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Caregiver Integration During Discharge Planning for Older Adults to Reduce Resource Use: A Metaanalysis

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Caregiver Integration During Discharge Planning for Older Adults to Reduce Resource Use: A Metaanalysis

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Abstract

Objectives

To determine the effect of integrating informal caregivers into discharge planning on postdischarge cost and resource use in older adults.

Design

A systematic review and metaanalysis of randomized controlled trials that examine the effect of discharge planning with caregiver integration begun before discharge on healthcare cost and resource use outcomes. MEDLINE, EMBASE, and the Cochrane Library databases were searched for all English-language articles published between 1990 and April 2016.

Setting

Hospital or skilled nursing facility.

Participants

Older adults with informal caregivers discharged to a community setting.

Measurements

Readmission rates, length of and time to post-discharge rehospitalizations, costs of postdischarge care.

Results

Of 10,715 abstracts identified, 15 studies met the inclusion criteria. Eleven studies provided sufficient detail to calculate readmission rates for treatment and control participants. Discharge planning interventions with caregiver integration were associated with a 25% fewer readmissions at 90 days (relative risk (RR) = 0.75, 95% confidence interval (CI) = 0.62–0.91) and 24% fewer readmissions at 180 days (RR = 0.76, 95% CI = 0.64–0.90). The majority of studies reported statistically significant shorter time to readmission, shorter rehospitalization, and lower costs of postdischarge care among discharge planning interventions with caregiver integration.

Conclusion

For older adults discharged to a community setting, the integration of caregivers into the discharge planning process reduces the risk of hospital readmission.

Discharge planning promotes safe and timely transfer between levels of care and between care settings, especially during discharge from a hospital or skilled-nursing facility to a home or community setting.[1], [2] Discharge planning includes determining the person's appropriate posthospital discharge destination and identifying needs for a safe transition. Effective discharge planning is especially significant for older adults, for whom informal caregivers, defined as unpaid individuals who provide support for medical tasks and daily activities, are critical to daily life and health. As hospital lengths of stay continue to decrease, informal caregivers of older adults are responsible for increasingly complex treatment, including caring for wounds, managing medications, and operating specialized medical equipment.[3] Caregivers often report unmet needs and dissatisfaction with the discharge planning process.[1]

Recently adopted caregiver advise, record, and enable (CARE) legislation and proposed Medicare regulations require caregiver integration into the discharge planning process.[4], [5] Although implementation of these requirements may require additional time for caregiver education and training, the inclusion of caregivers in the discharge planning process may improve outcomes and help hospitals to avoid economic penalties for resource use and costs under programs such as the Hospital Readmissions Reduction Program (HRRP).[6] Under HRRP, for instance, the federal government reduces payments to hospitals among the top quartile for high rates of readmissions. There is limited evidence as to how caregiver integration into the discharge process could affect resource use and costs.[4], [5], [7] The aim of this systematic review and metaanalysis was to evaluate evidence of the effects of integrating informal caregivers of older adults into the discharge planning process on postdischarge cost and resource-use outcomes, including readmission rates, length of postdischarge rehospitalizations, and cost of postdischarge care.

Methods

The search strategy was developed, and studies were screened and evaluated using systematic review methods.[8] A public health informationist developed literature search strategies for two concepts: discharge planning and older adults. The search was further refined using terms for randomized trials or intervention studies and tested to determine that it was appropriate to limit studies to English-language articles published from 1990 to April 2016. The PubMed, EMBASE, and Cochrane Library Databases were searched. Reference lists of all review articles were screened, and content experts were surveyed for additional article recommendations. The review protocol has been registered in PROSPERO, an international register of systematic reviews (ID# 37374).

Study Selection and Data Extraction

For inclusion, a study had to be a randomized controlled trial (RCT) published in English, have a study sample of participants with an average age of 65 and older, examine the effect of a discharge planning intervention from a hospital or skilled nursing facility on healthcare outcomes, and integrate an informal caregiver into at least one part of a discharge planning intervention. Exclusion criteria were discharge planning interventions that did not begin before discharge and discharge to a noncommunity setting. Centers for Medicare and Medicaid Services definitions for settings were used and included home, retirement community, and independent and assisted living facility (community settings) and nursing facility and inpatient care setting (noncommunity settings).[9] No specific criteria were established to define an informal caregiver except that the person providing care could not be present in a professional capacity. Four members of the project team, the coders and an investigator with content expertise, conducted a pilot abstract screening on a random sample of approximately 10% of total study abstracts to ensure consistency between coders and to refine the coding process.[10] Three investigators then independently reviewed abstracts, and weekly meetings were held with the complete project team to resolve coding questions and ensure continued fidelity to the initial training. An identical process was used for full-text review and data extraction. For all included studies, two independent reviewers coded interventions to evaluate the extent of caregiver integration, and two team members assessed systematic errors or deviations from the truth using the Cochrane Collaboration's risk-of-bias tool.[11] A statistician oversaw the extraction process and analysis of study outcomes. Discrepancies were resolved through team discussion.

The following data were extracted from all included RCTs: study setting, discharge location, patient and caregiver demographic characteristics, components of the discharge planning intervention, who administered the intervention, and healthcare resource use and cost outcomes.

Qualitative Synthesis of Evidence

Study results and methodological limitations of included studies were summarized, as were patterns or inconsistencies, main themes, and potential explanations for patterns or inconsistencies.

Quantitative Synthesis of Evidence

Based on data availability, Relative risks (RRs) for 90- and 180-day readmission were estimated. The RR is the ratio of intervention group readmission rate to the control group readmission rate. RRs less than 1 indicate a lower readmission rate for the intervention group than the control group. Study results were pooled in a random-effects (DerSimonian and Laird) model estimating the RR and 95% confidence interval (CI).12 Potential statistical inconsistencies between studies despite methodological variability were assessed by calculating the I^2 statistic.13 Potential for publication bias was assessed using the Egger regression and the Begg rank tests.14, 15 All analyses were conducted using Stata (Stata Corp., College Station, TX).

Quality Rating

Two expert reviewers assessed the overall quality of the evidence for each included study based on the specific criteria outlined in the Cochrane Risk of Bias tool. For each included study, reviewers provided assessments of sequence generation, allocation concealment, blinding, completeness of outcome data, selectiveness of outcome reporting, and other sources of bias.

Results

After duplicate removal, 10,546 abstracts remained, and 169 were identified through reference lists and expert opinion. In total, 10,715 abstracts were reviewed. Of the 99 studies that met participation and intervention criteria, 27 were randomized controlled trials (RCTs), and 15 of these included outcomes on cost or health resource use (Figure S1).

Study Characteristics

Table 1 summarizes the details of the 15 cost or resource usage RCTs. Two included studies reported different results from the same trial.16, 17 Studies were published over a period of 19 years. Total study participant group size ranged from 49 to 930, with control group size ranging from 24 to 478 and intervention group size ranging from 25 to 450. Study locations were varied; seven studies were conducted in the United States and eight outside the United States. Study definitions of caregivers were not available. Studies indicated inclusion of caregivers or family members, but none specified methods of definition and identification.

Table 1. Study Characteristics, Intervention Components, and Interventionists

Study	Participants	Components	Interventionist
Naylor et al. (1994)18 United States	N = 276; medical, n = 142 (CG = 70, IG = 72); surgical, n = 134 (CG = 66, IG = 68); aged ≥70	ID, WI, LV, CNX	Nurse
Rich et al. (1995)19 United States	N = 282 (CG = 140, IG = 142); aged ≥70 hospitalized for congestive heart failure	MR, CNX	Multidisciplinary team
Naylor et al. (1999)1 United States	N = 363 (CG = 186, IG = 177); aged ≥65, hospitalized in last 4 years	LV, CA, WI, CNX	Nurse
Li et al. (2003)21 United States	N = 49 (CG = 24, IG = 25); caregivers of hospitalized elderly adults admitted to one of four units in an academic medical center	WI	Not specified
Laramee et al. (2003)25 United States	N = 287 (CG = 146, IG = 141); hospitalized with cardiac conditions	ID, LV, CA, CNX, WI	Case manager
Lim et al. (2003)26 Australia	N = 598 (CG = 287, IG = 311); aged ≥65, hospitalized and required community services after discharge	CA, CNX	Nurse or allied health professional
Naylor et al. (2004)20 United States	N = 239 (CG = 118, IG = 121); aged ≥65, hospitalized with heart failure	CA, ID, LV, CNX, WI	Advance practice nurse

Huang & Liang (2005)27 Taiwan	N = 126 (CG = 59, IG = 63); aged ≥65, hospitalized because of falling	CA, ID, LV, WI, CNX	Gerontological nurse
Shyu et al. (2005)28 Taiwan	N = 137 (CG = 69, IG = 68); aged ≥60, hospitalized with hip fracture	CA, CNX	Gerontological nurse
Shyu et al. (2010)23 Taiwan	N = 158 (CG = 86, IG = 72); dyads of older adults with stroke and family caregivers	ID, CA, CNX	Nurse
Legrain et al. (2011)17 France	N = 665 (CG = 348, IG = 317); admitted to 6 geriatric hospital units	MR, LV, WI, CNX	Geriatrician
Li et al. (2012)36 United States	N = 407 (CG = 205, IG = 202); dyads of hospitalized older adults and family caregivers	CA, WI	Research assistant
Bonnet et al. (2013)16 France	N = 665 (CG = 348, IG = 317); admitted to geriatric hospital unit	MR, WI, CNX	Geriatrician
Lainscak et al. (2013)24 Slovenia	N = 253 (CG = 135, IG = 118); hospitalized for acute exacerbation of chronic obstructive pulmonary disease	CA, CNX	Coordinator
Forster et al. (2013)22 United Kingdom	N = 930 (CG = 478, IG = 450); dyads of medically stable individuals with stroke and caregivers helping with activities of daily living	LV, CA, CNX	Multidisciplinary team

- CG=control group; IG=intervention group; MR=medication reconciliation; ID=in-person demonstration; LV=teach back or learning validation; CA=caregiver assessment; WI=written instructions; CNX=connection to external or community resources.

Study Populations

The 13 unique study populations included a total of 4,361 participants, 56% of whom were female. Participants in all studies had a mean age of 70 and older. Six studies with 2,137 participants included data on race and had largely white populations (78%).[1, 18-22] Participants in all studies were discharged from hospital or skilled nursing facility settings, but because of a lack of detail in reporting, it was not possible to determine the number of participants discharged from a hospital versus those discharged from a nursing facility. Demographic information for caregivers was presented in only three of the studies; in these, 34% of caregivers were male, and their ages varied widely.[21-23] Two studies presented information on caregiver relationship to patient (caregiver, n = 1,086), in which 61% were a spouse or partner and 35% were adult children.[22, 23]

Intervention Components

Table 1 shows intervention components documented in the studies. Of the 15 studies, 13 had an intervention component that linked caregivers to external or community resources (such as sending hospitalization records to the primary care physician), and nine included written care plans. Caregiver assessment was a component in eight studies, and three included medication reconciliation. Live or video demonstrations of care tasks were included in five studies, and seven included “teach back” techniques, in which caregivers or patients demonstrate care skills to the interventionist. Fourteen of the studies included more than one intervention component, and nine included more than two components.

Eleven of the 15 studies had interventions that began in the hospital or nursing home and continued after discharge to the community.[1, 18-20, 22-28] The length of the interventions that continued after discharge, when described, ranged from 1 week to 3 months and included follow-up telephone calls (4 studies),[20, 25-27] a telephone call and a home visit (3 studies),[22, 24, 28] and multiple home visits and telephone calls (3 studies).[1, 20, 23] One study did not specify the type of postdischarge intervention.[18]

Interventionists

The interventionists most frequently involved in the RCTs were nurses (n = 7), with two studies using gerontological nurses and one an advanced practice nurse (Table 1). Geriatricians were involved in two studies, and two studies examined multidisciplinary teams made up of multiple specialists. In two studies, a discharge coordinator or case manager was the interventionist. One study relied on research assistants to perform the intervention. One study did not specify the interventionist involved.

Outcomes

All studies reported at least some results on readmissions, with 14 reporting readmissions for any cause (Table 2). Six studies reported time to readmission, and seven reported length of rehospitalization. Other usage outcomes included unscheduled acute care visits after discharge, skilled nursing facility admission, emergency department visits, and caregiver and patient use of a range of services.[17, 21-23] Three studies reported the cost of initial hospitalization, and seven reported the cost of rehospitalization.

Table 2. Evidence Table of Included Studies: Readmissions and Costs

Study	Readmissions, %[a]	Length of Rehospitalization[b]	Mean Cost, Initial Hospitalization	Mean Cost, Rehospitalization
Naylor et al. (1994) [18]	12-week medical: 33 (CG), 22 (IG) 12-week surgical: 32 (CG), 27 (IG)	12-week: [c] Medical: 222 (CG); 131 (IG) Surgical: 110 (CG), 149 (IG)	Medical: $23,810 (CG), $24,352 (IG) Surgical: $96,640 (CG), $105,936 (IG)	6–12 week: Medical: $340,496 (CG), $471,456 (IG) Surgical: $85,124 (CG), $170,248 (IG)
Rich et al. (1995)[19]	90-day: 46 (CG); 34 (IG) ($P < .1$) 90 days, >1 re-admission: 16 (CG), 6 (IG) ($P < .01$)	90-day: 6.2 (CG), 3.9 (IG) ($P = .04$)	N/A	90-day, total: $5,275 (CG) $4,815 (IG) ($P < .05$) 90-day, readmissions: $3,236 (CG), $2,178 (IG) ($P < .05$);
Naylor et al. (1999)[1]	≤24-week: 37.1 (CG), 20.3 (IG) ($P < .01$) >24-week: 14.5 (CG), 6.2 (IG) ($P < .01$)	24-week: 1.53 (IG), 4.09 days (CG) ($P < .001$) 24-week, re-admitted patients: 10.1 (CG), 7.50 (IG) ($P < .001$)	N/A	24-week, aggregate costs: $1,024,218 (CG), $427,217(IG) ($P < .001$)
Li et al. (2003)[21]	60-day: [d] 0.21 (CG), 0.04 (IG) ($P < .1$)	N/A	N/A	N/A
Laramee et al. (2003)[25]	90-day: 37 (CG), 37 (IG)	9.5(CG), 6.9 (IG) ($P = .15$)	$19,081 (CG), $16,119 (IG) ($P = .18$)	90-day readmission: $5,163 (CG), $5,253 (IG) 90-day readmission, readmitted patients: $16,395 (CG), $15,417 (IG)
Lim et al. (2003)[26]	180 Days: 28 (CG), 25 (IG)	5.2(CG), 3.0(IG) ($P = .01$)	N/A	6-month hospital: $10,161 (CG), $8,390 (IG) ($P = .02$) 6-month total: $10,687 (CG), $9,142 (IG) ($P = .05$)
Naylor et al. (2004)[20]	52-week: 61.2 (CG); 51.2 (IG) ($P = .01$)	52-week: 8 (CG), 5 (IG) ($P < .07$)		52-week, total adjusted per-patient: $12,481

				(CG), $7,636 (IG) (*P* = .002)
Huang & Liang (2005)27	90-day: 20.63 (CG), 6.35 (IG) (*P* = .02)	N/A	N/A	N/A
Shyu et al. (2005)28	30-day: 7.6 (CG), 4.5 (IG); 90-day: 14.1 (CG); 7.9 (IG)	N/A	N/A	N/A
Shyu et al. (2010)23	6-month: 19.5 (CG); 13 (IG) 6–12 month: 7.2 (CG); 0 (IG)	N/A	N/A	N/A
Legrain et al. (2011)17	90-day: 28.4 (CG), 20.2 (IG) (*P* < .05) 180-day: 38.2 (CG); 32.5 (IG)	N/A	N/A	N/A
Li et al. (2012)36	60-day, mean number per patient: 0.06 (CG), 0.11 (IG)	N/A	N/A	N/A
Bonnet et al. (2013)16	6-month: 28.7 (CG), 17.3 (IG) (*P* = .12)	N/A	N/A	N/A
Lainscak et al. (2013)24	180-day: 44 (CG), 31 (IG) (*P* < .05)	N/A	N/A	N/A
Forster et al. (2013)22	6-month: 19 (CG), 18 (IG) 6–12 month: 18 (CG), 15 (IG)	6-month: 8 (CG), 12 (IG) 6- to 12-month: 9 (CG); 9 (IG)	6-month: £12, 471 (CG), £13,127 (IG)	6-month: £26,381 (CG), £26,894 (IG) (*P* = .43) 12-month: £37,884 (CG), £37,453 (IG) (*P* = .16)

CG=control group; IG=intervention group; N/A=Not available.
[a] Percentage readmitted unless otherwise noted.
[b] Mean days unless otherwise noted.
[c] Total days.
[d] Mean per patient.

Table **2** provides greater detail on several common outcomes: readmissions, length of rehospitalization, and costs of initial hospitalization and rehospitalization. Of the 14 studies that reported readmissions for any cause, nine reported statistically significant reductions. Five of six studies reporting time to readmission reported statistically significant shorter time in the intervention group. Five of seven studies with outcomes on length of rehospitalization also reported statistically significant shorter stays. Of the seven studies reporting outcomes on cost of postdischarge care, four reported significantly lower costs. One study reported significantly costs of initial hospitalizations (before discharge).

Eleven studies provided sufficient detail to calculate readmission rates for treatment and control participants (six at 90 days, five at 180 days). One study reported 90-day readmission rates for the intervention and control group in the same study.**18** Another provided detail for 180- and 90-day readmission rates.**17** As Figure **1** shows, for all studies that reported 90-day readmission rates, the pooled intervention effect was (RR = 0.75, 95% CI =

0.62–0.91, *P* = .004). This indicates that integrating caregivers in the discharge planning process yielded 25% less risk for 90-day readmissions. Evidence of heterogeneity in 90-day readmission rates was limited (I^2 = 27.6%, *P* = .22). In all studies that reported 180-day readmission rates, the pooled intervention effect was (RR = 0.76, 95% CI = 0.64–0.90; *P* = .001) (Figure 2). This indicates that integrating caregivers in the discharge planning process yielded 24% less risk for 180-day readmissions. Limited statistical inconsistency was found using the test for heterogeneity across the studies assessing 180-day readmission rates (I^2 = 30.8%, *P* = .22).

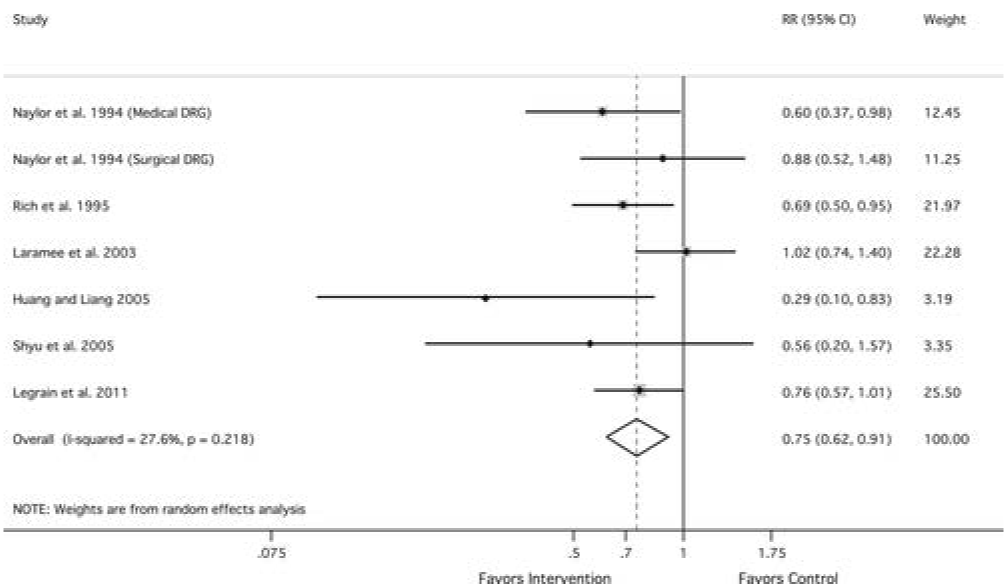

Figure 1 Relative risk (RR) status of intervention compared to control, 90-day readmissions (CI=confidence interval)

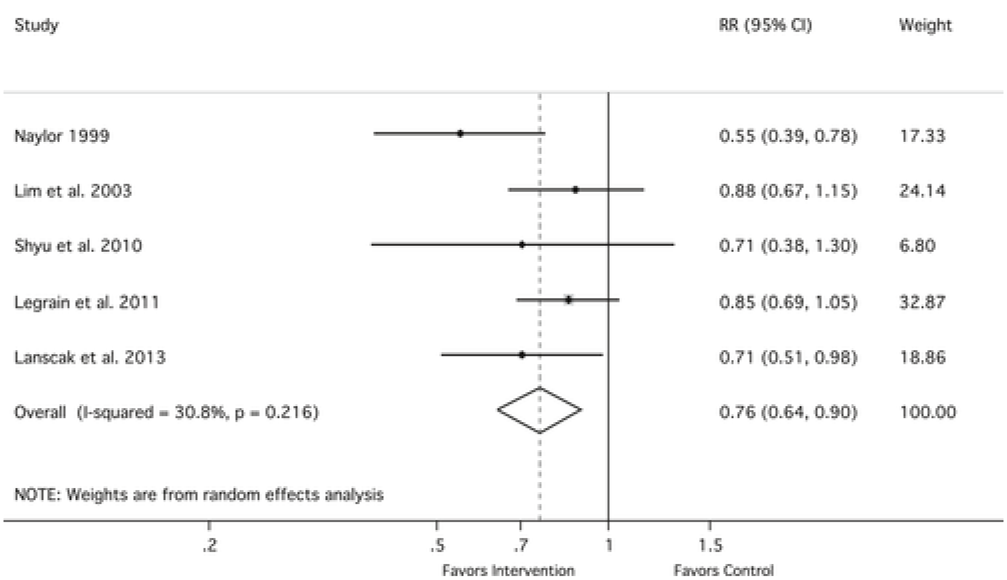

Figure 2 Relative risk (RR) status of intervention compared to control, 180-day readmissions (CI=confidence interval)

Publication Bias

For studies analyzing readmissions within 180 days, no evidence of publication bias was identified (Egger test *P* = .34; Begg test *P* > .99). Results for readmissions at 90 days were similar (Egger test *P* = .38; Begg test *P* = .46).

Quality of Included RCTs

Several methodological limitations were identified for the 15 RCTs included (Table S1). Six studies provided no information on sequence generation. Eight studies provided no information on allocation concealment. One study did not provide adequate blinding of participants or outcome assessors, and seven provided inadequate information on blinding. Seven studies provided inadequate information on outcome reporting, and one study selectively reported outcomes.

Discussion

This study demonstrates that integration of informal caregivers in the discharge planning process for older adults in hospitals and nursing facilities reduces hospital readmissions. Integrating caregivers in discharge planning yielded 25% less risk of 90-day readmission and 24% less risk of 180-day readmission than usual care. One of the strengths of these findings is that included studies varied in how they included caregivers, yet the interventions did not treat patients and caregivers in isolation from one another. Thus, these findings represent the real world and older adults in the hospital or a nursing facility where caregivers could be included when appropriate. Adding to the credibility of these findings, the studies had low variability in the estimates due to statistical heterogeneity rather than sampling (I^2 = 27.6%) or methodological (30.8%) variability. This suggests that the effects found in the individual studies are similar, so one can be confident that the combined estimates provide a meaningful description of the group of studies.

The potential effect of incorporating caregivers in discharge planning could be significant. Potentially preventable 30-day readmissions have been estimated to cost $12 billion annually in Medicare spending alone.[29] As the result of programs like the HRRP, hospitals that have a high proportion of patients readmitted within a short time frame are looking for methods to reduce readmissions. One way to reduce readmissions may to enhance the discharge planning process. However, prior studies that examined discharge planning interventions and readmission risk have focused on disease-specific interventions and therefore may not be generalizable. For example, research has demonstrated that customized discharge interventions for individuals with congestive heart failure can reduce readmissions.[30, 31] An effective discharge planning intervention for these individuals includes an emphasis on nutrition because of the link between diet and severity of congestive heart failure—an emphasis that may not be beneficial for all people. The inclusion of caregivers in the discharge planning process may be generalizable outside of disease-specific interventions. Because of medical advances, shorter hospital stays, and the expansion of home care technology, caregivers are taking on considerable care responsibilities.[32] This study demonstrates that the systematic inclusion of caregivers in the discharge planning process may help hospitals avert readmissions in light of these complex care responsibilities.

Current health policy activity regarding the engagement of caregivers in discharge planning is trending in the direction of recognizing the value of including caregivers on greater patient health outcomes and lower health services use. More than 30 states and the District of Columbia have passed CARE legislation that requires hospitals to designate and provide instruction and training to informal caregivers.[4, 33, 34] CARE legislation in most states requires that providers demonstrate, or at least offer caregivers the opportunity to ask questions about, the performance of postdischarge activities such as wound care and administering medications. In addition, recently proposed Medicare regulations would require caregiver integration in the discharge planning process.[5] Under these new regulations, hospitals would be required to consider the availability of informal caregivers and community-based support in discharge planning.

Several of the intervention components identified in this study are commonly used in current practice, such as connecting patients and caregivers to community resources by recommending outpatient rehabilitation or home-health services. Likewise, the provision of written care plans and medication reconciliation are pervasive components in current practice that are intended to streamline medical service and information delivery. Less commonly reported in the studies reviewed were assessment of caregiver needs and use of teach-back, or learning validation, methods.

There was variability in the length of the interventions, although the majority continued after discharge. The continuation of the intervention after discharged allowed for new or ongoing patient and caregiver needs to be addressed. The effect of the continuation of services in the community versus services received only in a hospital or nursing facility could not be ascertained but warrants further investigation.

There was variability in the types of health professionals who delivered the interventions between studies. It may be that the specific professional background of the interventionist is less important than the systematic inclusion of a caregiver in the discharge planning process, but this warrants further investigation.

Limitations

These results must be interpreted in light of several limitations. First, although publication bias was assessed, the small number of studies available may mean that the power to detect such bias, if it does exist, was insufficient. Second, this was a study-level metaanalysis limited to RCTs. Although it may have been possible to more thoroughly assess the effect of incorporating caregivers in discharge planning had nonrandomized studies been included, such studies were not included because of potential bias. Furthermore, person-level data were not available, so it could not be determined whether caregiver inclusion better serve patients with certain characteristics or specific diseases. Bias may have existed in some of the included RCTs. For example, several of the RCTs were unclear in how they handled blinding, allocation concealment, and outcome reporting. These limitations are commonly noted in the caregiving literature.[35] Additionally, health outcomes were variably reported across studies, so how the inclusion of caregivers in discharge planning influences patient health or quality of life could not be determined.

Although all interventions included caregivers in the discharge planning process, methods of their inclusion varied across studies. It is therefore not possible to determine from the current literature what the most-effective method of caregiver integration is during discharge planning of older adults to reduce hospital readmissions. In addition, the included studies were predominately multimodal interventions. They relied on several intervention components to create their specific discharge planning intervention. Future studies may identify which intervention components are the most effective in reducing hospital readmissions.

The studies identified provided little information about their caregiver populations or the extent of caregiver participation in the discharge planning process, individual discharge planning intervention components, implementation factors, contextual factors affecting the success of the intervention, or costs of implementation. Attempts were made to identify study protocols and additional publications of the studies included, but it was not possible to find further material for them all. Those that were found generally provided little additional information that was helpful for this investigation. Given the small number of studies, it was also difficult to isolate the effects of caregiver-centered intervention components. Future research should consider addressing the amount of caregiver participation necessary, specific effects of intervention components, implementation barriers, and solutions for caregivers. This type of information will be needed to allow healthcare system leaders and policy-makers to plan strategically as they consider implementing programs to prevent readmissions and other harms associated with hospital discharge.

Conclusion

For older adults, the systematic inclusion of caregivers during discharge planning leads to more than 20% fewer hospital readmissions. These benefits were observed in older adults with various diseases. Given the potential for better care and lower costs, hospitals and nursing facilities should develop care delivery systems that integrate informal caregivers into discharge planning.

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Author Contributions: Study concept and design: Morton, Folb, James, Schulz. Acquisition, analysis, or interpretation of data: Rodakowski, Rocco, Ortiz, Folb, Morton, Hu, Leathers. Drafting of the manuscript: Rodakowski, Rocco. Critical revision of the manuscript for important intellectual content: Rodakowski, Rocco, Ortiz, Folb, Morton, Schulz. Statistical analysis: Morton, Rodakowski, Rocco. Obtained funding*:* James. Administrative, technical, or material support: James, Ortiz, Rocco. Study supervision: James, Ortiz. Drs. Rocco and Rodakowski drafted the article. Dr. Rocco produced tables and figures and performed the analysis. Dr. Morton, Ms. Folb, and Ms. Ortiz drafted the protocol. Ms. Folb conducted the literature searches. Drs. Rodakowski and Hu, Ms. Ortiz, and Ms. Leathers screened searched results and selected full-text studies for inclusion. Drs. Rocco and Rodakowski performed data extraction. Dr. Rodakowski and Ms. Leathers conducted the risk-of-bias assessment. Dr. Morton provided statistical consulting throughout the project. Dr. Schulz provided clarification in interpretation of the results. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Supporting Information

Filename	**Description**
jgs14873-sup-0001-FigS1-TableS1.docxWord document, 18.6 KB	**Figure S1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses study flow diagram. **Table S1.** Cochrane Risk of Bias Tool.

Figure S1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses study flow diagram.

Table S1. Cochrane Risk of Bias Tool

Article	Sequence Generation	Allocation Concealment	Blinding	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias
Naylor et al. (1994)	?	?	?	+	?	+
Rich et al. (1995)	?	?	?	+	?	+
Naylor et al. (1999)	+	?	?	+	+	+
Laramee et al. (2003)	?	?	?	+	?	+
Lim et al.(2003)	?	?	?	+	?	+
Naylor et al. (2004)	+	+	+	+	?	+
Huang and Liang (2005)	+	?	?	+	?	+
Shyu et al. (2005)	?	?	+	+	?	+
Shyu et al. (2010)	?	?	?	+	?	–
Legrain et al. (2011)	+	+	–	+	?	+

Li et al. (2012)	?	?	–	+	?	+
Bonnet-Zamponi et al. (2013)	?	?	+	+	+	–
Lainscak et al. (2013)	+	?	?	+	–	+
Forster et al. (2013)	?	?	+	+	?	+

+=low risk; ?=insufficient information; —=high risk.