lead to major service reorganization or savings elsewhere in the health care system • examples of admissions which case management had prevented, but overall hospital admissions did not significantly change, possibly due to increased case-finding
Jingping, Goehring, and Mancuso (2015)	Nurse case managers to coordinate care, educate patients to better recognise and respond to worsening health, and to support self-management goals using	No information about qualifications or training provided	Disabled (functional limitations who received in-home personal	C	• Some of the features of the program that might account for its success include frequent face-to-face contact with patients, facilitating the exchange of patient-related information among health care providers

	behaviour management techniques such as motivational interviewing.		care to assist with activities of daily living)		and use of patient education and behaviour changing techniques such as motivational interviewing
Kind et al. (2012)	Standardised protocols to achieve 'Four Pillars of Transitional Care' including education in medication management, medical follow-up in place, education regarding detection of clinical deterioration (red flags) and how to respond and providing a key contact for concerns. • Nurse case manager identified eligible participants and participated in multidisciplinary discharge rounds on the inpatient wards • Offered geriatric and transitional care advice • Made telephone contact within 72 hours post-discharge • Written information provided about post-discharge follow-up and up to three 'red flags' • Calls made on a weekly basis until medical follow-up or no further follow-up required • Primary care provider contacted by case manager if red flags or medication discrepancies identified • In-home visits provided if deemed necessary by case manager	Registered nurse	Hospitalised on medical or surgical ward with dementia, delirium, cognitive impairment or over 65 and living alone or previously hospitalised with 12 months.	I	• Comparatively low-cost for transitional care • Telephone-based program increases geographic reach • Refusal rate was low (may be due to close integration of case manager with inpatient team) • Program identified medication discrepancies for nearly half the participants
Koehler et al. (2009)	• Intensive patient-centred education program started within 24 hours of enrolment and ended within one week of discharge	Highly experienced (averaging >8 years of	Inpatients with more than 3 comorbidities, over 70, use of	I	• CC scope of duties was realistic for implementation

	• CC saw patients daily whilst in hospital emphasising optimal home self-care and contingency plans for clinical deterioration • On the post-discharge phone call, CC followed standardised protocol to check medical equipment, medications, home health arrangements and scheduling of follow-up as well as reinforcing education, symptom management and providing recommendations for care planning	inpatient floor nursing plus >10 years as CCs) and all had advanced nursing certifications (ACM, BSN, or MSN).	more than 5 medications, requiring home assistance and living at home		• hospital-based intervention's influence is strongest closer to the time of the initial hospital stay • Electronic health records could potentially facilitate these care transitions, beginning with an automated screening process for identification of high-risk inpatients and continuing through post-discharge follow-up. • Targeting medication management appears to be a high-yield intervention to reduce unplanned health care utilization following hospital discharge
Kogut, Johnson, Higgins, and Quilliam (2012)	Nurse case manager delivered education and assistance with health behaviour change goals. Participants also received reduced copayments for their diabetes medications	Registered nurses	Diabetics	C	• No difference in receipt of appropriate care
Kruse et al. (2010)	Nurse practitioner assessed health maintenance needs, reviewed medications, saw the patient in the office (often at the same visit as the primary care physician), provided patient education, coordinated referrals to specialty physicians and home health services, and provided both first access care on the telephone for patients with problems and follow-up phone care to check on patients after doctor visits or hospitalizations.	Nurse practitioner	Outpatients who attended primary care clinic		• Expected that hospitalisations were not impacted by this CC intervention because it was applied to patients not at high risk. • Direct phone access to the CC was reported as a valued aspect of the program • CC viewed as vital contributor to continuity of care
Medication self management for elderly(Marek	Advanced practice registered nurses worked closely with participants to identify their goals in care and provided education and tools for chronic disease self-management. Medication adherence	Advanced practice registered nurses	Older than 60 with impaired ability to manage medications	M	• Focus on medication management connected CC with participants via planned weekly telephone calls and bi-weekly home visits.

et al., 2014; Marek et al., 2013)	was supported by either a pill organiser or medication dispenser. CC visited participants a minimum of every 2 weeks. If hospitalised, CC visited participants during and after hospitalisation and participated in discharge planning.				• On-going contact facilitated quick intervention for exacerbations of chronic illness
Aging in Place (Marek, Adams, Stetzer, Popejoy, & Rantz, 2010; Marek, Popejoy, Petroski, & Rantz, 2006)	Aging in place (AIP) intervention which involved nurse care coordination. RNs trained in CC delivered the intervention. AIP participants received: • Individualised assessment • Care plan reviewed with participants and family no less than monthly during a home visit • Same nurse coordinated care • Additional nursing interventions to monitor and coordinate health care • Hospitalised participants were followed by CC who worked with hospital discharge planners and families on post-hospital plan of care	Advanced practice registered nurses	Missouri Care Options (MCO) program participants - Community based long-term care. Eligible for nursing facility care but could have needs met outside a facility	C	• Nurse care coordination is potentially more likely to influence clinical outcomes with more frail clients • Nurse care coordinator in this project also was the provider of the majority of skilled nursing care delivered to clients. This engagement in care provided the nurse care coordinator a more comprehensive perspective of each client's abilities and care needs. • Chronically ill older adults might need a longer time to show the effectiveness of the nurse care coordination intervention (12 months).
Parsons et al. (2012)	Experienced nurses working at an advanced level who were assigned to defined geographical areas and: • Developed strong partnerships with family physicians, practice nurses, and organizations within their area. • Performed standardised assessment • Organised required support services • Maintained continuation of care	Experienced nurses working at an advanced level	High risk of residential care	C	• CC became the point of contact for the family physician, the older person, and their family regarding care options and services • CC intervention did not increase the burden on or decrease the health-related quality of life of the primary informal caregiver • mechanism by which the outcome was achieved is not exactly understood (no effect on functional status • possibility that the intervention model was more adept at preventing deterioration in

	• Development of relationship and regular scheduled meetings with primary care physician				the health and home situation of the older adult through managing crises (p. 90)
Plant et al. (2015)	Three nursing roles were allocated: Inbound, Inflight and Outbound: • Inbound (manage patients at presentation to ED, assess health status and readmission risk and coordinate direction of care whether that be at hospital or home) • Inflight (monitoring progress and minimise delays to discharge) • Outbound (reviewing hospital stay, assessing need for out of hospital care and making arrangements for post-discharge care)	No information about qualifications or training provided	Chronic illness admitted to emergency department	I	• Nursing personnel was reduced from two nurses to one nurse during intervention period. The remaining CN nurse reviewed existing risk assessments, updating participants' requirements where required, but did not carry out any other part of the Inbound CN role due to availability of time and a lack of expertise in ED nursing. • CC did have an impact on the processes of care following discharge. Patients in the intervention group received more services from community health agencies, mainly nursing services. • Delivery of CC was largely within the hospital, with limited arrangements made for ongoing care after departure.
Price (1996)	Nurse telephoned patients monthly (or more often if required) to: • Educate • Facilitate adherence • Monitor health status • Facilitate resolution of identified problems • Facilitate access to primary care	No information about qualifications or training provided	Diabetics	T	• Intervention not require large investment in extra resources
Sidorov et al. (2002b)	Package of interventions over one year including: • Promotion of diabetes clinical guidelines by nurse CC in day to day interactions with primary care provider and patient	Registered nurses trained in diabetes patient education as well as tobacco cessation, congestive heart	Diabetics	C	• Findings may be biased due to non-randomised design • Diabetes disease management can simultaneously benefit patients and health service funders through lowering health

		failure, hypertension, chronic obstructive pulmonary disease, and asthma.			care use, cost savings and higher health care quality.
Sidorov, Fisher, Girolami, and Wolke (2002a)	Nurse case managers located in primary care clinics provide: • Promotion of clinical guidelines by nurse CC in day to day interactions with primary care provider and patient • Early and appropriate specialty clinic referral • Education by nurse CC	Registered nurses trained in diabetes patient education as well as tobacco cessation, congestive heart failure, hypertension, chronic obstructive pulmonary disease, and asthma.	Asthmatics, diabetics, chronic heart failure	C	• Results at high risk of selection bias and regression to the mean • primary care-based DM and case management were effectively promoting clinically indicated outpatient interventions, thereby avoiding complications associated with inpatient utilization and associated higher costs (p. 13)
Sullivan et al. (2015)	CC provided an orientation to care, care coordination, and regular phone contacts, utilizing a strengths-based perspective and motivational interviewing over a period of 8 months.	Licensed registered nurse (RN) with mental health training and experience	Women of colour with HIV	C	• See qualitative findings.
Taylor et al. (2013)	• assesses the patients' and families' comfort level in working with and navigating through the healthcare system • coaches families in the development of coordination skills, including how to partner with providers, track and organize	Bachelor's degree in nursing and at least 5 years of clinical experience in a complex	Children with special healthcare needs	C	• Further research required to address limitations in study design • CC intervention supports the IOM's recommendations that knowledge is shared between providers (Institute of Medicine, 2001).

	clinical information, and identify community • supports • evaluates the complexity of care needed in terms of the number and variety of services required • works with the family and patient's care team to define coordination needs and ensures that a clear care plan is defined • provides coordinated, centralized scheduling for patients to ensure continuity during transitions in care • identifies a long-term point person (or persons) to oversee the care plan, and, ultimately, transitions facilitation of ongoing coordination to that person.	medical environment.		
White, Carney, Flynn, Marino, and Fields (2014)	Responsibilities included fielding calls or electronic communications from the inpatient team, developing a hospital follow-up workflow, developing a standardized list of questions to ask each patient after discharge, and calling patients to ensure a follow-up appointment was scheduled, ideally within 2 to 3 days and at least within 7 days of discharge. The CC prioritized scheduling follow-up appointments with the patient's primary care provider to ensure the highest level of continuity.	Registered Nurse	Primary care	M

White, Carney, Flynn, Marino, and Fields (2014) additional column:
• Authors argue that outpatient adoption of the enhanced "reaching in" and a multicomponent intervention would have a significant positive impact on patient care and improve the transition from in- to outpatient care, and likely reduce readmissions.
• Implemented 8 of the 12 predischarge, postdischarge, and bridging interventions identified by Hansen et al

C: Community; I: Institution (eg hospital); T=Telehealth; M: Mixed.

SF Table 17: Quality of life findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Aiken et al. (2006)	190 randomised (85 provided data for final follow-up)	RCT	SF-36	Physical functioning, general health and vitality in COPD patients randomised to the care coordination group was greater than the usual care group at 9 months (p<0.05).	Downgraded to low quality due to risk of attrition bias and imprecision
CCHT (Barnett et al., 2006)	N=445	Single group longitudinal	SF-36	Significant improvement in Role limitations due to physical health (p=0.02), bodily pain (p=0.005) and social functioning (p=0.0498).	Downgraded to very low quality due to serious concerns about risk of bias
Bauer et al. (2006)	CC=166 Non CC=164	RCT	SF-36	• Mental component score for the CC group was significantly greater than the non-CC group at 6 months (p=0.01; effect size 0.27) • No difference in physical component score (p=0.298)	High quality
Boult et al. (2013)	N=274 CC; n=203 non-CC	Cluster RCT	SF-36	• Physical health component score overall treatment effect was -1.3 (95% CI = -3.02 to 0.41). • Mental health component score overall treatment effect was 1.05 (95% CI = -1.08 to 3.12)	High quality
Medicare Coordinated Care Demonstration (MCCD) (Peikes et al., 2009)	18309 (15 programs analysed separately)	Multi-site RCT	SF-36 Effect of primary condition on life	• None of the 12 programs had an effect on mental health component score • 1 of the 12 programs had a moderate impact on physical health component score • 1 of the 12 programs had a moderate impact on effect of primary condition on life	High quality
Ciccone et al. (2010)	N=1160	Single group	SF-12	Average score was 7.99 points above the national normal value (47.6) and 5.28 points above baseline	Downgraded to very low quality due to serious concerns about risk of bias

		longitudinal			
Fens et al. (2014)	N=58 CC, n=43 non-CC	Non-randomised comparison	• SASIP-30 (patients) • LiSAT-9 (carers)	• Median score was 6 (IQR 3, 10) in the CC group at 18 months follow up compared with median score of 4 (IQR 1-9) in the non-CC group (p=0.416) • Median score was 4.7 (IQR 4.4, 5) in the CC group at 18 months follow up compared with median score of 5 (IQR 4.9-5.3) in the non-CC group (p=0.005)	Downgraded to low quality due to serious concerns about risk of bias and imprecision
Gabbay et al. (2013)	N=232 CC N=313 non-CC	RCT	Audit of diabetes dependent quality of life	• Scores did not differ between groups at 2 years follow-up	Downgraded to moderate quality due to concerns about risk of bias
Marek et al. (2013)	N=414	RCT	SF-36	Participants who received CC and the pill organizer had significantly better quality of life than the control group, but the addition of the medication dispenser to CC did not result in better clinical outcomes.	High quality
Parsons et al. (2012)	N=351	Cluster RCT	EuroQOL	No differences between groups in overall QoL, cognitive performance scale, depression rating scale, changes in health and pain scale	High quality
Plant et al. (2015), Australia	RCT	N=259 at 24 month follow-up (52% of enrolled sample)	Mean difference in EQ-5D score	Mean difference was 0 (95% CI=-0.10 to 0.09)	High quality
Price (1996)	N=251 (CC 188)	RCT	SF-36	No between group differences for any domain	Downgraded to moderate quality due to concerns about risk of bias

SASIP-30=Stroke Adapted Sickness Impact Profile; SF-36= Medical outcomes short form 36 item survey; LiSAT-9=Life satisfaction questionnaire;

SF Table 18: Psychological morbidity findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Medicare Coordinated Care Demonstration (MCCD) (Brown et al., 2008)	18309 (15 programs analysed separately)	Multi-site RCT	SF-12 (individual items related to emotional distress and depression)	• 3 out of 12 programs produced a moderate improvement in emotional distress • None of the 12 programs had an effect on depression	Downgraded to moderate quality due to study limitations
Sweeney et al. (2007)	N=358 CC, n=398 non-CC	Non-randomised comparison	Difference in inpatient symptoms (measurement tool not reported)	• No patients had anxiety in CC group compared with 3 patients in non-CC group	Downgraded to very low quality due to serious concerns about risk of bias
Fens et al. (2014)	N=57 CC, n=43 non-CC	Non-randomised comparison	Hospital Anxiety and Depression Scale	Patients • Median difference from baseline to 18 months follow up for anxiety subscale was -1 (IQR -3.5, 1) in the CC group compared with -1 (IQR -3,1) in the non-CC group (not significant) • Median difference from baseline to 18 months follow up for depression subscale was -1 (IQR -2.5, 1) in the CC group compared with 0 (IQR -	Downgraded to low quality due to serious concerns about risk of bias and imprecision

				2,1) in the non-CC group (not significant)	
				Caregivers	
				• Median difference from baseline to 18 months follow up for anxiety subscale was -2.5 (IQR -4.3, 1) in the CC group compared with 0 (IQR -2.3,2.3) in the non-CC group (not significant) • Median difference from baseline to 18 months follow up for depression subscale was -1 (IQR -4, 0) in the CC group compared with 0 (IQR -2.3,1) in the non-CC group (not significant)	
Gabbay et al. (2013)	N=232 CC N=313 non-CC	RCT	• Centre for Epidemiological Studies-Depression • Problem areas in diabetes (PAID) scale (measures emotional distress related to diabetes	• Depression symptoms were rates as less severe at 2 years follow-up in the CC group (mean 10, SD 11 in CC group versus mean 14, SD 14 in non-CC group) • PAID scores were not significantly different at 2 years follow-up (mean 23, SD 21 in CC group versus mean 29, SD 27 in non-CC group)	Downgraded to moderate quality due to concerns about risk of bias

Marek et al. (2013)	N=414	RCT	• Geriatric depression scale	• Participants who received CC and the pill organizer had significantly better depression scores than the control group, but the addition of the medication dispenser to CC did not result in better clinical outcomes.	High quality
Marek et al. (2006)	CC=55; non-CC=30	Non-randomised comparison	OASIS (assessment tool used for all patients who receive Medicare home health services)	• At 12 months the CC group scored the same as the non-CC group	Low quality

HADS=Hospital anxiety and depression scale

SF Table 19: Symptom findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Aiken et al. (2006)	85 at final follow-up	RCT	Worst symptom frequency, severity and distress ratings measured using the Memorial Symptom Assessment Scale	CC patients with COPD reported lower symptom distress (p<0.05). CC patients with CHF had higher symptom distress (p<0.05).	Downgraded to moderate quality due to risk of attrition bias and imprecision
Medicare Coordinated Care Demonstration (MCCD) (Brown et al., 2008)	18309 (15 programs analysed separately)	Multi-site RCT	SF-12 (individual items used to determine 'poor sleep' and 'Pain interference with usual activities')	• 2 of 12 programs had a moderate improvement in poor sleep and pain	Downgraded to moderate quality due to study limitations
Marek et al. (2006)	CC=55; non-CC=30	Non-randomised comparison	OASIS (assessment tool used for all patients who receive Medicare home health services)	• At 12 months the CC group scored lower (better) than the non-CC group in the outcomes of pain and dyspnea	Low quality
Sweeney et al. (2007)	N=358 CC, n=398 non-CC	Non-randomised comparison	% difference in inpatient symptoms	• 44% less nausea and vomiting in CC group (not significant)	Downgraded to very low quality due to serious concerns about risk of bias

SF Table 20: Satisfaction with care findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Bauer et al. (2006)	CC=166 Non CC=164	RCT	Patient Satisfaction Index	Score for the CC group was significantly greater than the non-CC group at 6 months (p<0.001; effect size 0.55)	High quality
Boult et al. (2013)	N=274 CC; n=203 non-CC	RCT	Patient assessment of chronic illness care	Overall treatment effect of CC was 0.27 (95% CI = 0.08 to 0.45)	High quality
Fens et al. (2015); Fens et al. (2014)	N=64	Single group cross sectional	Satisfaction with stroke care part 2 (SASC-19)	• Mean score at 18 months 2.0 (SD 0.2) • 97.9% reported total to moderate satisfaction	Downgraded to low quality due to serious concerns about risk of bias and imprecision
Gabbay et al. (2013)	N=232 CC N=313 non-CC	RCT	Diabetes treatment satisfaction questionnaire	• Scores did not differ between groups at 2 years follow-up	Downgraded to moderate quality due to concerns about risk of bias

SF Table 21: Satisfaction with coordinator findings from included studies

Study	N	Design	Construct	Finding	GRADE
Fens et al. (2015); Fens et al. (2014)	N=53	Single group cross sectional	Satisfaction with stroke care part 1 (SASC-19)	• Mean score at 18 months 2.6 (SD 0.5) • 100% reported total to moderate satisfaction	Downgraded to low quality due to serious concerns about risk of bias and imprecision

SF Table 22: Family-reported satisfaction with care findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Engelhardt et al. (2008)	N=36	Single group cross-sectional	Client experiences questionnaire (1=extremely satisfied; 5=extremely dissatisfied)	Mean score was 1.89 (SD 0.524)	Downgraded to very low quality due to concerns about confounding
Fens et al. (2015); Fens et al. (2014)	N=38	Single group cross sectional	Satisfaction with stroke care part 2 (SASC-19)	• Mean score at 18 months 2.0 (SD 0.4) • 97.4% reported total to moderate satisfaction	Downgraded to low quality due to serious concerns about risk of bias and imprecision

SF Table 23: Family-reported satisfaction with coordinator intervention findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Fens et al. (2015); Fens et al. (2014)	N=38	Single group cross sectional	Satisfaction with stroke care part 1 (SASC-19)	• Mean score at 18 months 2.6 (SD 0.5) • 94.1% reported total to moderate satisfaction	Downgraded to low quality due to serious concerns about risk of bias and imprecision
Taylor et al. (2013)	N=25 CC; n=50 non-CC	Non-randomised comparison group	Care coordination composite score	• 83.5% 'agree' or 'strongly agree' in CC group compared with 56% in non-CC group (p<0.001)	Downgraded to very low quality due to concerns about attrition bias and confounding

SF Table 24: Staff-reported effectiveness of coordinator findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Berry et al. (2011)	Not reported	Pre-post test	Care coordinator domain of Medical Home Index	Post introduction of the CC, improvements in care coordination (1.25 pre, 2.0 post) and community outreach (1.0 pre to 1.5 post) domains were achieved. All other domains did not change.	Downgraded to very low quality due to concerns about attrition bias and confounding

SF Table 10: Hospitalisation findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Aldeen et al. (2014)	CC=408 Non CC=6806	Non-randomised comparison	• Difference in proportion of admissions to hospital • Difference in readmissions within 30 days	• 2.8% fewer admissions to hospital in the CC group (95% CI= 6.3% fewer to 1.3% higher) • 3.7% fewer readmissions to hospital within 30 days (95% CI = 6.9% fewer to 0.1% higher)	Downgraded to very low quality due to concerns about confounding
CCHT (Barnett et al., 2006)	391 cases and controls	Matched case control	Likelihood of having at least one admission within 24 months	9.1% less likely in CC group (p=0.02)	Low quality
Boult et al. (2013)	N=485 CC; n=419 non-CC	Cluster RCT	Difference in adjusted mean annual per capita use of health services	• 6% reduction in hospital admissions (0.94; 95% CI = 0.74 to 1.19) • 13% reduction in 30-day readmissions (0.87; 95% CI= 0.53 to 1.41)	Downgraded to moderate quality due to imprecision
Boyd et al. (2014)	29 facilities received CC compared with 25 facilities with no CC	Randomised comparison	Hospital admission rate ratio 1 year before and after CC	• 0.73 (95% CI=0.61 to 0.86) • 5.66 admissions less per facility for the CC group (95% CI = 0.38 to 10.94).	Downgraded to low quality due to serious concerns about risk of bias
Medicare Coordinated	18309 (results from programs	Multi-site RCT	Average annualized number	• One of the 15 programs had a statistically significant	High quality

Care Demonstration (MCCD) (Peikes et al., 2009)	analysed separately)		of hospital admissions	reduction (0.168 fewer hospitalisations per person per year; 90% confidence interval [CI], −0.283 to −0.054; 17% less than the control group mean, P=.02) • One of the programs had 0.118 more hospitalisations per person per year (90% CI, 0.025-0.210; 19% more than the control group mean, P=.04)	
Care Transitions (Coleman et al., 2006)	N=750	RCT	Odds ratio of re-hospitalisations within: 1. 30 days 2. 90 days 3. 180 days	1. OR 0.59 (95% CI=0.35 to 1.0) 2. OR 0.64 (95% CI=0.42 to 0.99) 3. OR 0.80 (95% CI=0.54 to 1.19)	Downgraded to moderate quality due to imprecision
Dajczman et al. (2013)	N=202	Pre-post test	• Reduction in admissions due to respiratory causes • Reduction in admissions due to any cause	• 58 (60%) less visits after CC implementation • 56 (34%) less visits after CC implementation	Downgraded to very low quality due to serious concerns about risk of bias
Engelhardt et al. (2008)	N=36 CC, n=113 non-CC	Historical control group comparison	Admissions	11%(n=4) in CC group versus 74%(n=84) in non CC group (p<0.001)	Downgraded to very low quality due to serious concerns about risk of bias

Sweeney et al. (2007)	N=358 CC, n=398 non-CC	Non-randomised comparison	% difference in admissions to hospital	29.4% less in CC group (noted to be marginally significant)	Downgraded to very low quality due to serious concerns about risk of bias
Hajewski and Shirey (2014)	Not reported	Non-randomised comparison with a control unit	Readmissions during a quarter year	Reduced by 4 admissions in CC group and by 19 days in non-cc group (p=0.068)	Downgraded to very low quality due to concerns about risk of bias and imprecision
Hawkins et al. (2015)	1604 propensity score matches (from 2015 participants compared with 7626 nonparticipants)	Non-randomised comparison (control group qualified for program but did not participate)	Hospital readmission within 30 days (OR greater than 1 indicates improvement in CC group)	• OR 1.1 overall • OR 1.5 for less than 10 months participation (p<0.05)	Downgraded to very low quality due to concerns about inconsistency and imprecision
Jingping et al. (2015)	907 CC group compared with 907 matched controls 910 CC group compared with 13847 matched controls	Non-randomised comparison with propensity score matched control group	Difference in inpatient admissions per 1,000 member months	9.64 admissions less per 1,000 member months in CC group (p=0.13)	Downgraded to very low quality due to concerns about imprecision
Kind et al. (2012)	Pre-post test	605 participants included in intervention period compared with 103	30-day readmissions	OR 0.55 (95% CI=0.33 to 0.9)	Downgraded to very low quality due to concerns about imprecision

		participants in baseline period			
Koehler et al. (2009)	Pilot RCT	41 inpatients who received transition care	• 30 day readmissions • 60 day readmissions	• Relative risk 0.26 (95% CI=0.06 to 1.08) • Relative risk 0.70 (95% CI=0.30 to 1.6)	Downgraded to low quality due to imprecision
Kruse et al. (2010)	Matched case control	CC=130; Non-CC=249 primary care patients	Inpatient stays (mean/1000 days)	1.04 (0.79-1.37) in CC group compared with 1.09 (0.9-1.34) in non-CC group (p=.75)	Low quality
Plant et al. (2015)	RCT	N=500 patients with chronic illness admitted to an emergency department	Difference in readmissions (rate ratio)	RR 0.85 (95% CI=0.7 to 1.04)	High quality
Sidorov et al. (2002b)	Non-randomised comparison	N=3118 CC; n=3681 non-CC	Mean number of inpatient admissions per year	0.12 in CC group compared with 0.16 in non-CC group (p<0.05)	Low quality
White et al. (2014)	Non-randomised comparison	N=961 (685 CC group)	Readmissions per month	Decrease in readmissions in CC group and no strong correlation between usual care and readmissions over time (P=.05).	Downgraded to very low quality due to concerns about risk of bias (unadjusted analysis)

SF Table 251: Length of stay findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Aldeen et al. (2014)	CC=408 Non CC=6806	Non-randomised comparison	Median difference in hours	18 hours less in the CC group	Downgraded to very low quality due to concerns about confounding
CCHT (Barnett et al., 2006)	391 cases and controls	Matched case control	• Percent increase in length of stay due to any cause (days) over 24 months • Difference in length of stay due to diabetes (days) over 24 months	• 7% higher in CC group (p=0.2) • 4.9% higher in CC group (p=0.31)	Downgraded to very low quality due to serious concerns about risk of bias
Bauer et al. (2006)	CC=166 Non CC=164	RCT	Difference in total days in hospital	3.7 less in the CC group (95% CI=16.1 less to 9.3 more)	Downgraded to moderate quality due to concerns about imprecision
Dajczman et al. (2013)	N=202	Pre-post test	• Reduction in total days spent in hospital for any cause • Reduction in total days spent in hospital for respiratory cause	• 37% decrease for any cause (709 days) • 71% decrease for respiratory cause (793 less days)	Downgraded to very low quality due to serious concerns about risk of bias
Engelhardt et al. (2008)	N=36 CC, n=113 non-CC	Historical control group comparison	Difference in mean length of stay	4.29 days less in CC group (p<0.001)	Downgraded to very low quality due to serious concerns about risk of bias

Sweeney et al. (2007)	N=358 CC, n=398 non-CC	Non-randomised comparison	% difference in mean days spent in hospital	24.3% less in CC group (not significant)	Downgraded to very low quality due to serious concerns about risk of bias
Hajewski and Shirey (2014)	Not reported	Non-randomised comparison with a control unit	Mean length of stay in days over quarter year	Reduced by 1 day in CC group and by 0.08 days in non-cc group (p=0.031)	Downgraded to very low quality due to concerns about risk of bias
Kind et al. (2012)	Pre-post test	605 participants included in intervention period compared with 103 participants in baseline period	Re-hospitalisation length of stay	408.7 less days in hospital in CC group	Downgraded to very low quality due to concerns about imprecision
Koehler et al. (2009)	Pilot RCT	41 inpatients who received transition care	Mean difference in length of stay	1.5 days less in CC group (SD 7.54; p=0.11)	Downgraded to low quality due to imprecision
Kruse et al. (2010)	Matched case control	CC=130; Non-CC=249 primary care patients	Total inpatient days (mean/1000 days)	6.65 (4.5-9.83) in CC group compared with 7.23 (5.45-9.6) in non-CC group (p=.74)	Low quality
Plant et al. (2015)	RCT	N=500 patients with chronic illness admitted	Difference in length of stay (rate ratio)	RR 0.98 (95% CI=0.82 to 1.17)	Downgraded to moderate quality due to imprecision

			to an emergency department		
Sidorov et al. (2002b)	Non-randomised comparison	N=3118 CC; n=3681 non-CC	Mean number of inpatient days per year	0.56 in CC group compared with 0.98 in non-CC group (p<0.05)	Low quality

SF Table 262: Emergency department use findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Aiken et al. (2006)	190	RCT	ED visits per month	0.11 (SD 0.34) in the care coordination group; 0.10 (SD 0.31) in usual care	Downgraded to moderate quality due to risk of attrition bias
Aldeen et al. (2014)	CC=408 Non CC=6806	Non-randomised comparison	ED length of stay (difference in median hours)	1.1 hours more in the CC group (p<0.001)	Downgraded to very low quality due to concerns about confounding
CCHT (Barnett et al., 2006)	391 cases and controls	Matched case control	• Likelihood of having at least one ED visit within 24 months • Likelihood of having at least one ED visit due to diabetes within 24 months	• 39.6% more likely in CC group (p=0.000) • 19.6% more likely in CC group (p=0.000)	Downgraded to very low quality due to serious concerns about risk of bias
Boult et al. (2013)	N=485 CC; n=419 non-CC	RCT	• Difference in adjusted mean annual per capita use of health services	2% increase in ED visits for CC group (1.02; 95% CI= 0.78 to 1.33)	Downgraded to moderate quality due to imprecision
Dajczman et al. (2013)	N=202	Pre-post test	• Reduction in ED visits due to respiratory causes	23 (38%) less visits	Downgraded to very low quality due to serious concerns about risk of bias and imprecision

Evercare UK (Gravelle et al., 2007)	Pre-post comparison with non-randomised propensity-score matched comparison	9 primary care trusts in the UK including 64 intervention practices compared with 6960-7695 practices (depending on outcome)	ED visits and bed days	Rates were higher in the CC group (not significant at the 5% level)	Low quality
Sweeney et al. (2007)	N=358 CC, n=398 non-CC	Non-randomised comparison	% difference in ED visits	23% less in CC group	Downgraded to very low quality due to serious concerns about risk of bias and imprecision
Jingping et al. (2015)	907 CC group compared with 907 matched controls 910 CC group compared with 13847 matched controls	Non-randomised comparison with propensity score matched control group	Difference in ED visits per 1,000 member months	• 10.81 less ED visits per 1,000 member months in CC group (p=0.33)	Low quality
Kruse et al. (2010)	Matched case control	CC=130; Non-CC=249 primary care patients	Emergency department visits (mean/1000 days)	0.714 (0.535-0.953) in CC group compared with 1.04 (0.859-1.27) in non-CC group (p=.034)	Low quality

Plant et al. (2015)	RCT	N=500 patients with chronic illness admitted to an emergency department	1. Difference in representations (rate ratio) 2. Difference in time to departure ready 3. Mean length of ED stay	1. RR 0.83 (95% CI=0.68 to 1.01) 2. RR 0.84 (95% CI=0.69 to 1.02) 3. RR 0.95 (95% CI=0.82 to 1.11)	Downgraded to moderate quality due to imprecision
Sidorov et al. (2002b)	Non-randomised comparisons	N=3118 CC; n=3681 non-CC	Mean number of ED visits over 2 years	0.49 visits per patient in CC group compared with 0.56 in non-CC group (not statistically significant in adjusted analysis)	Low quality

SF Table 273: Outpatient/clinic use findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
CCHT (Barnett et al., 2006)	391 cases and controls	Matched case control	1. Likelihood of having at least one visit to the podiatrist within 24 months 2. Likelihood of having at least one visit to the opthamology clinic within 24 months 3. Likelihood of having at least one visit to the diabetes clinic within 24 months	1. 8.7% more likely in CC group (p=0.04) 2. 6.2% less likely in CC group (p=0.07) 3. 5.3% more likely in CC group (p=0.14) 4. 1.2% less likely in CC group (p=0.36)	Downgraded to very low quality due to serious concerns about risk of bias
Kruse et al. (2010)	Matched case control	CC=130; Non-CC=249 I primary care	• Specialties visit (mean/1000 days)	• 16.9 (14.1-20.2) in CC group compared with 16.4 (14.3-18.7) in non-CC group (p=.79)	Low quality

SF Table 284: Home visit use findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Boult et al. (2013)	N=485 CC; n=419 non-CC	RCT	• Difference in adjusted mean annual per capita use of health services	29% reduction in home health care episodes (0.71; 95% CI= 0.51 to 0.97)	Downgraded to moderate quality due to imprecision

SF Table 295: Primary care provider visit findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Boult et al. (2013)	N=485 CC; n=419 non-CC	RCT	• Difference in adjusted mean annual per capita use of health services	1% reduction in primary care visits 0.99 (95% CI=0.82 to 1.18)	Downgraded to moderate quality due to imprecision
CCHT (Barnett et al., 2006)	391 cases and controls	Matched case control	Likelihood of having at least one visit to the primary care clinic within 24 months	8.7% more likely in CC group (p=0.04)	Downgraded to very low quality due to serious concerns about risk of bias
Kruse et al. (2010)	Matched case control	CC=130; Non-CC=249 primary care patients	• Urgent care visits (usual provider not available) (mean/1000 days) • Usual care provider visit (mean/1000 days)	• 0.174 (0.123-0.246) in CC group compared with 0.426 (0.362-0.502) in non-CC group (p<.001) • 15.1 (13.3-17.1) in CC group compared with 15.8 (14.4-17.3) in non-CC group (p=.56)	Low quality
Sidorov et al. (2002b)	Non-randomised	N=3118 CC; n=3681 non-CC	Mean number of visits per year	8.4 in CC group compared with 7.8 in non-CC group	Low quality

SF Table 306: Receipt of appropriate care findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Kogut et al. (2012)	CC=649; non-CC=9049	Retrospective propensity score matched comparison	Receiving 5 processes of care	CC patients were similarly likely to have all 5 recommended processes of care performed (40.1% vs 38.9%; p = 0.543).	Downgraded to very low quality due to risk of bias
Gabbay et al. (2013)	N=232 CC; N=313 non-CC	RCT	Diabetic complications screening	• More CC patients received neuropathy screening (22% versus 14%; p<0.001) • More CC patients received retinopathy screening (34% versus 24%, p<0.001) • More patients received nephropathy screening (92% versus 85%, p=0.017)	Downgraded to moderate quality due to concerns about risk of bias

SF Table 317: Treatment adherence findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Marek et al. (2013)	n=289	Single group	Correct medication doses per month	Average percent of correct doses per month was 98.8% in the CC group who received a medication disepenser and 97.4% in the CC group who received a pill organizer.	Low quality

SF Table 32: Survival findings from included studies

Study	N[1]	Design	Outcome measure	Finding	GRADE
Aldeen et al. (2014)	CC=408 Non CC=6806	Non-randomised comparison	Difference in proportion of death (no timepoint)	0.5% fewer in the CC group (95%CI=2.1% fewer to 1.9% higher)	Downgraded to very low quality due to concerns about confounding
Bauer et al. (2006)	CC=166 Non CC=164	RCT	Deaths	12 (7%) in CC group and 8 (5%) in non-CC group	Downgraded to moderate quality due to imprecision
Boult et al. (2013)	N=485 CC; n=419 non-CC	RCT	Mortality at 32 months	OR 0.88 (0.59 to 1.31)	Downgraded to moderate quality due to imprecision
CCHT (Chumbler et al., 2009)	N=387	Non-randomised comparison (propensity score matched control group)	Adjusted hazard ratio for mortality over 4 years follow-up	HR 0.68 (95% CI=0.5-0.92)	Low quality
Health Quality Partners (Coburn et al., 2012)	N=1736	RCT	Mortality (unadjusted and adjusted) over the 6 years of the program	Unadjusted • HR death 0.75 (95% CI=0.57-1.0 • 86 (9.9%) deaths in CC group vs 111 (12.9%) deaths in non CC group Adjusted for sex, age, primary diagnosis, perceived health, number of medications taken, hospital stays in the past 6 months and tobacco use • HR death 0.73 (95% CI=0.55 to 0.98)	High quality

Eloniemi-Sulkava et al. (2001)	RCT	N=100 demented patients and their families	Death in community care at 2 years	9 (17%) in CC group and 8(17%) in non CC group	Downgraded to low quality due to serious concerns about risk of bias and imprecision.
Engelhardt et al. (2008)	Historical control group comparison	N=36 CC, n=113 non-CC	Death	N=4 (11%) CC versus n=5(4%) non-CC (p=0.22)	Downgraded to very low quality due to risk of bias and imprecision
Evercare et al. (Gravelle et al., 2007)	Pre-post comparison with non-randomised propensity-score matched comparison	9 primary care trusts in the UK including 64 intervention practices compared with 6960-7695 practices (depending on outcome)	Mortality	Rates were higher in the CC group (not significant at the 5% level)	Low quality
Jingping et al. (2015)	907 CC group compared with 907 matched controls 910 CC group compared with 13847 matched controls	Non-randomised comparison with propensity score matched control group	Odds ratio of 12-month mortality	OR 0.82 (p=0.39)	Low quality
Kruse et al. (2010)	Matched case control	CC=130; Non-CC=249 primary care patients	Death within 5 years follow-up	26.9% in CC group compared with 27.3% in non-CC group. No difference in survival between groups using Cox regression adjusting for age and sex (p=0.56)	Low quality
Sweeney et al. (2007)	N=358 CC, n=398 non-CC	Non-randomised comparison	Death	71 patients in CC group died compared with 86 in non-CC group (p=0.80)	Downgraded to low quality due to risk of bias and imprecision
Parsons et al. (2012)	N=351	Cluster RCT	Death within 24 months	ARR 1.5% in CC group (n=21 vs n=17)	Downgraded to moderate quality due to imprecision

Plant et al. (2015)	RCT	N=500 patients with chronic illness admitted to an emergency department	Mortality	CC had no effect on mortality (hazard ratio, 0.92; 95% CI, 0.67–1.26; P = 0.60)	Downgraded to moderate quality due to imprecision

SF Table 19: Health service cost and income findings from included studies

Study	N	Design	Outcome measure	Finding	GRADE
Atherly et al. (2011)	CC=11284, non-CC=8607	Non-randomised comparison	Total annual medicare costs	total annual Medicare costs for the participating sample were 15.7% lower in 2007 ($3240) than for the control group, controlling for age, sex, race, and baseline risk	Low quality
Bauer et al. (2006)	CC=166 Non CC=164	RCT	Difference in costs between groups over three years	$2981 less in the CC group (95% CI=16030 less to 10601 more)	Downgraded to moderate quality due to imprecision
CCHT (Barnett et al., 2007)	N=387	Non-randomised comparison (propensity score matched control group)	Incremental cost-effectiveness ratio	• Mean ICER $60,941 • Program was cost-effective for one-third of participants	NA
Medicare Coordinated Care Demonstration (MCCD) (Peikes et al., 2009)	18309 (15 separate programs)	Multi-site RCT	Difference in cost between groups over 4 years	• No programs generated savings	High quality
Care Transitions (Coleman et al., 2006)	N=750	RCT	Difference in log transformed non-elective hospital costs at: 1. 30 days 2. 90 days 3. 180 days	Patients in the CC group had lower costs at 90 and 180 days (p=0.02 and 0.049)	High quality

Engelhardt et al. (2008)	N=36 CC, n=113 non-CC	Historical control group comparison	Difference in inpat(2014)ient costs	$17547.08 less in CC group	Downgraded to very low quality due to risk of bias
High Risk Case Management (Hawkins et al., 2015)	1604 propensity score matches (from 2015 participants compared with 7626 nonparticipants)	Non-randomised comparison (control group qualified for program but did not participate)	Return on investment (ratio of savings to costs where value over 1:1 indicates savings)	1.4:1 overall -5.3:1 with less than 10 months participation -0.5:1 with 10-18 months participation 1.2:1 with 19-37 months participation	Downgraded to very low quality due to inconsistency
Jingping et al. (2015)	907 CC group compared with 907 matched controls	Non-randomised comparison with propensity score matched control group	Per member per month healthcare costs	-$248 (p=0.09)	Downgraded to very low quality due to risk of bias and imprecision
Kind et al. (2012)	Pre-post test	605 participants included in intervention period compared with 103 participants in baseline period	Overall costs	$1255 per participant less in CC group	Downgraded to very low quality due to concerns about imprecision
Marek et al. (2014)	N=414	RCT	Monthly dollar savings	$296 savings per month for CC plus pill dispenser compared with control group	High quality
Marek et al. (2010)	Retrospective cohort design with non-	CC=57; non-CC=80	Monthly Medicare and Medicaid savings	$686 lower Medicare costs in first 12 months of intervention $203 higher Medicaid costs	Low quality

	randomised comparison group				
Sidorov et al. (2002b)	Non-randomised comparisons	N=3118 CC; n=3681 non-CC	Total paid claims	$394.62 per member per month in CC group compared with $502.48 per member per month in non-CC group (p<0.05)	Low quality
Sidorov et al. (2002a)	Pre-post test	N=396 asthmatics; n=3556 diabetics; n=3346 chronic heart failure	Total paid claims	Total mean reductions in claims over one year of follow-up from the day of entry for patients with asthma, diabetes mellitus, CHF and for case management programs were $US105 544, $US896 112, $US7 237 440 and $US17 907 992, respectively.	Low quality
Sweeney et al. (2007)	N=358 CC, n=398 non-CC	Non-randomised comparison	Difference in overall costs	$18599 less per patient in CC group	Downgraded to low quality due to risk of bias and imprecision