BMJ Open

A Systematic Review on the Effect of the Organization of Hospital Discharge on Patient Health Outcomes

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2016-012287
Article Type:	Research
Date Submitted by the Author:	14-Apr-2016
Complete List of Authors:	Couturier, Berengere; AP–HP, Hôpital St-Antoine, Unité de Santé Publique; Sorbonne Universités, UPMC Univ Paris 06, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP UMRS 1136) Carrat, Fabrice; AP–HP, Hôpital St-Antoine, Unité de Santé Publique; Sorbonne Universités, UPMC Univ Paris 06, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP UMRS 1136) Hejblum, Gilles; Sorbonne Universités, UPMC Univ Paris 06, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP UMRS 1136)
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Nursing, Public health
Keywords:	Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Risk management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

A Systematic Review on the Effect of the Organization of Hospital Discharge on Patient Health Outcomes

Bérengère Couturier[1,2*], Fabrice Carrat[1,2], Gilles Hejblum[1]

[1]Sorbonne Universités, UPMC Univ Paris 06, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP UMRS 1136), Paris, France

[2]AP–HP, Hôpital St-Antoine, Unité de Santé Publique, Paris, France

[*]Corresponding Author: Berengere Couturier, Assistance Publique - Hôpitaux de Paris, Unité de Santé Publique, Hôpital Saint Antoine, 184 rue du Faubourg Saint Antoine Paris, 75571 France.

E-mail:berengere.couturier@aphp.fr (B.C.).

Phone: 33 (0)149283228; fax: 33 (0)149283233.

Keywords: Continuity of Patient Care; Outcome Assessment (Health Care); Patient Discharge; Patient Handoff; Patient Readmission.

Word count: 3956 excluding title page, abstract, references, figures and tables

ABSTRACT (word count: 286)

Objective: The transition from hospital to home represents a key step in the management of patients and several problems related to this transition may arise, with potential adverse effects on patient health after discharge. The purpose of our study was to explore the association between components of the hospital-discharge process including continuity of care thereafter and patient outcomes in the post-discharge period.

Design: Systematic review of observational and interventional studies.

Setting: We conducted a combined search in the Medline and Web of Science databases. Additional studies were identified by screening the bibliographies of the included studies. The data-collection process was conducted using a standardized predefined grid, that included quality criteria.

Participants: A standard patient population returning home after hospitalization.

Primary and secondary outcomes: Adverse health outcomes occurring after hospital discharge.

Results: In the eighteen studies fulfilling our eligibility criteria, the main discharge-process components explored were: discharge summary (n=1), discharge instructions (n=2), drug-related problems at discharge (n=4), transition from hospital to home (n=5), and continuity of care after hospital discharge (n=6). The major patients' subsequent health outcomes measured were rehospitalizations (n=16), emergency department visits (n=7), and mortality (n=5). Seven of the sixteen studies exploring rehospitalizations, two of the seven studies examining emergency department visits and none of the studies that investigated patient mortality reported at least one significant association between discharge process and these outcomes.

Conclusions: Irrespective of the component of the discharge process explored, the outcome considered (composite or not), the sample size, and the study design, no consistent statistical association between hospital discharge and patient health outcome was identified. This systematic review highlights a wide heterogeneity between studies, especially in terms of the component(s) of the hospital-discharge process investigated, study designs, outcomes, and follow-up durations.

Strengths and limitations of this study

- This review analyses the available knowledge about the association between hospital discharge organization and patient's subsequent health care in a standard population returning home after hospitalization.
- There is a wide heterogeneity between studies exploring the effect of hospital-discharge process on patients' outcomes after discharge, especially in terms of hospital-discharge components, study designs, outcomes and follow-up durations.
- The heterogeneity observed prevents from performing a quantitative synthesis, and hampers a consistent assessment of the impact of discharge organization on patient health.

INTRODUCTION

Rationale

Since Forster et al.'s pioneering studies[1 2] in which around 20% of patients were reported to have experienced an adverse event within the 2 weeks following hospital discharge, several studies have documented the rates of adverse health outcomes, such as emergency department visits and hospital readmissions, occurring during the post-discharge period[3-5]. Therefore, return to home after hospital stay should not viewed by hospital staff as the completion of patient management. Ideally, scheduling outpatient follow-up visits, promoting direct communication with primary care providers and ensuring the transmission of the discharge summary, notifying pending test results at discharge, and, if necessary, arranging or suggesting outpatient post-discharge investigations, are various elements of the continuity of care after discharge that should be integrated within the hospital-discharge process. Consequently, hospital discharge and continuity of care thereafter constitute complex interrelated processes involved in a patient's transition from hospital to home. One can hypothesize that discharge organization affects, at least partially, patients' subsequent health care. For example, are there some discharge components specifically associated with reductions in the rates of patient rehospitalizations or emergency department visits?

Several observational studies aimed at identifying or reporting elements have highlighted deficiencies in the transition of care from the inpatient to the outpatient setting. Such studies focused on various aspects related to direct communication between inpatient and outpatient healthcare providers[6 7]; discharge summaries (content, timeliness, transmission to an outpatient physician)[8 9]; traceability and follow-up providers' information of pending test results at hospital discharge[10 11]; non-completion of recommended outpatient workups (diagnostic procedures, subspecialty referrals, and laboratory tests) after hospital discharge[12]; medication errors (omission or unjustified prescription) in discharge summaries[13 14]; drug-related problems after discharge[15 16]; and post-discharge follow-up outpatient visits[17 18]. Only a few observational studies have investigated the potential association between elements of the hospital-discharge process (and continuity of care thereafter) and patient health outcomes[19-21], and their reports are conflicting with regards to the effect of such processes on patient health after discharge. Moreover, these studies involved patients with various admissions sources and/or discharge locations, not only home, before and after hospital discharge. Other studies

aimed at exploring the perspectives of hospital staff and/or primary care providers[22-24], or patient opinions[25-27], or both[28 29], on hospital discharge and subsequent continuity of care. In particular, few studies have explored the association of such opinions on patient health outcomes such as rehospitalizations[30 31] or rehospitalizations and emergency department visits[32].

Finally, several reviews[33-43] examined the effect of various interventions related to hospital discharge. The perspectives of these reviews widely varied from one to another:

- One review was not a systematic review but highlighted several challenges, not necessarily directly focused on patient health outcomes[36].

- Three reviews concerned interventions on medication reconciliation at discharge[33 38 40], and in two of them[38 40], studies involving medication reconciliation at admission or during hospitalization were also included.

- One review only concerned older patients with congestive heart failure and considered only interventions combining comprehensive discharge planning with post-discharge support[41].

- One review explored a single outcome, the rehospitalization rate at 30 days after discharge[34].

- There were four reviews in which some[35 39 43] or all[37] outcomes considered were not patient health measures, e.g. discharge destination[39 43], length of stay[35 39 43], patient or health provider satisfaction[35 39 43], organizational outcomes (timeliness, accuracy, completeness, and overall quality of the information transfer)[37].

- One review categorized interventions according to the timing of these, pre-discharge, post-discharge and bridging interventions, and included studies in which the destination of patients after discharge could be nursing home or skilled nursing facility[42].

As regards results obtained, four reviews[34 39 42 43] paint a rather mixed picture: the effectiveness of interventions on patients' health was not clearly demonstrated, and was at best modest. Two reviews were more positive: Hesselink et al.[35] indicate that a significant effect was found in favor of the intervention for one or several outcome measures in 25 of the 36 studies included in their review; Phillips et al.'s systematic review[41] reports that comprehensive discharge planning plus post-discharge support for older patients with congestive heart failure resulted in a 25% reduction in the relative risk of readmission. The three reviews examining interventions related to medication reconciliation[33 38 40] indicated that it was not possible to link these interventions to clinically significant

improvements.

The relative contributions of discharge planning and subsequent continuity of care to the occurrence of events in the post-hospitalization period related to patients' health outcomes remains unclear. To our knowledge, there is no systematic review that estimates the real effect of the hospital-discharge process and continuity of care thereafter on the occurrence of adverse health outcomes after a patient's return to home.

Objective

We conducted a systematic review to explore the potential association between elements of the hospital-discharge process (including post-discharge continuity of care) and adverse outcomes (including healthcare-resource consumption) in the post-discharge period, in a standard population of patients returning home.

METHODS

The reporting of the systematic review is based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[44] (Supplementary File 1).

Eligibility criteria

The predefined study inclusion and exclusion criteria are detailed in Supplementary File 2.

Information sources

Between March 1, 2013 and June 30, 2013, we conducted a combined search in the Medline database via PubMed and in the Web of Science using different search terms to cover exploration of the organizational process for hospital discharge and subsequent continuity of care. Four independent searches were conducted, which focused on discharge summary, medication-reconciliation procedures (preferably at hospital discharge), global organization of discharge process and continuity of care thereafter, and care transition. We screened the bibliographies of review articles detected

during the database searches (which were not eligible for inclusion) to identify any additional studies that had been missed during the database searches.

Search strategies

The queries made in the Medline and Web of Science databases are detailed in Supplementary File 3.

Study selection

The eligibility of each retrieved article was assessed by one author (B.C.) in terms of its title, abstract and, if necessary, the full text. We decided *a priori* that in the case of doubt, a second reviewer (G.H.) would decide whether to include the study. The bibliography of each included study was screened to potentially identify any studies missed in the database searches. Whenever this resulted to the identification of an additional study, this screening process was repeated until no additional study was found.

Data collection process

The data-collection process was conducted (by B.C.) using a standardized predefined data-collection sheet and extracted data were checked.

Data items

The following information was extracted from each of the studies included: name of first author, journal, year of publication, component(s) of the discharge process investigated, study design, objective(s), setting, participants, sample size, method(s), description of the intervention and comparator (if applicable), main outcome measures, results, synthesis of the major results (i.e. significant association or not between the component(s) of the discharge process investigated and patient health outcomes), and study limitations.

Risk of bias in individual studies/quality assessment

The methodological quality of the selected studies was evaluated (by B.C.) using two tools that have been proposed for assessing studies, when the considered study set includes major differences in terms of experimental design. First, the Quality Assessment Tool for Quantitative Studies developed by the Effective Public Health Practice Project[45 46] rates study global quality according to three categories: strong, moderate, and weak. Second, the Mixed Methods Appraisal Tool – version 2011[47] grades the studies according to five categories, ranging from 0% (research questions not clearly stated), low (score=25%), moderate (score=50%), high (score=75%), to very high (score=100%) methodological quality. Both tools have strengths and weaknesses. For example, the Quality Assessment Tool for Quantitative Studies automatically assigns a strong score to randomized controlled, irrespective of the quality of randomization method and allocation concealment, while the Mixed Methods Appraisal Tool is limited to the evaluation of four items. Studies were finally ranked into three categories, weak, moderate, or strong, according to a combination of the ranks issued from the two tools: in a first step, low and very low, moderate, and high and very high rankings with the Mixed Methods Appraisal Tool were recategorized as weak, moderate, and strong, respectively. Then, final ranking of a given study was chosen as the lowest rank of the two tools.

Summary measures and synthesis of results

A standard quantitative synthesis, i.e. a meta-analysis, was deemed not to be appropriate because of wide variability in study designs, types of intervention (if applicable), and outcomes. Nevertheless, a synthesis of the results from the observational and interventional studies has been made in the form of a summary table and figures.

Risk of bias across studies

The possibility of publication bias resulting in more positive than negative studies being published may have affected the results of our review but could not be assessed.

Additional analyses

No prespecified additional analysis was performed.

RESULTS

Study selection

The results of the eight independent searches (four major queries in each of the databases) identified 1144 publications, 890 after excluding 254 duplicates, of which eight studies were initially included (see Supplementary File 4 that indicates the references of full-text articles excluded and details the corresponding reason). Screening the bibliographies of the initial included studies resulted in the inclusion of 10 additional studies. No additional studies were identified from the bibliographies of reviews identified during the database searches. Thus, the final set consisted of 18 studies[12 31 48-63] (Figure 1).

Study characteristics

The study characteristics are summarized in Supplementary File 5. The 18 selected studies were published between 2001 and 2013 and were performed in the USA (n=13), Canada (n=3), Australia (n=1), and United Kingdom (n=1). Ten studies were observational[12 31 51 54 55 57 58 60-62] and eight were interventional[48-50 52 53 56 59 63] (including four randomized controlled studies[50 53 56 59]). The interventions were mostly multifaceted interventions; four were pharmacist interventions[48 53 59 63] and four focused on the transition from hospital to home[49 50 52 56].

In 14 studies, patients were discharged from general medical and/or surgical units. Four studies targeted patients with heart failure[31 49 55 62], with one study targeting a somewhat larger population[31].

Sample sizes ranged from 83[48] to 738[56] patients for interventional studies and from 86[64] to 938,933[60] patients for observational studies.

Risk of bias within studies/Quality assessment

According to the Quality Assessment Tool for Quantitative Studies, 11 studies were rated as having a strong[31 50 51 54-57 59-62], five a moderate[48 52 53 58 64], and two a weak[49 63] methodological quality (Figure 2).

According to the Mixed Methods Appraisal Tool, seven studies were rated as having a very high[31 51 54-57 60], two a high[62 64], six a moderate[48 50 52 58 59 61], two a low[49 63], and one a very low[53] methodological quality (Figure 2).

When combining the two quality tools, eight studies were rated as having a strong[31 51 54-57 60 62], seven a moderate[48 50 52 58 59 61 64], and three a weak[49 53 63] combined methodological quality (Figure 2).

Results of individual studies

Components of the discharge process investigated (Table 1)

Five discharge-process components or aspects were explored primarily: discharge summary (n=1) [58], discharge instructions as mentioned in the medical records (n=2)[31 62], drug-related problems at discharge (n=4)[48 53 59 63], transition from hospital to home (n=5)[49-52 56], and continuity of care after hospital discharge (n=6)[54 55 57 60 61 64].

Only one study investigated the discharge-summary component[58]. This observational study examined the timeliness of the discharge summary. However, this component was also explored in two other studies[51 61] in combination with other components of the hospital-discharge process. In particular, the availability of the discharge summary to the physician during post-discharge visits was investigated.

The component relating to documentation of discharge instructions provided to patients was explored in two observational studies[31 62], and both concerned patients with congestive heart failure.

Drug-related problems were addressed via the assessment of a pharmacist intervention in four studies[59 63]. The type and number of intervention elements (e.g. pharmaceutical counseling, education, medication review, medication reconciliation, follow-up with a pharmacist after discharge), varied between studies. Similarly, the component “transition from hospital to home” was explored mainly in four interventional studies[49 50 52 56], with the number and type of intervention elements (e.g. patient therapeutic education, medication reconciliation, post-hospitalization follow-up) varying

between studies. Only one observational study[51] explored the transition from hospital to home, focusing on different aspects of the communication between hospital staff and primary care physicians (primary care physician's awareness of his or her patient's hospitalization, receipt of a discharge summary, direct exchanges with the multidisciplinary hospital team).

In contrast, the component "continuity of care after discharge" was investigated exclusively in observational studies. The elements targeted in these studies were documented follow-up appointment arrangements scheduled before discharge[54], timing of outpatient follow-up after discharge[55 57], post-discharge follow-up by hospital physicians or general practitioners[60], a score for continuity of care[61], and medical errors related to discontinuity of care from the inpatient to the outpatient setting[64].

Table 1 Hospital discharge process and subsequent continuity of care, and associated patient health outcomes.

	Discharge summary (n=1)	**Discharge instructions documented in medical records (n=2)**	**Drug-related problems at hospital discharge (n=4)**	**Transition from hospital to home (n=5)**	**Continuity of care after hospital discharge (n=6)**
Significant association	Li et al., 2003[a] (readmission rate at 7 and 28 days)	VanSuch et al., 2006[a] (time to readmission for HF/any cause 12 months)	Al-Rashed et al., 2002[b] (readmissions at 15–22 days and 3 months; unplanned GP visits at 15–22 days and 3 months)	Anderson et al., 2005[b] (readmissions rate at 6 months)	Grafft et al., 2010[a] (composite endpoint: ED visits or readmissions at 180 days)
			Dudas et al., 2001[b] (ED visits at 30 days)	Balaban et al., 2008[b] (no follow-up at 21 days)	Hernandez et al., 2010[a] (composite endpoint: mortality or readmissions at 30 days; readmissions at 30 days)
				Dedhia et al., 2009[b] (composite endpoint: ED visits or readmissions at 1 week; readmissions at 30 days)	Moore et al., 2003[a] (work-up errors and readmissions at 3 months)
				Jack et al., 2009[b] (composite endpoint: all ED visits and readmissions at 30 days; ED visits at 30 days; visited PCP at 30 days)	van Walraven et al., 2004[a] (composite endpoint: death or readmissions at 30 days)

Table 1 (Continued)

Non-significant association		Jha et al., 2009[a] (readmission rate at 30 days)	Dudas et al., 2001[b] (readmissions at 30 days)	Balaban et al., 2008[b] (readmissions at 31 days; ED visits at 31 days; incomplete outpatient work-up)	Grafft et al., 2010[a] (composite end point: ED visits or readmissions at 30 days; readmissions at 30 days; ED visits at 30 days; mortality at 30 days; readmissions at 180 days, mortality at 180 days)
		VanSuch et al., 2009[a] (survival time to death from any cause censored at 12 months)	Schnipper et al., 2006[b] (composite endpoint: ED visits or readmissions at 30 days)	Bell et al., 2009[a,c] (composite endpoint: readmission or ED visit or death at 30 days)	Hernandez et al., 2010[a] (mortality at 30 days)
			Walker et al., 2009[b] (readmission rate at 14 and 30 days; ED visits at 72 hours, 14 days, 30 days; composite endpoint: all ED visits and readmissions at 30 days)	Dedhia et al., 2009[b] (ED visits at 30 days)	Kashiwagi et al., 2012[a] (readmissions at 30 days)
				Jack et al., 2009[b] (readmissions at 30 days)	Moore et al., 2003[a] (medication continuity errors, test follow-up errors and readmissions at 3 months)
					van Walraven et al., 2010[a,c] (death at 6 months; readmissions at 6 months)

ED, emergency department; GP, general practitioner; HF, heart failure; PCP, primary care provider.
[a]Observational study.
[b]Interventional study.
[c]Study also exploring discharge summary component.

Patient health outcomes post-discharge (Table 1)

The major outcomes measured in the included studies were, in order of frequency, rehospitalizations (n=16)[31 48-58 61-64], emergency department visits (n=7)[50-54 56 63] and mortality (n=5)[51 54 55 61 62]. Two studies investigated only composite outcomes: emergency department visits or rehospitalizations[59], and rehospitalizations or mortality[60]. In addition, six studies investigated outcomes separately and in combination: emergency department visits and/or rehospitalizations[52 54 56 63], rehospitalizations or mortality[55], emergency department visits or rehospitalizations or mortality[51].

The rate of post-discharge visits to a general practitioner was another, less frequently, measured outcome[48 50 56]. This outcome was considered from a different perspective in each of the three corresponding studies: unplanned visits to a general practitioner[48], no outpatient follow-up within 21 days[50], and follow-up visits with the primary care provider[56].

The duration of follow-up after discharge varied from 7 days[58] to 12 months[62] for rehospitalizations, from 72 hours[63] to 31 days[50] for emergency department visits, from 30 days[54 55] to 12 months[62] for death, and from 15 days[48] to 3 months[48] for visits to the general practitioner.

Synthesis of results

All of the studies included were published within the past 15 years, indicating that the effect of discharge components on patient health outcomes is a relatively recent area of investigation. Whereas the studies' underlying healthcare organizations were relatively homogeneous (with most studies originating from the USA), the components of the discharge process investigated were not (Supplementary File 5). Even when considering a given category of this process, the variable of interest and the associated investigation method varied widely between studies, including follow-up duration for assessing patient outcome (see Table 1), which precluded us from performing a meta-analysis that would generate meaningful results. Nevertheless, the effect of components of the discharge process on the main patient health outcomes is shown in Figure 3, and provides a synthesis of the corresponding associations.

In 12 studies[48-50 52-56 58 60 62 64], at least one significant association was reported between component(s) of the hospital-discharge process and any patient health outcome explored, irrespective of the type of outcomes and the follow-up duration.

Considering the 16 studies[31 48-58 61-64] that explored the potential association between hospital-discharge process and rehospitalizations, six reported a significant association[48 49 52 55 58 62], while nine reported a non-significant association[31 50 51 53 54 56 57 61 63]. The remaining study[64] evaluated three types of medical errors (work-up errors, medication continuity errors, and test follow-up errors) related to the discontinuity of care from the inpatient to the outpatient setting and found a significant association only between work-up errors and rehospitalizations. When restricting the analysis to the 12 studies[31 48 50-58 63] that investigated rehospitalizations within approximately 30 days of discharge (including 15–22 days[48], 28 days[58] and 31 days[50]), four studies[48 52 55 58] reported a significant association between this outcome and the hospital-discharge process, while eight[31 50 51 53 54 56 57 63] reported a non-significant association.

Considering the seven studies[50-54 56 63] (five of which were interventional studies[50 52 53 56 63]) that investigated post-discharge visits to the emergency department as an outcome, two interventional studies[53 56] reported a significant association between this outcome and the investigated intervention (which concerned either medication-related problems at discharge[53] or transition from hospital to home[56]).

The five studies that investigated patient mortality[51 54 55 61 62] (all of which were observational) all reported a non-significant association between discharge process and death.

Eight studies[51 52 54-56 59 60 63] explored a composite outcome (mostly based on 30-day follow-up duration, n=7), the nature of the combination varying from one study to another (Table 1 and Figure 4). The association between component(s) of the discharge process and continuity of care thereafter and the composite outcome was reported as significant in four studies[52 55 56 60] and as non-significant in three studies[51 59 63]. In the remaining study[54], the association between documented follow-up appointment arrangements and rehospitalizations or emergency department visits within 30 days and 180 days was non-significant and significant, respectively. In addition, despite the authors' initial hypothesis that specific instructions provided during follow-up appointment would be associated with fewer hospital readmissions, follow-up instructions were significantly associated with a slightly higher likelihood of having either an emergency department visit or a hospital readmission within 180 days of the initial hospital discharge.

Risk of bias across studies

This item was especially difficult to evaluate because of the wide heterogeneity between studies (e.g. design, sample size, hospital-discharge components, outcomes, follow-up duration). In addition, as this heterogeneity prevented from performing a meaningful meta-analysis, assessing the risk of bias across studies might appear questionable. Most of all, a potential publication bias against the publication of studies with negative or non-significant associations would not change our overall results.

Additional analyses

No additional analysis was performed.

DISCUSSION

Summary of evidence

The major outcomes used to estimate the effect of the discharge process and subsequent continuity of care on patient health after discharge were rehospitalizations and emergency department visits, most commonly measured at approximately 30 days after discharge. Considering rehospitalizations, seven out of the sixteen studies that explored this outcome reported at least one significant association between discharge process and rehospitalizations. As regards emergency department visits, two of the seven studies that investigated this outcome reported a significant association. No study reported a significant association between a discharge component and mortality. This systematic review highlights a wide heterogeneity across the studies, especially in terms of the component(s) of the hospital-discharge process investigated, study designs, outcomes measured, and follow-up durations. Such an heterogeneity in critical elements prevents from performing an appropriate and meaningful meta-analysis. Nevertheless, Figures 3 and 4 indicate globally that irrespective of the component of the discharge process explored, outcome considered, sample size, and study design, one cannot identify any consistent statistical association between hospital discharge and patient health outcome. The global picture from our review indicates that the effect of discharge process and subsequent continuity of care components on patient health after

discharge remains unclear, and was very difficult to estimate, especially in light of the heterogeneity across studies. Therefore, it is not possible to draw any conclusions about the most critical organizational discharge-process components on which to base potential recommendations. However, this review suggests that attempts to improve discharge process is likely to result, at most, in a modest impact on patient health after discharge.

Among the 18 studies included in this review, eight described interventions, only four of which were randomized trials; this finding raises concerns about the potential effect of confounding factors that might have influenced patient outcomes after discharge. Indeed, in many of the studies, features related to elements of the patients' hospital stay (such as disease progression, severity of illness, and comorbidities), which were unrelated to discharge components, may have contributed to patients' health outcomes after discharge.

Another concern is the variability of discharge protocols from one hospital department to another. As reported by Hernandez et al.[55], such protocols are poorly documented in study reports. Although 16 of the 18 studies were conducted in USA (n = 13) or Canada (n = 3), between-protocol variability (from one department, hospital, region, or country to another) might result in variability in the effect of the hospital-discharge process on a patient's subsequent health. General recommendations for managing the hospital–primary-care interface have been proposed by several societies[65], as well as discharge checklists[66 67]. Similarly, Kripalani et al.[36] attempted to identify challenges and to propose recommendations, given the lack of evidence-based recommendations for hospital discharge applicable to a broad range of patients. However, the rate of adoption of standardized evidence-based recommendations in health organizations remains unknown.

Limitations

This review is subject to several limitations, the first of which concerns the potential omission of relevant studies. However, our iterative process of screening the bibliographies of included studies is likely to have minimized this limitation. Of note, we did not identify any new studies when we searched the bibliographies of reviews identified during the database searches. In any event, the omission of a small number of studies is unlikely to change our overall findings.

The second limitation concerns the populations studied. The inclusion criteria restricted the analysis to studies on general medical or surgical patients originating from home and discharged to home.

Studies on specific populations were excluded, but we decided to keep studies involving patients with heart failure given the prevalence of such patients and the substantial volume of literature available on hospital discharge and continuity of care. However, a sensitivity analysis in which the four studies involving these patients[31 49 55 62] were excluded did not change the overall findings.

The third limitation was the heterogeneity revealed by our synthesis of the results. This heterogeneity may be linked to the fact that the processes investigated were complex, multifaceted and interconnected. Previous reviews in the domain of hospital-discharge process and continuity of care also report such heterogeneity[33-35 37 39 40 42 43], also attested by the fact that only two reviews performed meta-analyses[41 43]. This heterogeneity appeared to be the major element preventing frank conclusions to be drawn as to the beneficial effect, or otherwise, of the interventions aimed at improving the organization of discharge and continuity-of-care processes.

The fourth limitation was the limited scientific evidence of the included studies, given the various designs. Unsurprisingly, studies with a high sample size were observational. Assessment of the methodological quality of the studies indicated that only eight of the 18 studies were categorized as having a strong score in terms of methodological quality, when combining the two quality tools used (see Figure 2). Finally, a risk of publication bias cannot be excluded against the publication of studies that did not find an association between hospital discharge component(s) and patient health outcome(s).

Conclusions and perspectives

This systematic review highlights the wide heterogeneity between studies evaluating the effect of hospital-discharge organization process on patients' outcomes post-discharge. The role of this heterogeneity in the variance observed in the study results (i.e. either a positive effect or absence of effect) is unknown. Globally, the effect of the complex interrelated hospital-discharge and continuity-of-care processes on patient health outcomes requires further investigations, but because of the inherent multicomponent nature of these processes and the interweaving of these processes in the whole hospital stay, estimating such an effect is difficult. To obtain a clearer global picture, future studies would benefit from better standardization of the adverse outcomes explored, including follow-up duration. In addition, technological developments may enhance overall management of patients at the hospital–primary-care interface. A major challenge concerns the interoperability between hospital and

primary-care electronic health-information systems, for facilitating exchanges of hospital–primary-care information. Moreover, implementation of information systems collecting patient opinions after hospital discharge may document important information on current organization, and constitute the basis of systems devoted to improving management.

Acknowledgements

Sophie Rushton-Smith, PhD (Medlink Healthcare Communications Limited) provided editorial support on the final version of the article and was funded by the authors.

Competing Interests

None declared.

Funding

This work was supported by a grant from Assistance Publique-Hôpitaux de Paris, program "Recherche Infirmière" (BC). This institution had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Author contributions

Study conception and design: B.C., F.C., and G.H.; data acquisition: B.C.; analysis and interpretation of data: B.C. and G.H.; wrote first draft of the paper: B.C. and G.H.; all authors read and approved the final version of the paper.

Data sharing statement

No additional data are available.

REFERENCES

1. Forster AJ, Clark HD, Menard A, et al. Adverse events among medical patients after discharge from hospital. *CMAJ*. 2004;170:345-9.

2. Forster AJ, Murff HJ, Peterson JF, et al. The incidence and severity of adverse events affecting patients after discharge from the hospital. *Ann Intern Med*. 2003;138:161-7.

3. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med*. 2009;360:1418-28.

4. Rising KL, White LF, Fernandez WG, et al. Emergency department visits after hospital discharge: a missing part of the equation. *Ann Emerg Med*. 2013;62:145-50.

5. Vashi AA, Fox JP, Carr BG, et al. Use of hospital-based acute care among patients recently discharged from the hospital. *JAMA*. 2013;309:364-71.

6. Arora VM, Prochaska ML, Farnan JM, et al. Problems after discharge and understanding of communication with their primary care physicians among hospitalized seniors: a mixed methods study. *J Hosp Med*. 2010;5:385-91.

7. Pantilat SZ, Lindenauer PK, Katz PP, et al. Primary care physician attitudes regarding communication with hospitalists. *Am J Med*. 2001;111:15S-20S.

8. Horwitz LI, Jenq GY, Brewster UC, et al. Comprehensive quality of discharge summaries at an academic medical center. *J Hosp Med*. 2013;8:436-43.

9. van Walraven C, Seth R, Laupacis A. Dissemination of discharge summaries - Not reaching follow-up physicians. *Can Fam Phys*. 2002;48:737-42.

10. Roy CL, Poon EG, Karson AS, et al. Patient safety concerns arising from test results that return after hospital discharge. *Ann Intern Med*. 2005;143:121-8.

11. Were MC, Li XC, Kesterson J, et al. Adequacy of hospital discharge summaries in documenting tests with pending results and outpatient follow-up providers. *J Gen Intern Med*. 2009;24:1002-6.

12. Moore C, McGinn T, Halm E. Tying up loose ends: discharging patients with unresolved medical issues. *Arch Intern Med*. 2007;167:1305-11.

13. McMillan TE, Allan W, Black PN. Accuracy of information on medicines in hospital discharge summaries. *Intern Med J*. 2006;36:221-5.

14. Perren A, Previsdomini M, Cerutti B, et al. Omitted and unjustified medications in the discharge summary. *Qual Saf Health Care*. 2009;18:205-8.

15. Ellitt GR, Engblom E, Aslani P, et al. Drug related problems after discharge from an Australian teaching hospital. *Pharm World Sci*. 2010;32:622-30.

16. Paulino EI, Bouvy ML, Gastelurrutia MA, et al. Drug related problems identified by European community pharmacists in patients discharged from hospital. *Pharm World Sci*. 2004;26:353-60.

17. Roughead EE, Kalisch LM, Ramsay EN, et al. Continuity of care: when do patients visit community healthcare providers after leaving hospital? *Intern Med J*. 2011;41:662-7.

18. van Walraven C, Taljaard M, Bell CM, et al. A prospective cohort study found that provider and information continuity was low after patient discharge from hospital. *J Clin Epidemiol*. 2010;63:1000-10.

19. Coleman EA, Smith JD, Raha D, et al. Posthospital medication discrepancies: prevalence and contributing factors. *Arch Intern Med*. 2005;165:1842-7.

20. Hansen LO, Strater A, Smith L, et al. Hospital discharge documentation and risk of rehospitalisation. *BMJ Qual Saf*. 2011;20:773-8.

21. van Walraven C, Seth R, Austin PC, et al. Effect of discharge summary availability during post-discharge visits on hospital readmission. *J Gen Intern Med*. 2002;17:186-92.

22. Davis MM, Devoe M, Kansagara D, et al. "Did I do as best as the system would let me?" Healthcare professional views on hospital to home care transitions. *J Gen Intern Med*. 2012;27:1649-56.

23. Greysen SR, Schiliro D, Horwitz LI, et al. "Out of sight, out of mind": housestaff perceptions of quality-limiting factors in discharge care at teaching hospitals. *J Hosp Med*. 2012;7:376-81.

24. Harding J. Study of discharge communications from hospital doctors to an inner London general practice. *J R Coll Gen Pract*. 1987;37:494-5.

25. Flacker J, Park W, Sims A. Hospital discharge information and older patients: do they get what they need? *J Hosp Med*. 2007;2:291-6.

26. Hadjistavropoulos H, Biem H, Sharpe D, et al. Patient perceptions of hospital discharge: reliability and validity of a Patient Continuity of Care Questionnaire. *Int J Qual Health Care*. 2008;20:314-23.

27. Horwitz LI, Moriarty JP, Chen C, et al. Quality of discharge practices and patient understanding at an academic medical center. *JAMA Intern Med*. 2013;173:1715-22.

28. Hesselink G, Schoonhoven L, Plas M, et al. Quality and safety of hospital discharge: a study on experiences and perceptions of patients, relatives and care providers. *Int J Qual Health Care*. 2013;25:66-74.

29. Hesselink G, Vernooij-Dassen M, Pijnenborg L, et al. Organizational culture an important context for addressing and improving hospital to community patient discharge. *Med Care*. 2013;51:90-8.

30. Boulding W, Glickman SW, Manary MP, et al. Relationship between patient satisfaction with inpatient care and hospital readmission within 30 days. *Am J Manag Care*. 2011;17:41-8.

31. Jha AK, Orav EJ, Epstein AM. Public reporting of discharge planning and rates of readmissions. *N Engl J Med*. 2009;361:2637-45.

32. Weiss M, Yakusheva O, Bobay K. Nurse and patient perceptions of discharge readiness in relation to postdischarge utilization. *Med Care*. 2010;48:482-6.

33. Garcia-Caballos M, Ramos-Diaz F, Jimenez-Moleon JJ, et al. Drug-related problems in older people after hospital discharge and interventions to reduce them. *Age Ageing*. 2010;39:430-8.

34. Hansen LO, Young RS, Hinami K, et al. Interventions to reduce 30-day rehospitalization: a systematic review. *Ann Intern Med*. 2011;155:520-8.

35. Hesselink G, Schoonhoven L, Barach P, et al. Improving patient handovers from hospital to primary care: a systematic review. *Ann Intern Med*. 2012;157:417-28.

36. Kripalani S, Jackson AT, Schnipper JL, et al. Promoting effective transitions of care at hospital discharge: a review of key issues for hospitalists. *J Hosp Med*. 2007;2:314-23.

37. Kripalani S, LeFevre F, Phillips CO, et al. Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care. *JAMA*. 2007;297:831-41.

38. Kwan JL, Lo L, Sampson M, et al. Medication reconciliation during transitions of care as a patient safety strategy: a systematic review. *Ann Intern Med*. 2013;158:397-403.

39. Mistiaen P, Francke AL, Poot E. Interventions aimed at reducing problems in adult patients discharged from hospital to home: a systematic meta-review. *BMC Health Serv Res*. 2007;7:47.

40. Mueller SK, Sponsler KC, Kripalani S, et al. Hospital-based medication reconciliation practices: a systematic review. *Arch Intern Med*. 2012;172:1057-69.

41. Phillips CO, Wright SM, Kern DE, et al. Comprehensive discharge planning with postdischarge support for older patients with congestive heart failure: a meta-analysis. *JAMA*. 2004;291:1358-67.

42. Rennke S, Nguyen OK, Shoeb MH, et al. Hospital-initiated transitional care interventions as a patient safety strategy: a systematic review. *Ann Intern Med*. 2013;158:433-40.

43. Shepperd S, Lannin NA, Clemson LM, et al. Discharge planning from hospital to home. *Cochrane Database Syst Rev*. 2013;1:CD000313.

44. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med*. 2009;6:e1000100.

45. Jackson N, Waters E, Guidelines for Systematic Reviews in Health P, et al. Criteria for the systematic review of health promotion and public health interventions. *Health Promot Int*. 2005;20:367-74.

46. Thomas BH, Ciliska D, Dobbins M, et al. A process for systematically reviewing the literature: providing the research evidence for public health nursing interventions. *Worldviews Evid Based Nurs*. 2004;1:176-84.

47. Pace R, Pluye P, Bartlett G, et al. Testing the reliability and efficiency of the pilot Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. *Int J Nurs Stud*. 2012;49:47-53.

48. Al-Rashed SA, Wright DJ, Roebuck N, et al. The value of inpatient pharmaceutical counselling to elderly patients prior to discharge. *Br J Clin Pharmacol*. 2002;54:657-64.

49. Anderson C, Deepak BV, Amoateng-Adjepong Y, et al. Benefits of comprehensive inpatient education and discharge planning combined with outpatient support in elderly patients with congestive heart failure. *Congest Heart Fail*. 2005;11:315-21.

50. Balaban RB, Weissman JS, Samuel PA, et al. Redefining and redesigning hospital discharge to enhance patient care: a randomized controlled study. *J Gen Intern Med*. 2008;23:1228-33.

51. Bell CM, Schnipper JL, Auerbach AD, et al. Association of communication between hospital-based physicians and primary care providers with patient outcomes. *J Gen Intern Med*. 2009;24:381-6.

52. Dedhia P, Kravet S, Bulger J, et al. A quality improvement intervention to facilitate the transition of older adults from three hospitals back to their homes. *J Am Geriatr Soc*. 2009;57:1540-6.

53. Dudas V, Bookwalter T, Kerr KM, et al. The impact of follow-up telephone calls to patients after hospitalization. *Am J Med Qual*. 2001;111:26S-30S.

54. Grafft CA, McDonald FS, Ruud KL, et al. Effect of hospital follow-up appointment on clinical event outcomes and mortality. *Arch Intern Med*. 2010;170:955-60.

55. Hernandez AF, Greiner MA, Fonarow GC, et al. Relationship between early physician follow-up and 30-day readmission among Medicare beneficiaries hospitalized for heart failure. *JAMA*. 2010;303:1716-22.

56. Jack BW, Chetty VK, Anthony D, et al. A reengineered hospital discharge program to decrease rehospitalization: a randomized trial. *Ann Intern Med*. 2009;150:178-87.

57. Kashiwagi DT, Burton MC, Kirkland LL, et al. Do timely outpatient follow-up visits decrease hospital readmission rates? *Am J Med Qual*. 2012;27:11-5.

58. Li JYZ, Yong TY, Hakendorf P, et al. Timeliness in discharge summary dissemination is associated with patients' clinical outcomes. *J Eval Clin Pract*. 2013;19:76-9.

59. Schnipper JL, Kirwin JL, Cotugno MC, et al. Role of pharmacist counseling in preventing adverse drug events after hospitalization. *Arch Intern Med*. 2006;166:565-71.

60. van Walraven C, Mamdani M, Fang JM, et al. Continuity of care and patient outcomes after hospital discharge. *J Gen Intern Med*. 2004;19:624-45.

61. van Walraven C, Taljaard M, Etchells E, et al. The independent association of provider and information continuity on outcomes after hospital discharge: implications for hospitalists. *J Hosp Med*. 2010;5:398-405.

62. VanSuch M, Naessens JM, Stroebel RJ, et al. Effect of discharge instructions on readmission of hospitalised patients with heart failure: do all of the Joint Commission on Accreditation of Healthcare Organizations heart failure core measures reflect better care? *Qual Saf Health Care*. 2006;15:414-7.

63. Walker PC, Bernstein SJ, Jones JN, et al. Impact of a pharmacist-facilitated hospital discharge program: a quasi-experimental study. *Arch Intern Med*. 2009;169:2003-10.

64. Moore C, Wisnivesky J, Williams S, et al. Medical errors related to discontinuity of care from an inpatient to an outpatient setting. *J Gen Intern Med*. 2003;18:646-51.

65. Snow V, Beck D, Budnitz T, et al. Transitions of Care Consensus policy statement: American College of Physicians, Society of General Internal Medicine, Society of Hospital Medicine, American Geriatrics Society, American College Of Emergency Physicians, and Society for Academic Emergency Medicine. *J Hosp Med*. 2009;4:364-70.

66. Halasyamani L, Kripalani S, Coleman E, et al. Transition of care for hospitalized elderly patients--development of a discharge checklist for hospitalists. *J Hosp Med*. 2006;1:354-60.

67. Soong C, Daub S, Lee J, et al. Development of a checklist of safe discharge practices for hospital patients. *J Hosp Med*. 2013;8:444-9.

SUPPLEMENTARY FILES

Supplementary File 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement checklist.

Supplementary File 2 Study inclusion and exclusion criteria.

Supplementary File 3 List of the search strategies.

Supplementary File 4 Assessment for eligibility on full-text articles.

Supplementary File 5 Overview of included studies.

LEGENDS

Figure 1 Flow diagram of the systematic review process.

(A) Flow diagram of the four independent searches in the Medline and Web of Science databases. (B) Flow diagram of the process screening the bibliographies of the reviews and initial included studies.

Figure 2 Methodological quality of the studies included**.**

Dotted lines delineate the quality issued from the combination of both quality tools (abscissa and ordinate, respectively).

Figure 3 Effect of hospital-discharge process and subsequent continuity of care components on patients' health outcomes.

The first letter in parenthesis corresponds to the type of component investigated: (A), discharge summary; (B), discharge instructions; (C), drug-related problems; (D), transition from hospital to home; (E), continuity of care. In addition, interventional studies are identified by an asterisk.

Studies in bold and normal characters correspond to a significant and a non-significant association reported, respectively.

Small, medium, and large sized characters correspond to a weak, moderate, and strong methodological quality.

[a]Measured outcome: rehospitalizations related to work-up errors.

[b]Measured outcomes: rehospitalizations related to medication continuity errors and to test follow-up errors.

Figure 4 Effect of hospital-discharge process and subsequent continuity of care components on patients' composite health outcomes.

The first letter in parenthesis corresponds to the type of component investigated: (A), discharge summary; (B), discharge instructions; (C), drug-related problems; (D), transition from hospital to home; (E), continuity of care. In addition, interventional studies are identified by an asterisk.

Studies in bold and normal characters correspond to a significant and a non-significant association reported, respectively.

Small, medium, and large sized characters correspond to a weak, moderate, and strong methodological quality.

The follow-up duration in each study is indicated, for example 30d indicates that the follow-up reported is the post-discharge period of 30 days.

ED, emergency department.

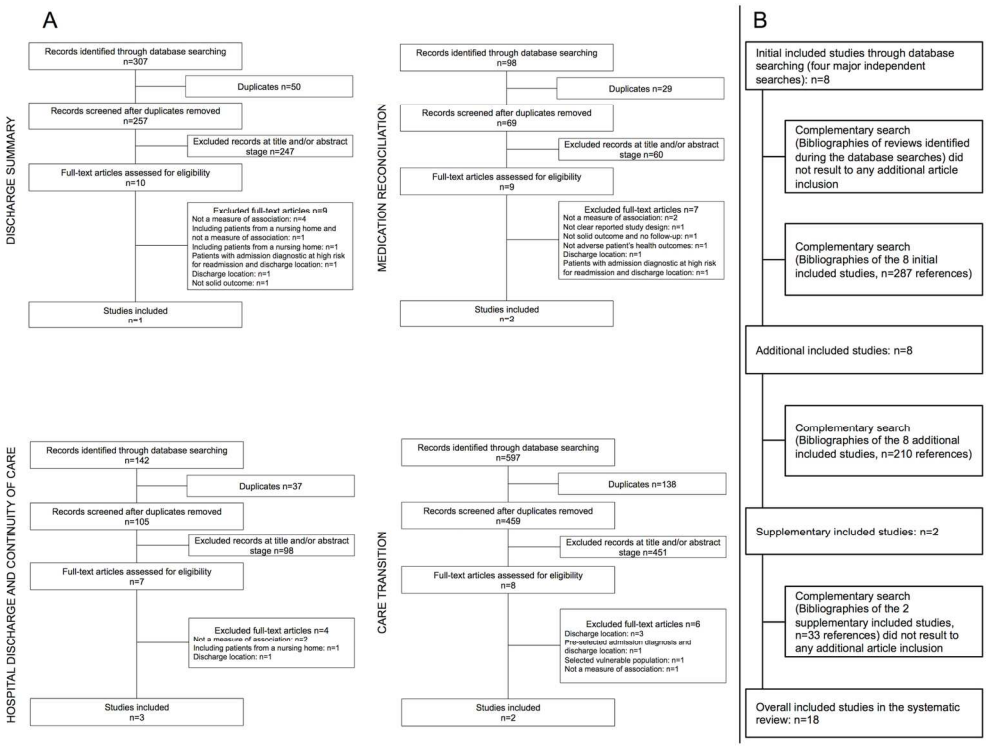

Figure 1

160x120mm (300 x 300 DPI)

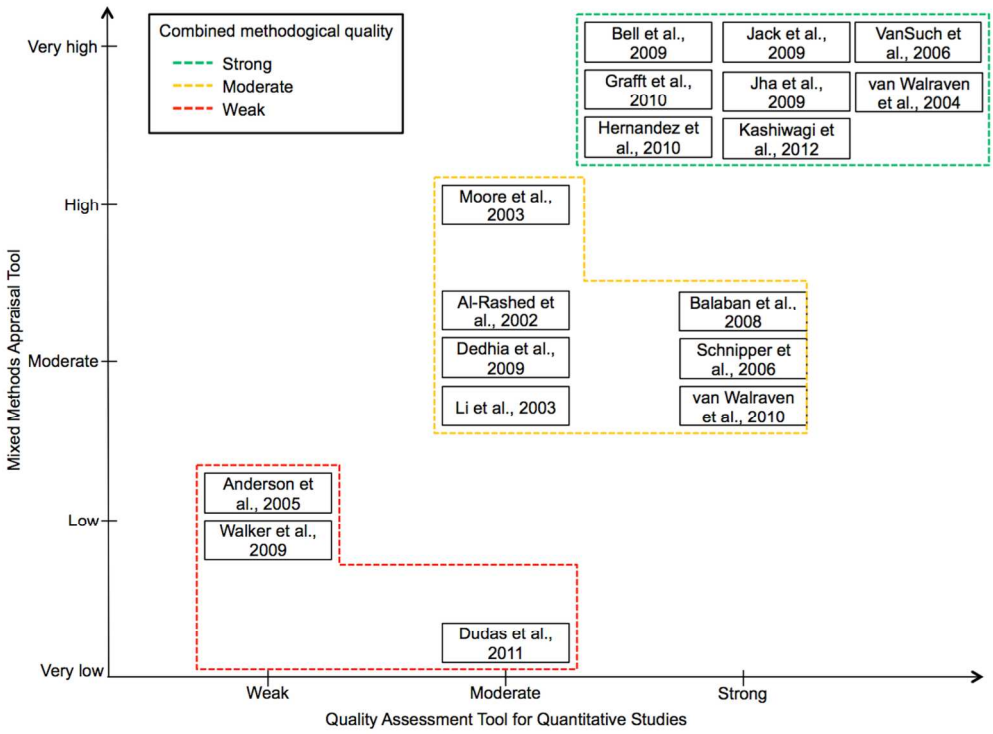

Figure 2

160x119mm (300 x 300 DPI)

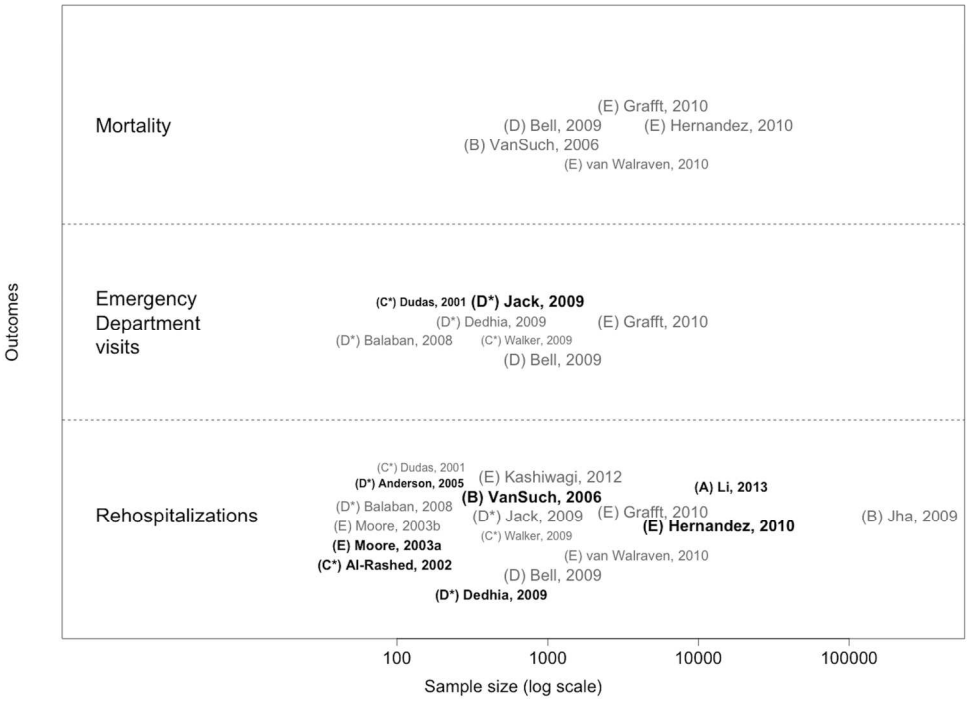

Figure 3

167x127mm (300 x 300 DPI)

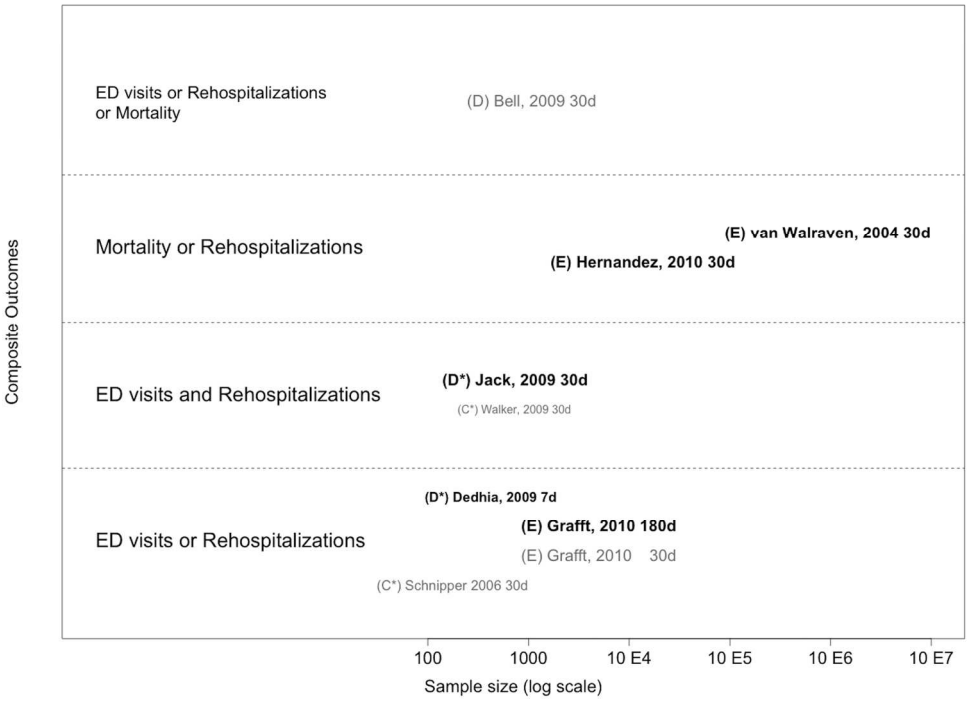

Figure 4

167x127mm (300 x 300 DPI)

Supplementary File 1 PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	NA
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6, Supplementary File 2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6-7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	7, Supplementary File 3
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8

Supplementary File 1 PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	9
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9, Figure 1, Supplementary File 4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9, Supplementary File 5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10, Figure 2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10-14, Table 1, Supplementary File 5
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	14-15, Table 1, Figures 3 and 4
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	16
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	16
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16-17
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	17-18
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	18-19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	19

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Supplementary File 2 Study inclusion and exclusion criteria.

Inclusion criteria	
1.	Focus: studies on hospital discharge and subsequent continuity of care, care transition from hospital directly to home only
2.	Setting: acute care
3.	Participants: adult patients without cognitive impairment or chronic mental illness
4.	Type of studies: published quantitative (observational or interventional) studies
5.	Language: papers in the English language only
6.	Outcomes: quantitative studies exploring a potential association between components of the hospital-discharge process, including continuity of care thereafter, and patients' health outcomes after discharge (e.g. emergency department visits, post-hospitalization visits to primary care providers, readmissions, death)
Exclusion criteria	
1.	Type of studies: systematic or non-systematic reviews, meta-analyses, meta-reviews, letters, commentaries, editorials, notes, case reports, study protocols, news, research letters
2.	No available full text
3.	Duplicate studies
4.	Other focus than hospital discharge; transitions other than from hospital to home
5.	Specific settings (e.g. developing countries, rural settings)
6.	Discharge destinations such as nursing homes, skilled nursing facilities, inpatient rehabilitation units, hospices, other acute care hospitals, long-term care
7.	Admission source: nursing homes or skilled nursing facilities
8.	Specific populations (e.g. frail patients, medically vulnerable patients, low-income patients, ethnic minorities, patients judged to be at "high risk for readmission")
9.	Specific care/pathology (e.g. pediatrics, rehabilitation, palliative care, psychiatry, oncology, pregnancy)[a]
10.	Patients' health outcomes: no available data, outcomes not sufficiently robust, no follow-up after discharge
11.	Lack of clarity regarding the study design

[a]Studies involving patients with heart failure were kept, given the prevalence of such patients and the substantial volume of literature available on hospital discharge and continuity of care.

Supplementary File 3 Search strategies.

1/ Discharge summary[a]

Search 1

PubMed #1 discharge summary [TI] (74 references)

Web of Science #2 TI=(discharge summary) (191 references)

#1 OR #2 (265 references including 43 duplicates: 222 references)

Search 2

PubMed #3 discharge documentation [TI] (4 references)

Web of Science #4 TI=(discharge documentation) (38 references)

#3 OR #4 (42 references including 4 duplicates: 38 references)

#1 OR #2 OR #3 OR #4 (260 references including 3 duplicates: 257 references)

2/ Medication reconciliation[b]

PubMed #1 medication reconciliation [TIAB] AND discharge [TI] (40 references)

Web of Science #2 (TS=medication reconciliation) AND (TI=discharge) (58 references)

#1 OR #2 (98 references including 29 duplicates: 69 references)

3/ Global discharge and continuity-of-care organization[c]

Search 1

PubMed #1 (continuity of care [TI]) AND discharge [TI] (45 references)

Web of Science #2 TI=(continuity of care) AND TI=(discharge) (28 references)

#1 OR #2 (73 references including 11 duplicates: 62 references)

Search 2

PubMed #3 (hospital discharge [TI]) AND (continuity of care [TIAB]) (17 references)

Web of Science #4 TI=hospital discharge AND TS=continuity of care (52 references)

#3 OR #4 (69 references including 12 duplicates: 57 references)

#1 OR #2 OR #3 OR #4 (119 references including 14 duplicates: 105 references)

4/ Care transition[d]

PubMed #1 "care transition" [ALL] OR "care transitions" [ALL] (399 references)

WOS #2 (TS = discharge) AND ((TS = "care transition") OR (TS = "care transitions")) (198 references)

#1 OR #2 (597 references including 138 duplicates: 459 references)

[a]18 April 2013.

[b]31 May 2013.

[c]1 March 2013.

[d]30 June 2013.

Supplementary File 4 Assessment for eligibility on full-text articles.

The reasons for excluding 20 articles on full-text screening are detailed below, and the corresponding references are provided.

1/ Discharge summary[a] (Excluded full-text articles n=9)

Reasons for exclusion

Not a measure of association (n=4)[1-4]

Including patients from a nursing home and not a measure of association (n=1)[5]

Including patients from a nursing home (n=1)[6]

Patients with admission diagnostic at high risk for readmission and discharge location (n=1)[7]

Discharge location (n=1)[8]

Not solid outcome (n=1)[9]

2/ Medication reconciliation[b] (Excluded full-text articles n=7)

Reasons for exclusion

Not a measure of association (n=2)[10 11]

Not clear reported study design (n=1)[12]

Not solid outcome and no follow-up (n=1)[13]

Not adverse patient's health outcomes (n=1)[14]

Discharge location (n=1)[15]

Patients with admission diagnostic at high risk for readmission and discharge location (n=1)[7]

3/ Hospital discharge and continuity-of-care[c] (Excluded full-text articles n=4)

Reasons for exclusion

Not a measure of association (n=2)[2 11]

Including patients from a nursing home (n=1)[6]

Discharge location (n=1)[8]

4/ Care transition[d] (Excluded full-text articles n=6)

Reasons for exclusion

Discharge location (n=3)[8 16 17]

Pre-selected admission diagnosis and discharge location (n=1)[18]

Selected vulnerable population (n=1)[19]

Not a measure of association (n=1)[20]

[a]18 April 2013.

[b]31 May 2013.

[c]1 March 2013.

[d]30 June 2013.

REFERENCES

1. Flyer B, Rubenstein LZ, Robbins AS, et al. An intervention to improve the hospital discharge summary. *J Med Educ*. 1988;63:407-9.
2. Grimes T, Delaney T, Duggan C, et al. Survey of medication documentation at hospital discharge: implications for patient safety and continuity of care. *Irish J Med Sci*. 2008;177:93-7.

3. McMillan TE, Allan W, Black PN. Accuracy of information on medicines in hospital discharge summaries. *Intern Med J*. 2006;36:221-5.

4. Perren A, Previsdomini M, Cerutti B, et al. Omitted and unjustified medications in the discharge summary. *Qual Saf Health Care*. 2009;18:205-8.

5. van Walraven C, Seth R, Laupacis A. Dissemination of discharge summaries - Not reaching follow-up physicians. *Can Fam Phys*. 2002;48:737-42.

6. van Walraven C, Seth R, Austin PC, et al. Effect of discharge summary availability during post-discharge visits on hospital readmission. *J Gen Intern Med*. 2002;17:186-92.

7. Hansen LO, Strater A, Smith L, et al. Hospital discharge documentation and risk of rehospitalisation. *BMJ Qual Saf*. 2011;20:773-8.

8. Maslove DM, Leiter RE, Griesman J, et al. Electronic versus dictated hospital discharge summaries: a randomized controlled trial. *J Gen Intern Med*. 2009;24:995-1001.

9. O'Leary KJ, Liebovitz DM, Feinglass J, et al. Outpatient physicians' satisfaction with discharge summaries and perceived need for an electronic discharge summary. *J Hosp Med*. 2006;1:317-20.

10. Geurts MM, van der Flier M, de Vries-Bots AM, et al. Medication reconciliation to solve discrepancies in discharge documents after discharge from the hospital. *Int J Clin Pharm*. 2013;35:600-7.

11. Grimes TC, Duggan CA, Delaney TP, et al. Medication details documented on hospital discharge: cross-sectional observational study of factors associated with medication non-reconciliation. *Br J Clin Pharmacol*. 2011;71:449-57.

12. Boso-Ribelles V, Montero-Hernandez M, Font-Noguera I, et al. Evaluation of a plan for cardiology medication reconciliation on admission, and patient

information at discharge, in a teaching hospital. *EJHP Practice*. 2011;17:26-30.

13. Wong JD, Bajcar JM, Wong GG, et al. Medication reconciliation at hospital discharge: evaluating discrepancies. *Ann Pharmacother*. 2008;42:1373-9.
14. Kripalani S, Roumie CL, Dalal AK, et al. Effect of a pharmacist intervention on clinically important medication errors after hospital discharge: a randomized trial. *Ann Intern Med*. 2012;157:1-10.
15. Showalter JW, Rafferty CM, Swallow NA, et al. Effect of standardized electronic discharge instructions on post-discharge hospital utilization. *J Gen Intern Med*. 2011;26:718-23.
16. Finn KM, Heffner R, Chang Y, et al. Improving the discharge process by embedding a discharge facilitator in a resident team. *J Hosp Med*. 2011;6:494-500.
17. Legrain S, Tubach F, Bonnet-Zamponi D, et al. A new multimodal geriatric discharge-planning intervention to prevent emergency visits and rehospitalizations of older adults: the optimization of medication in AGEd multicenter randomized controlled trial. *J Am Geriatr Soc*. 2011;59:2017-28.
18. Coleman EA, Parry C, Chalmers S, et al. The care transitions intervention: results of a randomized controlled trial. *Arch Intern Med*. 2006;166:1822-8.
19. Arora VM, Prochaska ML, Farnan JM, et al. Problems after discharge and understanding of communication with their primary care physicians among hospitalized seniors: a mixed methods study. *J Hosp Med*. 2010;5:385-91.
20. Feldman LS, Costa LL, Feroli ER, et al. Nurse-pharmacist collaboration on medication reconciliation prevents potential harm. *J Hosp Med*. 2012;7:396-401.

Supplementary File 5 Overview of included studies.

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Al-Rashed et al., 2002	UK	Drug-related problems at hospital discharge	To evaluate the impact of pre-discharge counseling about medicines and compliance by a pharmacist on patient's therapeutic management post-discharge	Interventional (controlled)	Patients (age >65 years) in elderly wards	83 (I=43, C=40)	Pharmaceutical counseling pre-discharge in combination with medication and information discharge summary and a medicine reminder card	Unplanned visits to the GP and readmission to hospital 15–22 days and at 3 months post-discharge	Data collected during post-discharge visits by patient interview but not clearly described for readmissions	Unplanned visits to the doctor at 15–22 days: intervention 19/43 (44.2%) vs. control 27/40 (67.5%) (P<0.05); unplanned visits to the doctor at 3 months: intervention 24/43 (55.8%) vs. control 32/40 (80.0%) (P<0.05); readmissions at 15–22 days: intervention 5/43 (11.6%) vs. control 13/40 (32.5%) (P<0.05); readmissions at 3 months: intervention 3/43 (7.0%) vs. control 15/40 (37.5%) (P<0.05)
Anderson et al., 2005	USA	Transition from hospital to home (coordination between inpatient and outpatient care)	To evaluate a targeted inpatient CHF education program with comprehensive discharge planning and immediate outpatient reinforcement through a coordinated, nurse-driven home health care program	Interventional (controlled)	CHF patients	121 (I=44, C=77)	Comprehensive community hospital-based HF program coupling targeted inpatient education and discharge planning with subsequent coordinated home care and telephone follow-up	6-month readmission rates	Patient interviews	Intervention subjects had an 11.4% readmission rate within 6 months, compared with a 44.2% readmission rate in control subjects (P=0.01)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Balaban et al., 2008	USA	Transition from hospital to home (communication between inpatient and outpatient care teams)	To evaluate a discharge-transfer intervention designed to improve communication between inpatient and outpatient care teams and to promptly reconnect discharged patients with their "medical home"	Interventional (RCT)	Medical-surgical patients	96 (I=47, C=49)	Discharge-transfer intervention in 4 steps: (1) a comprehensive, user-friendly Patient Discharge Form provided to patients; (2) the electronic transfer of the Patient Discharge Form to the RNs at the patient's primary care site; (3) telephone contact by a primary care RN to the patient; and (4) PCP review and modification of the discharge-transfer plan	No outpatient follow-up within 21 days, readmission within 31 days, ED visit within 31 days and failure to complete an outpatient workup recommended by a hospital doctor	Electronic medical record and hospital progress notes	No follow-up within 21 days: intervention 7/47 (14.9%) vs. control 20/49 (40.8%) (*P*=0.005); readmission within 31 days: 4/47 (8.5%) vs. control 4/49 (8.2%) (*P*=0.96); ED visit within 31 days: intervention 1/47 (2.1%) vs. control 1/49 (2.0%) (*P*=0.97)
Bell et al., 2009	Canada	Transition from hospital to home	To determine whether PCP knowledge of their patient's hospital admission, receipt of a discharge summary, and direct communication with the inpatient medical team are associated with 30-day composite patient outcomes	Observational	General medical patients	1078	Communication between hospital-based physicians and primary care providers: PCP aware of their patient's hospitalization, direct communication with inpatient medical team, availability of discharge summary	30-day composite patient outcomes of mortality, hospital readmission, and ED visits, 30-day readmission, 30-day ED visit, 30-day death	Follow-up telephone survey (30 days after discharge, patients or their proxies, readmissions and ED visits) and National Death Index search	PCP awareness of their patient's index admission to hospital not associated with the composite outcome (adjusted OR=1.08, 95% CI 0.73–1.59); similarly non-significant differences in adjusted 30-day composite outcomes if the PCP communicated directly with the hospital team (adjusted OR=0.87, 95% CI 0.56–1.34) or if the PCP saw a discharge summary (adjusted OR=0.84, 95% CI 0.57–1.22)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Dedhia et al., 2009	USA	Transition from hospital to home	To estimate the feasibility and effectiveness of a multifaceted discharge planning intervention	Interventional (quasi-experimental pre-post design)	General medical patients (age ≥65 years)	422 (I=185, C=237)	Multidisciplinary, comprehensive, multifaceted, hospital-based initiative with five core components: (1) admission assessment highlighting geriatric principles and values; (2) notification of PCP about admission; (3) multidisciplinary team coordination; (4) physician-pharmacist collaborative medication reconciliation; (5) scheduled discharge meeting	ED visits or readmissions within 1 week, 30-day readmission, 30-day ED visits	Patients	Follow-up within 1 week returned to the ED or readmitted to the hospital: crude OR=0.28, 95% CI 0.11–0.71; follow-up at 30 days returned to the ED: crude OR=0.61, 95% CI 0.36–1.03; follow-up at 30 days readmitted to the hospital: crude OR=0.59, 95% CI 0.34–0.97
Dudas et al., 2001	USA	Drug-related problems at hospital discharge	To evaluate the impact of a follow-up telephone call made by pharmacists within 2 days of discharge after pharmacy-facilitated discharges	Interventional (RCT)	General medical service patients	145 (I=71, C=74)	A follow-up telephone call made by pharmacists within 2 days of discharge for patients discharged to home from an inpatient hospital-based medical service after pharmacy-facilitated discharges	ED visits and readmissions to the hospital within 30 days of discharge	Hospital records	ED visits within 30 days: 10% phone call vs. 24% no phone call, (*P*=0.005); hospital readmissions within 30 days: 15% phone call vs. 25% no phone call (*P*=0.07)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Grafft et al., 2010	USA	Continuity of care after hospital discharge	To examine the effect of documented follow-up arrangements at hospital discharge on hospital readmission, ED visits and mortality	Observational	General medical patients	4989 (dismissal summaries)	Follow-up visits: documented hospital follow-up appointment arrangements in dismissal summaries scheduled prior to discharge	Hospital readmission, ED visits and mortality at 30 and 180 days after discharge and two composite end points	Administrative data	Rehospitalizations or ED visits at 30 days: patients with vs. without follow-up appointments (HR=1.05, 95% CI 0.93–1.18, *P*=0.42); rehospitalizations or ED visits at 180 days: patients with vs. without follow-up appointment arrangements (HR=1.10, 95% CI 1.01–1.20, *P*=0.03)
Hernandez et al., 2010	USA	Continuity of care after hospital discharge	To examine associations between outpatient follow-up within 7 days after discharge from a HF hospitalization and readmission within 30 days	Observational	Patients (age ≥65 years) hospitalized for HF	30,136	Timing of outpatient follow-up after discharge	All-cause readmission within 30 days after discharge and 30-day mortality	Administrative data	Inverse relationship between early follow-up and the hazard of 30-day readmission: compared with patients whose index hospitalization occurred in a hospital in the lowest quartile of early follow-up, the risk-adjusted hazard of 30-day readmission was significantly lower in the second quartile (risk-adjusted HR=0.85, 95% CI 0.78–0.93; non-significant difference in the 30-day mortality by quartile of early follow-up
Jack et al., 2009	USA	Transition from hospital to home	To evaluate a complex peridischarge intervention on hospital utilization after discharge	Interventional (RCT)	General medical patients	749 (I=373, C=376)	Complex peri-discharge intervention with a package of discharge services including patient-centered education, comprehensive discharge planning and post-discharge telephone reinforcement by a clinical pharmacist	ED visits, readmissions and rate of primary follow-up visits within 30 days of discharge; combined end-point of ED visits and readmissions within 30 days of discharge	Hospital's electronic medical records and participant report	Combined ED visits and readmissions: intervention (*n*=116) vs. control (*n*=166) (*P*=0.009); ED visits: intervention (*n*=61) vs. control (*n*=90) (*P*= 0.014); readmissions: intervention (*n*=55) vs. control (*n*=76) (*P*=0.090); visited PCP: intervention (*n*=190) vs. control (*n*=135) (*P*<0.001)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Jha et al., 2009	USA	Discharge instructions (as noted in the medical records)	To examine the association between performance, based on two measures of discharge planning (adequacy of documentation in the chart that discharge instructions were provided to patients with congestive heart failure, and patient-reported experiences with discharge planning) and rates of readmission for CHF and pneumonia.	Observational	Patients with CHF	252,266	Compliance with required discharge instructions for CHF patients	All-cause 30-day readmission rate for CHF	HCA database	No association found between performance on the chart-based measure and readmission rates among patients with CHF: readmission rates among hospitals performing in the highest quartile vs. the lowest quartile, 23.7% vs. 23.5% (*P*=0.54)
Kashiwagi et al., 2012	USA	Continuity of care after hospital discharge	To evaluate time to follow-up after hospital discharge and readmissions in general medical patients	Observational	General medical patients	1044	Timing of outpatient scheduled follow-up appointments after discharge	30-day unplanned readmission	Database (study institution's electronic medical record)	30-day readmission follow-up ≤14 days 57/518 (11%) vs. follow-up ≥15 days 8/52 (15%) (*P*=0.36); 30-day readmission follow-up ≤14 days 57/518 (11%) vs. no follow-up 47/474 (10%) (*P*=0.75); 30-day readmission follow-up ≥15 days 8/52 (15%) vs. no follow-up 47/474 (10%) (*P*=0.25)
Li et al., 2013	Australia	Discharge summary	To determine the relationship between the readmission rate of general medical patients to either the existence of a discharge summary or the timeliness of its dispatch	Observational	General medical patients	16,496 (patient admissions)	Existence of a discharge summary or timeliness of its dispatch: (1) within 7 days after discharge; (2) after more than 7 days; (3) not completed	Readmission rate within 7 or 28 days of discharge	Patient databases (inpatient database and ED database)	Significant association between delayed transmission or absence of a discharge summary and readmission rate at 7 (*P*<0.001) or 28 (*P*<0.001) days after discharge. Delay <7 days: number of summaries=13,099 (79.4%); readmission rate <7 days=2.9%; readmission rate <28 days=7.2%. Delay >7 days: number of summaries=1899 (11.5%); readmission rate <7 days=4.6%; readmission rate <28 days=9.5%. Never: number of summaries =1498 (9.1%); readmission rate <7 days=5.5%; readmission rate <28 days=10.3%

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Moore et al., 2003	USA	Continuity of care after hospital discharge	To determine the prevalence of medical errors related to the discontinuity of care from an inpatient to an outpatient setting, and to determine if there is an association between these medical errors and adverse outcomes	Observational	General medical patients who had a subsequent visit with an outpatient PCP within 2 months after discharge	86	Medical errors related to the discontinuity of care from the inpatient to the outpatient setting: work-up errors, medication continuity errors, test follow-up errors	Re-hospitalization within 3 months after the initial post-discharge outpatient primary care visit	Hospital's administrative database	Patients with at least 1 work-up error were 6.2 times (95% CI 1.3–30.3) more likely to be rehospitalized within 3 months after the first post-discharge PCP visit compared to patients with no work-up errors; not statistically significant association between medication continuity errors (OR=2.5, 95% CI 0.7–8.8) or test follow-up errors (OR=2.4, 95% CI 0.3–17.1) with rehospitalizations
Schnipper et al., 2006	USA	Drug-related problems at discharge	To identify drug-related problems during and after hospitalization and to determine the effect of patient counseling and follow-up by pharmacists on preventable adverse drug events	Interventional (RCT)	General medical patients	176 (I=92, C=84)	Pharmacist intervention: medication review, discharge counseling and a follow-up telephone call 3–5 days after discharge by pharmacists	ED visits or readmissions to the hospital within 30 days of discharge	Survey questions (patients) and hospital administrative data	ED visit or readmission within 30 days: intervention 28/92 (30%) vs. control 25/84 (30%) (*P*>0.99)
VanSuch et al., 2006	USA	Discharge instructions as reflected in the medical records	To determine whether documentation of compliance with any or all of the six required discharge instructions was correlated with readmissions to hospital or mortality	Observational	Patients with CHF	782	Compliance with required discharge instructions (discharge information and patient education) for CHF patients: activity, worsening symptoms, weight, drugs, follow-up appointment and diet	Time to death and time to readmission for HF or readmission for any cause and time to death	Administrative and medical record data	Patients who received all instructions were significantly less likely to be readmitted for any cause (*P*=0.003) and for HF (*P*=0.035) than those who missed at least one type of instruction; no association between documentation of discharge instructions and mortality (*P*=0.52)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Van Walraven et al., 2004	Canada	Continuity of care after hospital discharge	To determine whether outcomes changed when physicians who cared for patients during hospitalization saw them in follow-up	Observational	Medical or surgical patients	938,833	Follow-up by hospital physicians or regular community doctors after discharge	30-day death or non-elective readmission to hospital	Discharge Abstract Database (re-admissions) and Registered Patients Database (deaths)	Patients significantly less likely to die or be readmitted if they were seen in follow-up by a hospital physician rather than a community physician (HR= 0.95, 95% CI 0.95–0.96); relative risk of death or readmission decreased by 5% (95% CI 2--4%) when patients followed up with a hospital rather than a community physician
Van Walraven et al., 2010	Canada	Continuity of care after hospital discharge	To measure the independent association of several provider and information continuity measures on death or urgent readmission after hospital discharge	Observational	Medical or surgical patients with ≥2 physician visits prior to one of the study's outcomes or the end of patient observation	3876	Provider continuity (post-discharge physician) and information continuity (discharge summary, post-discharge visit information)	Time to all-cause death or urgent readmission 6 months post-discharge	Collected by phone (patient or principal contacts) and Office of the Provincial Registrar if the patient's vital status remained unclear	Death: adjusted HRs: post-discharge physician=0.97 (95% CI 0.89–1.06); discharge summary=0.96 (95% CI 0.89–1.04); post-discharge information=1.01 (95% CI 0.94–1.08). Readmission: adjusted HRs: post-discharge physician=0.98 (95% CI 0.95–1.01); discharge summary=1.01 (95% CI 0.98–1.04); post-discharge information=1.00 (95% CI 0.97–1.03)
Walker et al., 2009	USA	Drug-related problems at hospital discharge	To characterize medication discrepancies at hospital discharge and test the effects of a pharmacist intervention on healthcare utilization following discharge	Interventional (alternating month quasi-experimental design)	General medical patients	724 (I=358, C=366)	Pharmacist intervention: medication therapy assessment, medication reconciliation, screening for adherence concerns, patient counseling and education, and post-discharge telephone follow-up by a pharmacist	14- and 30-day readmission rates, ED visits within 72 hours, 14 days and 30 days after discharge, combined end-point of readmissions and ED visits within 30 days of discharge	Patients' medical records; clinical and administrative databases	Readmission at 14 days: intervention 45/358 (12.6%) vs. control 42/366 (11.5%) (*P*=0.65); readmission at 30 days: intervention 79/358 (22.1%) vs. control 66/366 (18.0%) (*P*=0.17), ED at 72 hours: intervention 10/358 (2.8%) vs. control 8/366 (2.2%) (*P*=0.60), ED at 14 days: intervention 22/358 (6.2%) vs. control 27/366 (7.4%) (*P*=0.51), ED at 30 days: intervention 34/358 (9.5%) vs. control 45/366 (12.3%) (*P*=0.23); composite end point all readmissions and ED visits at 30 days: intervention 98/358 (27.4%) vs. control 94/366 (25.7%) (*P*=0.61)

C, control; CI, confidence interval; CHF, congestive heart failure; ED, emergency department; GP, general practitioner; HF, heart failure; HQA, Hospital Quality Alliance; HR, hazard ratio; I, intervention; OR, odds ratio; PCP, primary care provider; RCT, randomized controlled trial; RN, research nurse.

BMJ Open

A Systematic Review on the Effect of the Organization of Hospital Discharge on Patient Health Outcomes

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2016-012287.R1
Article Type:	Research
Date Submitted by the Author:	02-Aug-2016
Complete List of Authors:	Couturier, Berengere; AP–HP, Hôpital St-Antoine, Unité de Santé Publique; Sorbonne Universités, UPMC Univ Paris 06, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP UMRS 1136) Carrat, Fabrice; AP–HP, Hôpital St-Antoine, Unité de Santé Publique; Sorbonne Universités, UPMC Univ Paris 06, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP UMRS 1136) Hejblum, Gilles; Sorbonne Universités, UPMC Univ Paris 06, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP UMRS 1136)
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Nursing, Public health
Keywords:	Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Risk management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

A Systematic Review on the Effect of the Organization of Hospital Discharge on Patient Health Outcomes

Bérengère Couturier,[1,2*] Fabrice Carrat,[1,2] Gilles Hejblum[1]

[1]Sorbonne Universités, UPMC Univ Paris 06, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP UMRS 1136), Paris, France

[2]AP–HP, Hôpital St-Antoine, Unité de Santé Publique, Paris, France

[*]Corresponding Author: Berengere Couturier, Assistance Publique - Hôpitaux de Paris, Unité de Santé Publique, Hôpital Saint Antoine, 184 rue du Faubourg Saint Antoine Paris, 75571 France.

E-mail:berengere.couturier@aphp.fr (B.C.).

Phone: 33 (0)149283228; fax: 33 (0)149283233.

Keywords: Continuity of Patient Care; Outcome Assessment (Health Care); Patient Discharge; Patient Handoff; Patient Readmission.

Word count: 4330 excluding title page, abstract, references, figures and tables

ABSTRACT (word count: 286)

Objective: The transition from hospital to home represents a key step in the management of patients and several problems related to this transition may arise, with potential adverse effects on patient health after discharge. The purpose of our study was to explore the association between components of the hospital-discharge process including continuity of care thereafter and patient outcomes in the post-discharge period.

Design: Systematic review of observational and interventional studies.

Setting: We conducted a combined search in the Medline and Web of Science databases. Additional studies were identified by screening the bibliographies of the included studies. The data-collection process was conducted using a standardized predefined grid, that included quality criteria.

Participants: A standard patient population returning home after hospitalization.

Primary and secondary outcomes: Adverse health outcomes occurring after hospital discharge.

Results: In the twenty studies fulfilling our eligibility criteria, the main discharge-process components explored were: discharge summary (n=2), discharge instructions (n=2), drug-related problems at discharge (n=4), transition from hospital to home (n=5), and continuity of care after hospital discharge (n=7). The major patients' subsequent health outcomes measured were rehospitalizations (n=18), emergency department visits (n=8), and mortality (n=5). Eight of the eighteen studies exploring rehospitalizations, two of the eight studies examining emergency department visits and none of the studies that investigated patient mortality reported at least one significant association between discharge process and these outcomes.

Conclusions: Irrespective of the component of the discharge process explored, the outcome considered (composite or not), the sample size, and the study design, no consistent statistical association between hospital discharge and patient health outcome was identified. This systematic review highlights a wide heterogeneity between studies, especially in terms of the component(s) of the hospital-discharge process investigated, study designs, outcomes, and follow-up durations.

Strengths and limitations of this study

- This review is the first to date focusing on the relationship between components of hospital-discharge organization and subsequent patient's health in a standard population returning home after hospitalization.
- The quality assessment of the included studies was based on two combined tools, in order to take into account the heterogeneity of the underlying studies' designs.
- The numerous discharge process elements investigated in the studies were categorized into several component types, and the impact of each component was assessed in regards to the corresponding health outcome(s) that were reported.
- A single author was involved in critical steps of the review (article selection, data abstraction, quality assessment of the included studies), and this constitutes a limitation of the study.
- The heterogeneity between studies on key issues such as hospital-discharge components, study designs, and outcomes (including follow-up durations), prevents from performing a quantitative synthesis, and hampers a consistent assessment of the impact of discharge organization on patient health.

INTRODUCTION

Rationale

Since Forster *et al*'s pioneering studies[1 2] in which around 20% of patients were reported to have experienced an adverse event within the 2 weeks following hospital discharge, several studies have documented the rates of adverse health outcomes, such as emergency department visits and hospital readmissions, occurring during the post-discharge period.[3-5] Therefore, return to home after hospital stay should not viewed by hospital staff as the completion of patient management. Ideally, scheduling outpatient follow-up visits, promoting direct communication with primary care providers and ensuring the transmission of the discharge summary, notifying pending test results at discharge, and, if necessary, arranging or suggesting outpatient post-discharge investigations, are various elements of the continuity of care after discharge that should be integrated within the hospital-discharge process. Consequently, hospital discharge and continuity of care thereafter constitute complex interrelated processes involved in a patient's transition from hospital to home. One can hypothesize that some components of the discharge organization affect, at least partially, patients' subsequent health care, for example, have an impact on the rate of rehospitalizations.

Several observational studies have highlighted deficiencies in the transition of care from the inpatient to the outpatient setting. Such studies focused on various aspects related to direct communication between inpatient and outpatient healthcare providers;[6 7] discharge summaries (content, timeliness, transmission to an outpatient physician);[8 9] traceability and follow-up providers' information of pending test results at hospital discharge;[10 11] non-completion of recommended outpatient workups (diagnostic procedures, subspecialty referrals, and laboratory tests) after hospital discharge;[12] medication errors (omission or unjustified prescription) in discharge summaries;[13 14] drug-related problems after discharge;[15 16] and post-discharge follow-up outpatient visits.[17 18] Only a few observational studies have investigated the potential association between elements of the hospital-discharge process (and continuity of care thereafter) and patient health outcomes,[19-21] and their reports are conflicting with regards to the effect of such processes on patient health after discharge. Moreover, these studies involved patients with various admissions sources and/or discharge locations, not only home, before and after hospital discharge. Other studies aimed at exploring the perspectives of hospital staff and/or primary care providers,[22-24] or patient opinions,[25-27] or both,[28 29] on hospital

discharge and subsequent continuity of care. In particular, few studies have explored the association of such opinions on patient health outcomes such as rehospitalizations[30 31] or rehospitalizations and emergency department visits.[32]

Finally, several reviews[33-45] examined the effect of various interventions related to hospital discharge. One review was not a systematic review but highlighted several challenges, not necessarily directly focused on patient health outcomes.[33] Three reviews concerned interventions on medication reconciliation at discharge,[34-36] and in two of them,[34 35] studies involving medication reconciliation at admission or during hospitalization were also included. One review only concerned older patients with congestive heart failure and considered only interventions combining comprehensive discharge planning with post-discharge support.[37] Two reviews focused on a single outcome, the rehospitalization rate at 30 days after discharge.[38 39] Conversely, one review focused on a single discharge component, telephone follow-up.[40] There were four reviews in which some[41-43] or all[44] outcomes considered were not patient health measures, e.g. discharge destination,[41 42] length of stay,[41-43] patient or health provider satisfaction,[41-43] organizational outcomes (timeliness, accuracy, completeness, and overall quality of the information transfer).[44] One review categorized interventions according to the timing of these pre-discharge, post-discharge and bridging interventions, and included studies in which the destination of patients after discharge could be a nursing home or skilled nursing facility.[45]

As regards results obtained, the review on telephone follow-up interventions[40] as well as the three reviews examining interventions related to medication reconciliation[34-36] indicated that it was not possible to link these interventions to clinically significant improvements. Similarly, the review focusing on the 30-day readmission outcome was negative.[38] Three reviews[41 42 45] paint a rather mixed picture: the effectiveness of interventions on patients' health was not clearly demonstrated, and was at best modest. Three reviews[37 39 43] were more positive. First, based on the selection of randomized trials in which the intervention under study explicitly described one or more components that aimed to improve the handover of care between hospital and primary care providers during hospital discharge, the review of Hesselink *et al*[43] indicates that a significant effect was found in favor of the intervention for one or several outcome measures in 25 of the 36 studies. Second, Phillips *et al*'s systematic review[37] reports that comprehensive discharge planning plus post-discharge support for older patients with congestive heart failure resulted in a 25% reduction in the relative risk of readmission, considering

studies with a follow-up ranging from 3 to 12 months. Third, based on the inclusion of 42 randomized trials, with most studies relating to populations of patients at high risk, the meta-analysis of Leppin *et al*[39] indicates that peri-discharge interventions are associated with a reduction in the rehospitalization rate at 30 days after discharge.

The perspectives widely varied from one review to another as regards the elements of the discharge process explored, the targeted population, the outcome(s) considered (including follow-up duration), and patient location after discharge. Considering the common case of a standard hospitalized patient of the general population returning home after discharge, the simple question "are there some discharge components specifically associated with health outcomes ?", is not answered in the available reviews. *De facto*, we failed to identify a work providing a synthesis of the available knowledge on this question.

Objective

We conducted a systematic review to explore the potential association between elements of the hospital-discharge process (including post-discharge continuity of care) and adverse outcomes (including healthcare-resource consumption) in the post-discharge period, in a standard population of patients returning home.

METHODS

The reporting of the systematic review is based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[46] (Supplementary File 1).

Eligibility criteria

The predefined study inclusion and exclusion criteria are detailed in Supplementary File 2.

Information sources

Initial searches in the databases were made between March 1, 2013 and June 30, 2013, with no limit considered for the start date, and all searches were updated on July 13, 2016. A combined

search in the Medline database via PubMed and in the Web of Science was performed, using different search terms to cover exploration of the organizational process for hospital discharge and subsequent continuity of care. Four independent searches were conducted, which focused on discharge summary, medication-reconciliation procedures (preferably at hospital discharge), global organization of discharge process and continuity of care thereafter, and care transition. We screened the bibliographies of review articles detected during the database searches (which were not eligible for inclusion) to identify any additional studies that had been missed during the database searches.

Search strategies

The queries made in the Medline and Web of Science databases are detailed in Supplementary File 3.

Study selection

The eligibility of each retrieved article was assessed by one author (BC) in terms of its title, abstract and, if necessary, the full text. We decided *a priori* that in the case of doubt, a second reviewer (G.H.) would decide whether to include the study. The bibliography of each included study was screened to potentially identify any studies missed in the database searches. Whenever this resulted to the identification of an additional study, this screening process was repeated until no additional study was found.

Data collection process

The data-collection process was conducted (by BC) using a standardized predefined data-collection sheet and extracted data were checked.

Data items

The following information was extracted from each of the studies included: name of first author, journal, year of publication, component(s) of the discharge process investigated, study design, objective(s), setting, participants, sample size, method(s), description of the intervention and

comparator (if applicable), main outcome measures, results, synthesis of the major results (i.e. significant association or not between the component(s) of the discharge process investigated and patient health outcomes), and study limitations.

Risk of bias in individual studies/quality assessment

The methodological quality of the selected studies was evaluated (by BC) using two tools that have been proposed for assessing studies, when the considered study set includes major differences in terms of experimental design (n.b., we formalized *a priori* that in the case of doubt when rating the methodological quality of a study, a second author (GH) would be solicited for this rating). First, the Quality Assessment Tool for Quantitative Studies[47 48] rates study global quality according to three categories: strong, moderate, and weak. Second, the Mixed Methods Appraisal Tool – version 2011[49] grades the studies according to five categories, ranging from 0% (research questions not clearly stated), low (score=25%), moderate (score=50%), high (score=75%), to very high (score=100%) methodological quality. Both tools have strengths and weaknesses. For example, the Quality Assessment Tool for Quantitative Studies automatically assigns a strong score to randomized controlled trials, irrespective of the quality of randomization method and allocation concealment, while the Mixed Methods Appraisal Tool is limited to the evaluation of four items. Studies were finally ranked into three categories, weak, moderate, or strong, according to a combination of the ranks issued from the two tools: in a first step, low and very low, moderate, and high and very high rankings with the Mixed Methods Appraisal Tool were recategorized as weak, moderate, and strong, respectively. Then, final ranking of a given study was chosen as the lowest rank of the two tools.

Summary measures and synthesis of results

A standard quantitative synthesis, i.e. a meta-analysis, was deemed not to be appropriate because of wide variability in study designs, types of intervention (if applicable), and outcomes. Nevertheless, a synthesis of the results from the observational and interventional studies has been made in the form of a summary table and figures with the aim of identifying emerging patterns relating components of the discharge process and patient's health outcomes.

Risk of bias across studies

The possibility of publication bias resulting in more positive than negative studies being published may have affected the results of our review but could not be assessed.

Additional analyses

No prespecified additional analysis was performed.

RESULTS

Study selection (Figure 1)

The results of the eight initial independent searches (four major queries in each of the databases) identified 1144 publications, 890 after excluding 254 duplicates, of which eight studies were initially included (see Supplementary File 4 that indicates the references of full-text articles excluded and details the corresponding reason). Screening the bibliographies of the initial included studies resulted in the inclusion of 10 additional studies. No additional studies were identified from the bibliographies of reviews identified during the database searches. Thus, the initial set consisted of 18 studies[31 50-66]. Update of the searches made on July 13th 2016 resulted in including two additional studies.[67 68]

Study characteristics

The study characteristics are summarized in Supplementary File 5. The 20 selected studies were published between 2001 and 2015 and were performed in the USA (n=14), Canada (n=4), Australia (n=1), and United Kingdom (n=1). Eleven studies were observational[31 50-58 67] and nine were interventional[59-66 68] (including five randomized controlled studies[59-62 68]). The interventions were mostly multifaceted interventions; four were pharmacist interventions[59 60 63 64] and four focused on the transition from hospital to home.[61 62 65 66] Only one was an intervention with a single component (a post-discharge phone call).[68]

In 15 studies, patients were discharged from general medical and/or surgical units. Five studies targeted patients with heart failure,[31 50 51 65 67] with one study targeting a somewhat larger population.[31]

Sample sizes ranged from 83[63] to 738[62] patients for interventional studies and from 86[52] to 938,933[53] patients for observational studies.

Risk of bias within studies/Quality assessment

According to the Quality Assessment Tool for Quantitative Studies, 12 studies were rated as having a strong,[31 50 51 53-57 60-62 67] six a moderate,[52 58 59 63 66 68] and two a weak[64 65] methodological quality (Figure 2).

According to the Mixed Methods Appraisal Tool, seven studies were rated as having a very high,[31 50 53-56 62] three a high,[51 52 67] six a moderate,[57 58 60 61 63 66] three a low,[64 65 68] and one a very low[59] methodological quality (Figure 2).

When combining the two quality tools, nine studies were rated as having a strong,[31 50 51 53-56 62 67] seven a moderate,[52 57 58 60 61 63 66] and four a weak[59 64 65 68] combined methodological quality (Figure 2).

Results of individual studies

Components of the discharge process investigated (Table 1)

Five discharge-process components were explored primarily: discharge summary (n=2),[58 67] discharge instructions as mentioned in the medical records (n=2)[31 51], drug-related problems at discharge (n=4),[59 60 63 64] transition from hospital to home (n=5),[54 61 62 65 66] and continuity of care after hospital discharge (n=7).[50 52 53 55-57 68]

Two observational studies[58 67] investigated the discharge-summary component. One study[58] examined the timeliness of the discharge summary finalization and the other[67] investigated the timeliness, the documented transmission to the follow-up physician and the content of the discharge summary. This component was also explored in two other studies[54 57] in combination with other components of the hospital-discharge process. In particular, the availability of the discharge summary to the physician during post-discharge visits was investigated.

The component relating to documentation of discharge instructions provided to patients was explored in two observational studies,[31 51] and both concerned patients with congestive heart failure.

Drug-related problems were addressed via the assessment of a pharmacist intervention in four studies.[59 60 63 64] The type and number of intervention elements (e.g. pharmaceutical counseling,

education, medication review, medication reconciliation, follow-up with a pharmacist after discharge), varied between studies. Similarly, the component “transition from hospital to home” was explored mainly in four interventional studies,[61 62 65 66] with the number and type of intervention elements (e.g. patient therapeutic education, medication reconciliation, post-hospitalization follow-up) varying between studies. Only one observational study[54] explored the transition from hospital to home, focusing on different aspects of the communication between hospital staff and primary care physicians (primary care physician’s awareness of his or her patient’s hospitalization, receipt of a discharge summary, direct exchanges with the multidisciplinary hospital team).

In contrast, excepted a single interventional study that explored the impact of a post-discharge phone call,[68] the component "continuity of care after discharge" was investigated exclusively in observational studies. The elements targeted in these studies were documented follow-up appointment arrangements scheduled before discharge,[55] timing of outpatient follow-up after discharge,[50 56] post-discharge follow-up by hospital physicians or general practitioners,[53] a score for continuity of care,[57] and medical errors related to discontinuity of care from the inpatient to the outpatient setting.[52]

Table 1 Hospital discharge process and subsequent continuity of care, and associated patient health outcomes.

	Discharge summary (n=2)	**Discharge instructions documented in medical records (n=2)**	**Drug-related problems at hospital discharge (n=4)**	**Transition from hospital to home (n=5)**	**Continuity of care after hospital discharge (n=7)**
Significant association	Al-Damluji *et al*, 2015[67a] (readmissions at 30 days)	VanSuch *et al*, 2006[51a] (time to readmission for HF/any cause 12 months)	Al-Rashed *et al*, 2002[63b] (readmissions at 15–22 days and 3 months; unplanned GP visits at 15–22 days and 3 months)	Anderson *et al*, 2005[65b] (readmission rate at 6 months)	Grafft *et al*, 2010[55a] (composite endpoint: ED visits or readmissions at 180 days)
	Li *et al*, 2003[58a] (readmission rate at 7 and 28 days)		Dudas *et al*, 2001[59b] (ED visits at 30 days)	Balaban *et al*, 2008[61b] (no follow-up at 21 days)	Hernandez *et al*, 2010[50a] (composite endpoint: mortality or readmissions at 30 days; readmissions at 30 days)
				Dedhia *et al*, 2009[66b] (composite endpoint: ED visits or readmissions at 1 week; readmissions at 30 days)	Moore *et al*, 2003[52a] (work-up errors and readmissions at 3 months)
				Jack *et al*, 2009[62b] (composite endpoint: all ED visits and readmissions at 30 days; ED visits at 30 days; visited PCP at 30 days)	van Walraven *et al*, 2004[53a] (composite endpoint: death or readmissions at 30 days)

Table 1 (Continued)

	Discharge summary (n=2)	Discharge instructions documented in medical records (n=2)	Drug-related problems at hospital discharge (n=4)	Transition from hospital to home (n=5)	Continuity of care after hospital discharge (n=7)
Non-significant association		Jha *et al*, 2009[31a] (readmission rate at 30 days)	Dudas *et al*, 2001[59b] (readmissions at 30 days)	Balaban *et al*, 2008[61b] (readmissions at 31 days; ED visits at 31 days; incomplete outpatient work-up)	Grafft *et al*, 2010[55a] (composite end point: ED visits or readmissions at 30 days; readmissions at 30 days; ED visits at 30 days; mortality at 30 days; readmissions at 180 days, mortality at 180 days)
		VanSuch *et al*, 2009[51a] (survival time to death from any cause censored at 12 months)	Schnipper *et al*, 2006[60b] (composite endpoint: ED visits or readmissions at 30 days)	Bell *et al*, 2009[54a,c] (readmissions at 30 days ; ED visits at 30 days ; death at 30 days ; composite endpoint: readmission or ED visit or death at 30 days)	Hernandez *et al*, 2010[50a] (mortality at 30 days)
			Walker *et al*, 2009[64b] (readmission rate at 14 and 30 days; ED visits at 72 hours, 14 days, 30 days; composite endpoint: all ED visits and readmissions at 30 days)	Dedhia *et al*, 2009[66b] (ED visits at 30 days)	Kashiwagi *et al*, 2012[56a] (readmissions at 30 days)
				Jack *et al*, 2009[62b] (readmissions at 30 days)	Moore *et al*, 2003[52a] (medication continuity errors, test follow-up errors and readmissions at 3 months)
					Soong *et al*, 2014[68b] (ED visits at 30 days, readmissions at 30 days)
					van Walraven *et al*, 2010[57a,c] (death at 6 months; readmissions at 6 months)

ED, emergency department; GP, general practitioner; HF, heart failure; PCP, primary care provider.
[a]Observational study.
[b]Interventional study.
[c]Study also exploring discharge summary component.

Patient health outcomes post-discharge (Table 1)

The major outcomes measured in the included studies were, in order of frequency, rehospitalizations (n=18),[31 50-52 54-59 61-68] emergency department visits (n=8),[54 55 59 61 62 64 66 68] and mortality (n=5).[50 51 54 55 57] Two studies investigated only composite outcomes: emergency department visits or rehospitalizations[60], and rehospitalizations or mortality[53]. In addition, six studies investigated outcomes separately and in combination: emergency department visits and/or rehospitalizations,[55 62 64 66] rehospitalizations or mortality,[50] emergency department visits or rehospitalizations or mortality.[54]

The rate of post-discharge visits to a general practitioner was another, less frequently, measured outcome.[61-63] This outcome was considered from a different perspective in each of the three corresponding studies: unplanned visits to a general practitioner,[63] no outpatient follow-up within 21 days,[61] and follow-up visits with the primary care provider.[62]

Follow-up duration after discharge varied from 7 days[58] to 12 months[51] for rehospitalizations, from 72 hours[64] to 31 days[61] for emergency department visits, from 30 days[50 54 55] to 12 months[51] for death, and from 15 days[63] to 3 months[63] for visits to the general practitioner.

Synthesis of results

The included studies were published within the past 15 years, suggesting a relatively recent area of investigation. Whereas the studies' underlying healthcare organizations were relatively homogeneous (with most studies originating from the USA), the components of the discharge process investigated were not (Supplementary File 5). Even when considering a given component category the variable of interest and the associated investigation method varied widely across studies, including follow-up duration for assessing patient outcome (see Table 1), which precluded us from performing a meta-analysis that would generate meaningful results. Nevertheless, a picture synthesizing the effect of components of the discharge process on the main patient health outcomes is shown in Figure 3.

In 13 studies,[50-53 55 58 59 61-63 65-67] at least one significant association was reported between component(s) of the hospital-discharge process and any patient health outcome explored, irrespective of the type of outcomes and the follow-up duration.

Considering the 18 studies[31 50-52 54-59 61-68] that explored the potential association between hospital-discharge process and rehospitalizations, seven reported a significant association,[50 51 58 63 65-

[67] while ten reported a non-significant association.[31 54-57 59 61 62 64 68] The remaining study[52] evaluated three types of medical errors (work-up errors, medication continuity errors, and test follow-up errors) related to the discontinuity of care from the inpatient to the outpatient setting and found a significant association only between work-up errors and rehospitalizations. When restricting the analysis to the 14 studies[31 50 54-56 58 59 61-64 66-68] that investigated rehospitalizations within approximately 30 days of discharge (including 15–22 days,[63] 28 days[58] and 31 days[61]), five studies[50 58 63 66 67] reported a significant association between this outcome and the hospital-discharge process, while nine[31 54-56 59 61 62 64 68] reported a non-significant association.

Considering the eight studies[54 55 59 61 62 64 66 68] (six of which were interventional studies[59 61 62 64 66 68]) that investigated post-discharge visits to the emergency department as an outcome, two interventional studies[59 62] reported a significant association between this outcome and the investigated intervention.

The five studies that investigated patient mortality[50 51 54 55 57] were all observational, and all reported no significant association between discharge process and death.

Eight studies[50 53-55 60 62 64 66] explored a composite outcome (mostly based on 30-day follow-up duration, n=7), the nature of the combination varying from one study to another (Table 1 and Figure 4). The association between component(s) of the discharge process and continuity of care thereafter and the composite outcome was reported as significant in four studies[50 53 62 66] and as non-significant in three studies.[54 60 64] In the remaining study,[55] there was no significant association between documented follow-up appointment arrangements and rehospitalizations or emergency department visits within 30 days. However, documented follow-up appointment arrangements were significantly associated with a higher likelihood of having either an emergency department visit or a hospital readmission within 180 days of the initial hospital discharge.

Finally, Figures 3 and 4 indicate that irrespective of the component explored, one cannot identify any consistent statistical association between any hospital-discharge component and any patient health outcome.

Risk of bias across studies

This item was especially difficult to evaluate because of the wide heterogeneity between studies (e.g. design, sample size, hospital-discharge components, outcomes, follow-up duration). Any

correction of a potential publication bias against studies with negative or non-significant associations would have reduced the variability found in this review, with a corresponding mechanic effect favoring a consistent absence of association between discharge organization and patient's subsequent health.

Additional analyses

No additional analysis was performed.

DISCUSSION

Summary of evidence

The major outcomes used to estimate the effect of the discharge process and subsequent continuity of care on patient health after discharge were rehospitalizations and emergency department visits, most commonly measured at approximately 30 days after discharge. Considering rehospitalizations, eight out of the eighteen studies that explored this outcome reported at least one significant association between discharge process and rehospitalizations. As regards emergency department visits, two of the eight studies that investigated this outcome reported a significant association. No study reported a significant association between a discharge component and mortality. This systematic review highlights a wide heterogeneity across the studies, especially in terms of the component(s) of the hospital-discharge process investigated, study designs, outcomes measured (including follow-up durations). Such an heterogeneity in critical elements prevents from performing a meaningful meta-analysis. Nevertheless, Figures 3 and 4 indicate globally that irrespective of the component of the discharge process explored, outcome considered, sample size, and study design, one cannot identify any consistent statistical association between the presence of a component or an intervention likely improving the quality of hospital-discharge process and an improvement of a patient health outcome. The global picture from our review indicates that the effect of discharge process and subsequent continuity of care components on patient health after discharge remains unclear. Therefore, it is not possible to draw any conclusions about the most critical organizational discharge-process components on which to base potential recommendations. This contrasts with the review of Leppin *et al*[39] which indicates that peri-discharge interventions targeting specific populations were effective at reducing hospital readmissions. At least three reasons may be

thought for contributing to this difference: the heterogeneous general population that was targeted in our review might require very large sample sizes for evidencing a comparable impact, personalized interventions in specific populations might be more efficient, and finally study designs involved in our review include observational studies whereas Leppin *et al*[39] only considered randomized trials. In any case, a major implication of our findings is a better standardization of future studies in order to get a clearer picture of the impact of discharge elements on the general population of patients. For example, a 30-day readmission delay could be considered as a reasonable standardized outcome (long-term outcomes are probably more subject to be biased by confounding factors).

Among the 20 studies included in this review, nine described interventions, only five of which were randomized trials; this finding raises concerns about the potential effect of confounding factors that might have influenced patient outcomes after discharge. Indeed, in many of the studies, features related to elements of the patients' hospital stay (such as disease progression, severity of illness, and comorbidities), which were unrelated to discharge components, may have contributed to patients' health outcomes after discharge.

Another concern is the variability of discharge protocols from one hospital department to another. Such protocols are poorly reported in the studies.[50] Although 18 of the 20 studies were conducted in USA (n = 14) or Canada (n = 4), between-protocol variability might result in variability in the effect of the hospital-discharge process on a patient's subsequent health. General recommendations for managing the hospital–primary-care interface have been proposed by several societies,[69] as well as discharge checklists.[70 71] Similarly, Kripalani *et al*[33] attempted to identify challenges and to propose recommendations, given the lack of evidence-based recommendations for hospital discharge applicable to a broad range of patients. However, the rate of adoption of standardized evidence-based recommendations in health organizations remains unknown.

Limitations

This review is subject to several limitations. Firstly, a single author was involved in critical steps of the review (initial phases leading to article selection, data abstraction, risk assessment of the included studies). This constitutes a significant risk for individual and systematic bias, and thus is a major limitation of this systematic review.

The second limitation concerns the potential omission of relevant studies. However, our iterative

process of screening the bibliographies of included studies is likely to have minimized this limitation. Of note, we did not identify any new studies when we searched the bibliographies of reviews identified during the database searches.

The third limitation concerns the populations studied. The inclusion criteria restricted the analysis to studies on general medical or surgical patients originating from home and discharged to home. Studies on specific populations were excluded, but we decided to keep studies involving patients with heart failure given the prevalence of such patients and the substantial volume of literature available on hospital discharge and continuity of care. However, removing the five studies,[31 50 51 65 67] involving these patients, shown in italic in Figures 3 and 4, would not resolve the above-mentioned absence of identification of any consistent pattern. Moreover, despite the exclusion of studies that were focused on specific population (see exclusion criterion #7 in Supplementary File 2), some of the studies included in the review may not have excluded or measured as a covariate any factor related to frailty or socio-economic status and this may have contributed to the heterogeneity of the results.

The fourth limitation was the heterogeneity revealed by our synthesis of the results. This heterogeneity may be linked to the fact that the processes investigated were complex, multifaceted and interconnected. Previous reviews in the domain of hospital-discharge process and continuity of care also report such heterogeneity,[35 36 38 40-45] also attested by the fact that only three reviews performed meta-analyses.[37 39 42]

The fifth limitation was the limited scientific evidence of the included studies, given the various designs. Unsurprisingly, studies with a high sample size were observational. Assessment of the methodological quality of the studies indicated that only nine of the 20 studies were categorized as having a strong score in terms of methodological quality (see Figure 2). Finally, one cannot exclude a risk of publication bias against studies that did not find an association between hospital-discharge component(s) and patient health outcome(s).

Conclusions and perspectives

This systematic review highlights the wide heterogeneity between studies evaluating the effect of hospital-discharge organization process on patients' outcomes post-discharge in a standard population of patients returning home. The role of this heterogeneity in the variance observed in the study results (i.e. either a positive effect or absence of effect) is unknown. Globally, the effect of the

complex interrelated hospital-discharge and continuity-of-care processes on patient health outcomes requires further investigations, but because of the inherent multicomponent nature of these processes and the interweaving of these processes in the whole hospital stay, estimating such an effect is difficult. To obtain a clearer global picture, future studies would benefit from better standardization of the adverse outcomes explored, including follow-up duration. In addition, technological developments may enhance overall management of patients at the hospital–primary-care interface. A major challenge concerns the interoperability between hospital and primary-care electronic health-information systems, for facilitating exchanges of hospital–primary-care information. Moreover, implementation of information systems collecting patient opinions after hospital discharge may document important information on current organization, and constitute the basis of systems devoted to improving management.

Acknowledgements

Sophie Rushton-Smith, PhD (Medlink Healthcare Communications Limited) provided editorial support on the final version of the article and was funded by the authors.

Competing Interests

None declared.

Funding

This work was supported by a grant from Assistance Publique-Hôpitaux de Paris, program "Recherche Infirmière" (BC). This institution had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Author contributions

Study conception and design: BC, FC, and GH; data acquisition: BC; analysis and interpretation of data: BC and GH; wrote first draft of the paper: BC and GH; all authors read and approved the final version of the paper.

Data sharing statement

No additional data are available.

REFERENCES

1. Forster AJ, Murff HJ, Peterson JF, et al. The incidence and severity of adverse events affecting patients after discharge from the hospital. *Ann Intern Med* 2003;138:161-7.
2. Forster AJ, Clark HD, Menard A, et al. Adverse events among medical patients after discharge from hospital. *CMAJ* 2004;170:345-9.
3. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med* 2009;360:1418-28.
4. Rising KL, White LF, Fernandez WG, et al. Emergency department visits after hospital discharge: a missing part of the equation. *Ann Emerg Med* 2013;62:145-50.
5. Vashi AA, Fox JP, Carr BG, et al. Use of hospital-based acute care among patients recently discharged from the hospital. *JAMA* 2013;309:364-71.
6. Arora VM, Prochaska ML, Farnan JM, et al. Problems after discharge and understanding of communication with their primary care physicians among hospitalized seniors: a mixed methods study. *J Hosp Med* 2010;5:385-91.
7. Pantilat SZ, Lindenauer PK, Katz PP, et al. Primary care physician attitudes regarding communication with hospitalists. *Am J Med* 2001;111:15S-20S.
8. Horwitz LI, Jenq GY, Brewster UC, et al. Comprehensive quality of discharge summaries at an academic medical center. *J Hosp Med* 2013;8:436-43.
9. van Walraven C, Seth R, Laupacis A. Dissemination of discharge summaries - Not reaching follow-up physicians. *Can Fam Phys* 2002;48:737-42.
10. Roy CL, Poon EG, Karson AS, et al. Patient safety concerns arising from test results that return after hospital discharge. *Ann Intern Med* 2005;143:121-8.
11. Were MC, Li XC, Kesterson J, et al. Adequacy of hospital discharge summaries in documenting tests with pending results and outpatient follow-up providers. *J Gen Intern Med* 2009;24:1002-6.
12. Moore C, McGinn T, Halm E. Tying up loose ends: discharging patients with unresolved medical issues. *Arch Intern Med* 2007;167:1305-11.
13. McMillan TE, Allan W, Black PN. Accuracy of information on medicines in hospital discharge summaries. *Intern Med J* 2006;36:221-5.

14. Perren A, Previsdomini M, Cerutti B, et al. Omitted and unjustified medications in the discharge summary. *Qual Saf Health Care* 2009;18:205-8.
15. Ellitt GR, Engblom E, Aslani P, et al. Drug related problems after discharge from an Australian teaching hospital. *Pharm World Sci* 2010;32:622-30.
16. Paulino EI, Bouvy ML, Gastelurrutia MA, et al. Drug related problems identified by European community pharmacists in patients discharged from hospital. *Pharm World Sci* 2004;26:353-60.
17. Roughead EE, Kalisch LM, Ramsay EN, et al. Continuity of care: when do patients visit community healthcare providers after leaving hospital? *Intern Med J* 2011;41:662-7.
18. van Walraven C, Taljaard M, Bell CM, et al. A prospective cohort study found that provider and information continuity was low after patient discharge from hospital. *J Clin Epidemiol* 2010;63:1000-10.
19. Coleman EA, Smith JD, Raha D, et al. Posthospital medication discrepancies: prevalence and contributing factors. *Arch Intern Med* 2005;165:1842-7.
20. Hansen LO, Strater A, Smith L, et al. Hospital discharge documentation and risk of rehospitalisation. *BMJ Qual Saf* 2011;20:773-8.
21. van Walraven C, Seth R, Austin PC, et al. Effect of discharge summary availability during post-discharge visits on hospital readmission. *J Gen Intern Med* 2002;17:186-92.
22. Davis MM, Devoe M, Kansagara D, et al. "Did I do as best as the system would let me?" Healthcare professional views on hospital to home care transitions. *J Gen Intern Med* 2012;27:1649-56.
23. Greysen SR, Schiliro D, Horwitz LI, et al. "Out of sight, out of mind": housestaff perceptions of quality-limiting factors in discharge care at teaching hospitals. *J Hosp Med* 2012;7:376-81.
24. Harding J. Study of discharge communications from hospital doctors to an inner London general practice. *J R Coll Gen Pract* 1987;37:494-5.
25. Flacker J, Park W, Sims A. Hospital discharge information and older patients: do they get what they need? *J Hosp Med* 2007;2:291-6.
26. Hadjistavropoulos H, Biem H, Sharpe D, et al. Patient perceptions of hospital discharge: reliability and validity of a Patient Continuity of Care Questionnaire. *Int J Qual Health Care* 2008;20:314-23.
27. Horwitz LI, Moriarty JP, Chen C, et al. Quality of discharge practices and patient understanding at an academic medical center. *JAMA Intern Med* 2013;173:1715-22.

28. Hesselink G, Schoonhoven L, Plas M, et al. Quality and safety of hospital discharge: a study on experiences and perceptions of patients, relatives and care providers. *Int J Qual Health Care* 2013;25:66-74.
29. Hesselink G, Vernooij-Dassen M, Pijnenborg L, et al. Organizational culture an important context for addressing and improving hospital to community patient discharge. *Med Care* 2013;51:90-8.
30. Boulding W, Glickman SW, Manary MP, et al. Relationship between patient satisfaction with inpatient care and hospital readmission within 30 days. *Am J Manag Care* 2011;17:41-8.
31. Jha AK, Orav EJ, Epstein AM. Public reporting of discharge planning and rates of readmissions. *N Engl J Med* 2009;361:2637-45.
32. Weiss M, Yakusheva O, Bobay K. Nurse and patient perceptions of discharge readiness in relation to postdischarge utilization. *Med Care* 2010;48:482-6.
33. Kripalani S, Jackson AT, Schnipper JL, et al. Promoting effective transitions of care at hospital discharge: a review of key issues for hospitalists. *J Hosp Med* 2007;2:314-23.
34. Kwan JL, Lo L, Sampson M, et al. Medication reconciliation during transitions of care as a patient safety strategy: a systematic review. *Ann Intern Med* 2013;158:397-403.
35. Mueller SK, Sponsler KC, Kripalani S, et al. Hospital-based medication reconciliation practices: a systematic review. *Arch Intern Med* 2012;172:1057-69.
36. Garcia-Caballos M, Ramos-Diaz F, Jimenez-Moleon JJ, et al. Drug-related problems in older people after hospital discharge and interventions to reduce them. *Age Ageing* 2010;39:430-8.
37. Phillips CO, Wright SM, Kern DE, et al. Comprehensive discharge planning with postdischarge support for older patients with congestive heart failure: a meta-analysis. *JAMA* 2004;291:1358-67.
38. Hansen LO, Young RS, Hinami K, et al. Interventions to reduce 30-day rehospitalization: a systematic review. *Ann Intern Med* 2011;155:520-8.
39. Leppin AL, Gionfriddo MR, Kessler M, et al. Preventing 30-day hospital readmissions: a systematic review and meta-analysis of randomized trials. *JAMA Intern Med* 2014;174:1095-107.
40. Mistiaen P, Poot E. Telephone follow-up, initiated by a hospital-based health professional, for postdischarge problems in patients discharged from hospital to home. *Cochrane Database Syst Rev* 2006;4:CD004510.
41. Mistiaen P, Francke AL, Poot E. Interventions aimed at reducing problems in adult patients discharged from hospital to home: a systematic meta-review. *BMC Health Serv Res* 2007;7:47.

42. Shepperd S, Lannin NA, Clemson LM, et al. Discharge planning from hospital to home. *Cochrane Database Syst Rev* 2013;1:CD000313.

43. Hesselink G, Schoonhoven L, Barach P, et al. Improving patient handovers from hospital to primary care: a systematic review. *Ann Intern Med* 2012;157:417-28.

44. Kripalani S, LeFevre F, Phillips CO, et al. Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care. *JAMA* 2007;297:831-41.

45. Rennke S, Nguyen OK, Shoeb MH, et al. Hospital-initiated transitional care interventions as a patient safety strategy: a systematic review. *Ann Intern Med* 2013;158:433-40.

46. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med* 2009;6:e1000100.

47. Jackson N, Waters E, Guidelines for Systematic Reviews in Health P, et al. Criteria for the systematic review of health promotion and public health interventions. *Health Promot Int* 2005;20:367-74.

48. Thomas BH, Ciliska D, Dobbins M, et al. A process for systematically reviewing the literature: providing the research evidence for public health nursing interventions. *Worldviews Evid Based Nurs* 2004;1:176-84.

49. Pace R, Pluye P, Bartlett G, et al. Testing the reliability and efficiency of the pilot Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. *Int J Nurs Stud* 2012;49:47-53.

50. Hernandez AF, Greiner MA, Fonarow GC, et al. Relationship between early physician follow-up and 30-day readmission among Medicare beneficiaries hospitalized for heart failure. *JAMA* 2010;303:1716-22.

51. VanSuch M, Naessens JM, Stroebel RJ, et al. Effect of discharge instructions on readmission of hospitalised patients with heart failure: do all of the Joint Commission on Accreditation of Healthcare Organizations heart failure core measures reflect better care? *Qual Saf Health Care* 2006;15:414-7.

52. Moore C, Wisnivesky J, Williams S, et al. Medical errors related to discontinuity of care from an inpatient to an outpatient setting. *J Gen Intern Med* 2003;18:646-51.

53. van Walraven C, Mamdani M, Fang JM, et al. Continuity of care and patient outcomes after hospital discharge. *J Gen Intern Med* 2004;19:624-45.
54. Bell CM, Schnipper JL, Auerbach AD, et al. Association of communication between hospital-based physicians and primary care providers with patient outcomes. *J Gen Intern Med* 2009;24:381-6.
55. Grafft CA, McDonald FS, Ruud KL, et al. Effect of hospital follow-up appointment on clinical event outcomes and mortality. *Arch Intern Med* 2010;170:955-60.
56. Kashiwagi DT, Burton MC, Kirkland LL, et al. Do timely outpatient follow-up visits decrease hospital readmission rates? *Am J Med Qual* 2012;27:11-5.
57. van Walraven C, Taljaard M, Etchells E, et al. The independent association of provider and information continuity on outcomes after hospital discharge: implications for hospitalists. *J Hosp Med* 2010;5:398-405.
58. Li JYZ, Yong TY, Hakendorf P, et al. Timeliness in discharge summary dissemination is associated with patients' clinical outcomes. *J Eval Clin Pract* 2013;19:76-9.
59. Dudas V, Bookwalter T, Kerr KM, et al. The impact of follow-up telephone calls to patients after hospitalization. *Am J Med Qual* 2001;111:26S-30S.
60. Schnipper JL, Kirwin JL, Cotugno MC, et al. Role of pharmacist counseling in preventing adverse drug events after hospitalization. *Arch Intern Med* 2006;166:565-71.
61. Balaban RB, Weissman JS, Samuel PA, et al. Redefining and redesigning hospital discharge to enhance patient care: a randomized controlled study. *J Gen Intern Med* 2008;23:1228-33.
62. Jack BW, Chetty VK, Anthony D, et al. A reengineered hospital discharge program to decrease rehospitalization: a randomized trial. *Ann Intern Med* 2009;150:178-87.
63. Al-Rashed SA, Wright DJ, Roebuck N, et al. The value of inpatient pharmaceutical counselling to elderly patients prior to discharge. *Br J Clin Pharmacol* 2002;54:657-64.
64. Walker PC, Bernstein SJ, Jones JN, et al. Impact of a pharmacist-facilitated hospital discharge program: a quasi-experimental study. *Arch Intern Med* 2009;169:2003-10.
65. Anderson C, Deepak BV, Amoateng-Adjepong Y, et al. Benefits of comprehensive inpatient education and discharge planning combined with outpatient support in elderly patients with congestive heart failure. *Congest Heart Fail* 2005;11:315-21.

66. Dedhia P, Kravet S, Bulger J, et al. A quality improvement intervention to facilitate the transition of older adults from three hospitals back to their homes. *J Am Geriatr Soc* 2009;57:1540-6.

67. Al-Damluji MS, Dzara K, Hodshon B, et al. Association of discharge summary quality with readmission risk for patients hospitalized with heart failure exacerbation. *Circ Cardiovasc Qual Outcomes* 2015;8:109-11.

68. Soong C, Kurabi B, Wells D, et al. Do post discharge phone calls improve care transitions? A cluster-randomized trial. *PLoS One* 2014;9:e112230.

69. Snow V, Beck D, Budnitz T, et al. Transitions of Care Consensus policy statement: American College of Physicians, Society of General Internal Medicine, Society of Hospital Medicine, American Geriatrics Society, American College Of Emergency Physicians, and Society for Academic Emergency Medicine. *J Hosp Med* 2009;4:364-70.

70. Halasyamani L, Kripalani S, Coleman E, et al. Transition of care for hospitalized elderly patients--development of a discharge checklist for hospitalists. *J Hosp Med* 2006;1:354-60.

71. Soong C, Daub S, Lee J, et al. Development of a checklist of safe discharge practices for hospital patients. *J Hosp Med* 2013;8:444-9.

SUPPLEMENTARY FILES

Supplementary File 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement checklist.

Supplementary File 2 Study inclusion and exclusion criteria.

Supplementary File 3 List of the search strategies.

Supplementary File 4 Assessment for eligibility on full-text articles.

Supplementary File 5 Overview of included studies.

LEGENDS

Figure 1 Flow diagram of the systematic review process.

(A) Flow diagram of the four independent searches in the Medline and Web of Science databases. (B) Flow diagram of the process screening the bibliographies of the reviews and initial included studies.

Figure 2 Methodological quality of the studies included**.**

Dotted lines delineate the quality issued from the combination of both quality tools (abscissa and ordinate, respectively).

Figure 3 Effect of hospital-discharge process and subsequent continuity of care components on patients' health outcomes.

The first letter in parenthesis corresponds to the type of component investigated: (A), discharge summary; (B), discharge instructions; (C), drug-related problems; (D), transition from hospital to home; (E), continuity of care. In addition, interventional studies are identified by an asterisk.

Studies in bold and normal characters correspond to a significant and a non-significant association reported, respectively.

Studies in italic characters correspond to studies involving patients with heart failure.

Small, medium, and large sized characters correspond to a weak, moderate, and strong methodological quality.

[a]Measured outcome: rehospitalizations related to work-up errors.

[b]Measured outcomes: rehospitalizations related to medication continuity errors and to test follow-up errors.

Figure 4 Effect of hospital-discharge process and subsequent continuity of care components on patients' composite health outcomes.

The first letter in parenthesis corresponds to the type of component investigated: (A), discharge summary; (B), discharge instructions; (C), drug-related problems; (D), transition from hospital to home; (E), continuity of care. In addition, interventional studies are identified by an asterisk.

Studies in bold and normal characters correspond to a significant and a non-significant association reported, respectively.

Studies in italic characters correspond to studies involving patients with heart failure.

Small, medium, and large sized characters correspond to a weak, moderate, and strong methodological quality.

The follow-up duration in each study is indicated, for example 30d indicates that the follow-up reported is the post-discharge period of 30 days.

ED, emergency department.

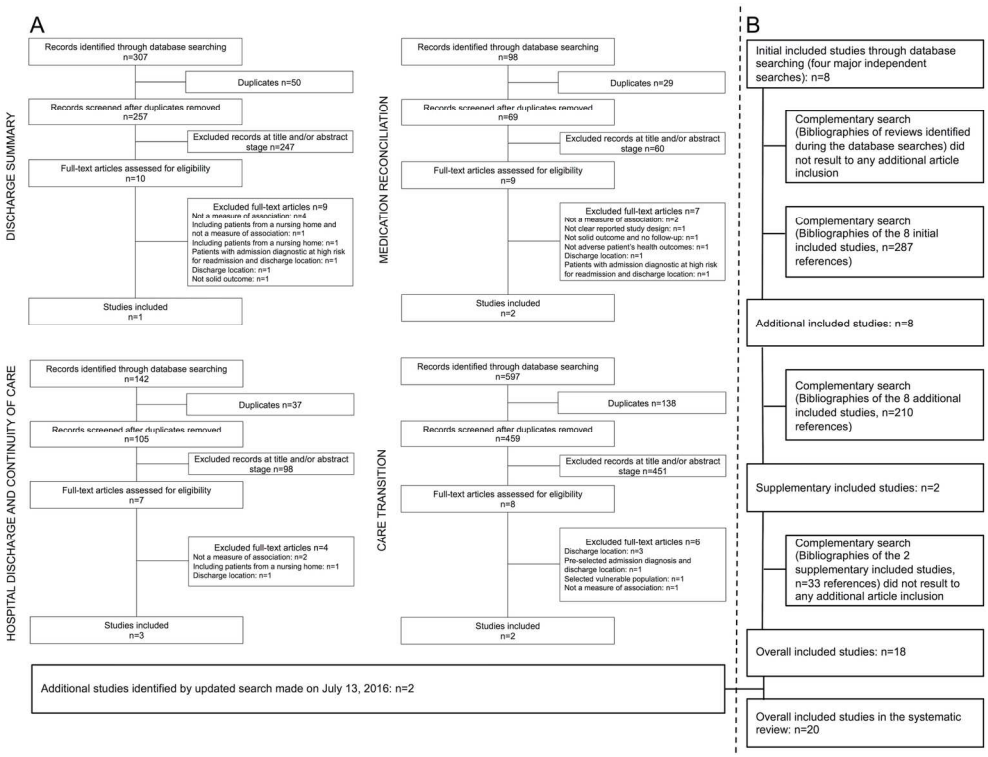

Figure 1 Flow diagram of the systematic review process.

160x120mm (300 x 300 DPI)

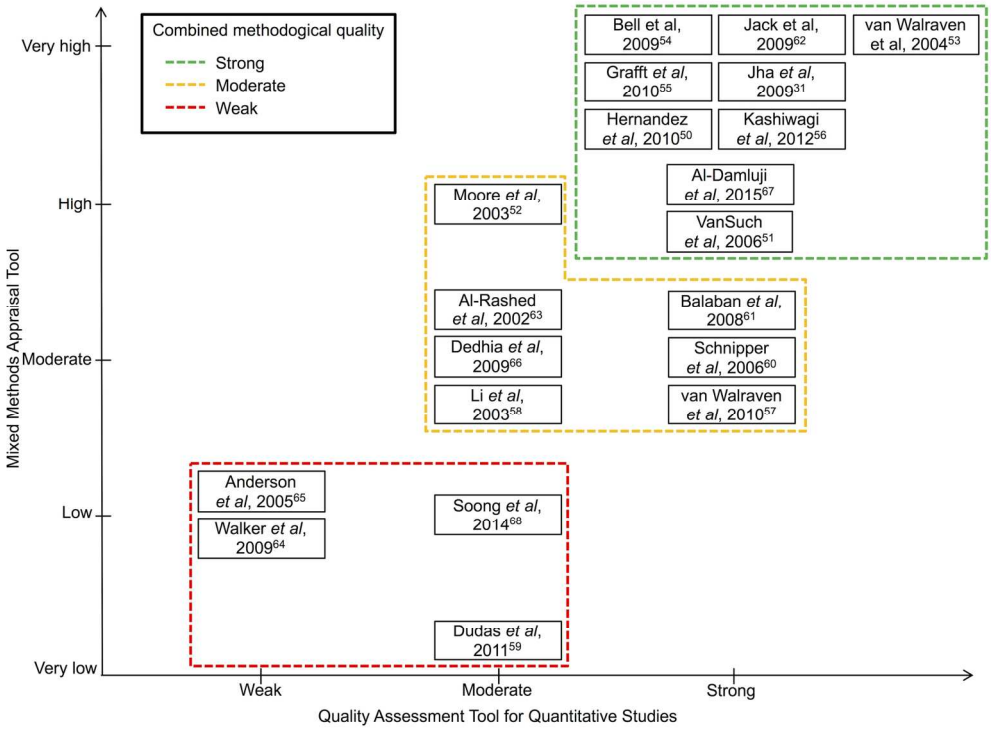

Figure 2 Methodological quality of the studies included.

160x120mm (300 x 300 DPI)

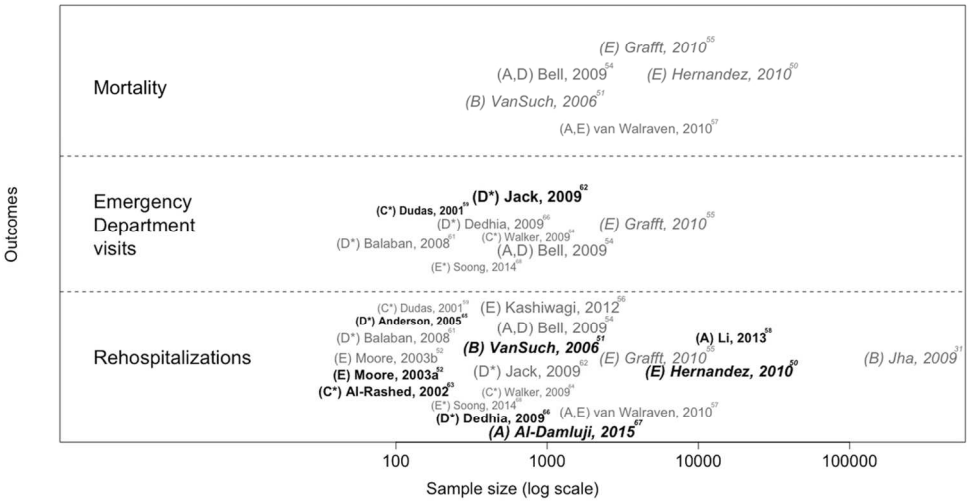

Figure 3 Effect of hospital-discharge process and subsequent continuity of care components on patients' health outcomes.

119x67mm (300 x 300 DPI)

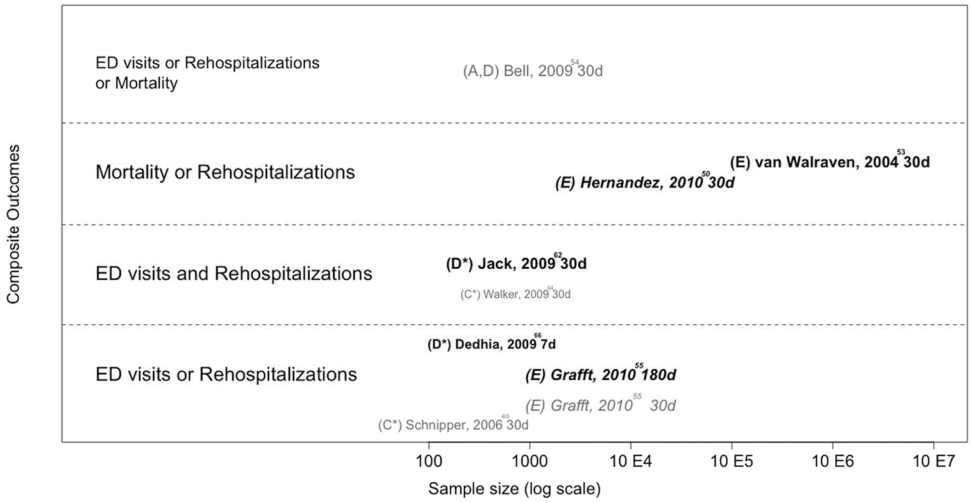

Figure 4 Effect of hospital-discharge process and subsequent continuity of care components on patients' composite health outcomes.

119x67mm (300 x 300 DPI)

Supplementary File 1 PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	NA
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6, Supplementary File 2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6-7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	7, Supplementary File 3
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7-8
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8

Supplementary File 1 PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	9
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9, Figure 1, Supplementary File 4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9-10, Supplementary File 5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10, Figure 2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10-14, Table 1, Supplementary File 5
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	14-15, Table 1, Figures 3 and 4
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	15-16
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	16
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16-17
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	17-18
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	18-19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	19

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Supplementary File 2 Study inclusion and exclusion criteria.

Inclusion criteria	
1.	Focus: studies on hospital discharge and subsequent continuity of care, care transition from hospital directly to home only
2.	Setting: acute care
3.	Participants: adult patients without cognitive impairment or chronic mental illness
4.	Type of studies: published quantitative (observational or interventional) studies
5.	Language: papers in the English language only
6.	Outcomes: quantitative studies exploring a potential association between components of the hospital-discharge process, including continuity of care thereafter, and patients' health outcomes after discharge (e.g. emergency department visits, post-hospitalization visits to primary care providers, readmissions, death)
Exclusion criteria	
1.	Type of studies: systematic or non-systematic reviews, meta-analyses, meta-reviews, letters, commentaries, editorials, notes, case reports, study protocols, news, research letters
2.	No available full text
3.	Duplicate studies
4.	Other focus than hospital discharge; transitions from hospital to other locations than home (e.g. nursing homes, inpatient rehabilitation units, long-term care)
5.	Countries outside of Europe, North America, and Australia
6.	Admission source: nursing homes or skilled nursing facilities
7.	Specific populations (e.g. frail patients, medically vulnerable patients, low-income patients, ethnic minorities, patients judged to be at "high risk for readmission")
8.	Specific care/pathology (e.g. pediatrics, rehabilitation, palliative care, psychiatry, oncology, pregnancy)[a]
9.	Patients' health outcomes: no available data, outcomes not sufficiently robust
10.	Lack of clarity regarding the study design

[a]Studies involving patients with heart failure were kept, given the prevalence of such patients and the substantial volume of literature available on hospital discharge and continuity of care.

Supplementary File 3 Search strategies.

Number of references below concern the initial searches in the databases, that were made between March 1, 2013 and June 30, 2013, with no limit for the starting and ending dates. All searches were updated on July 13, 2016 (see Figure 1 in the main manuscript).

1/ Discharge summary[a]

Search 1

PubMed #1 discharge summary [TI] (74 references)

Web of Science #2 TI=(discharge summary) (191 references)

#1 OR #2 (265 references including 43 duplicates: 222 references)

Search 2

PubMed #3 discharge documentation [TI] (4 references)

Web of Science #4 TI=(discharge documentation) (38 references)

#3 OR #4 (42 references including 4 duplicates: 38 references)

#1 OR #2 OR #3 OR #4 (260 references including 3 duplicates: 257 references)

2/ Medication reconciliation[b]

PubMed #1 medication reconciliation [TIAB] AND discharge [TI] (40 references)

Web of Science #2 (TS=medication reconciliation) AND (TI=discharge) (58 references)

#1 OR #2 (98 references including 29 duplicates: 69 references)

3/ Global discharge and continuity-of-care organization[c]

Search 1

PubMed #1 (continuity of care [TI]) AND discharge [TI] (45 references)

Web of Science #2 TI=(continuity of care) AND TI=(discharge) (28 references)

#1 OR #2 (73 references including 11 duplicates: 62 references)

Search 2

PubMed #3 (hospital discharge [TI]) AND (continuity of care [TIAB]) (17 references)

Web of Science #4 TI=hospital discharge AND TS=continuity of care (52 references)

#3 OR #4 (69 references including 12 duplicates: 57 references)

#1 OR #2 OR #3 OR #4 (119 references including 14 duplicates: 105 references)

4/ Care transition[d]

PubMed #1 "care transition" [ALL] OR "care transitions" [ALL] (399 references)

WOS #2 (TS = discharge) AND ((TS = "care transition") OR (TS = "care transitions"))

(198 references)

#1 OR #2 (597 references including 138 duplicates: 459 references)

[a]18 April 2013.

[b]31 May 2013.

[c]1 March 2013.

[d]30 June 2013.

Supplementary File 4 Assessment for eligibility on full-text articles.

The reasons for excluding 20 articles on full-text screening are detailed below, and the corresponding references are provided.

1/ Discharge summary[a] (Excluded full-text articles n=9)

Reasons for exclusion

Not a measure of association (n=4)[1-4]

Including patients from a nursing home and not a measure of association (n=1)[5]

Including patients from a nursing home (n=1)[6]

Patients with admission diagnostic at high risk for readmission and discharge location (n=1)[7]

Discharge location (n=1)[8]

Not solid outcome (n=1)[9]

2/ Medication reconciliation[b] (Excluded full-text articles n=7)

Reasons for exclusion

Not a measure of association (n=2)[10 11]

Not clear reported study design (n=1)[12]

Not solid outcome and no follow-up (n=1)[13]

Not adverse patient's health outcomes (n=1)[14]

Discharge location (n=1)[15]

Patients with admission diagnostic at high risk for readmission and discharge location (n=1)[7]

3/ Hospital discharge and continuity-of-care[c] (Excluded full-text articles n=4)

Reasons for exclusion

Not a measure of association (n=2)[2 11]

Including patients from a nursing home (n=1)[6]

Discharge location (n=1)[8]

4/ Care transition[d] (Excluded full-text articles n=6)

Reasons for exclusion

Discharge location (n=3)[8 16 17]

Pre-selected admission diagnosis and discharge location (n=1)[18]

Selected vulnerable population (n=1)[19]

Not a measure of association (n=1)[20]

[a]18 April 2013.

[b]31 May 2013.

[c]1 March 2013.

[d]30 June 2013.

REFERENCES

1. Flyer B, Rubenstein LZ, Robbins AS, et al. An intervention to improve the hospital discharge summary. *J Med Educ* 1988;63:407-9.
2. Grimes T, Delaney T, Duggan C, et al. Survey of medication documentation at hospital discharge: implications for patient safety and continuity of care. *Irish J Med Sci* 2008;177:93-7.

3. McMillan TE, Allan W, Black PN. Accuracy of information on medicines in hospital discharge summaries. *Intern Med J* 2006;36:221-5.
4. Perren A, Previsdomini M, Cerutti B, et al. Omitted and unjustified medications in the discharge summary. *Qual Saf Health Care* 2009;18:205-8.
5. van Walraven C, Seth R, Laupacis A. Dissemination of discharge summaries - Not reaching follow-up physicians. *Can Fam Phys* 2002;48:737-42.
6. van Walraven C, Seth R, Austin PC, et al. Effect of discharge summary availability during post-discharge visits on hospital readmission. *J Gen Intern Med* 2002;17:186-92.
7. Hansen LO, Strater A, Smith L, et al. Hospital discharge documentation and risk of rehospitalisation. *BMJ Qual Saf* 2011;20:773-8.
8. Maslove DM, Leiter RE, Griesman J, et al. Electronic versus dictated hospital discharge summaries: a randomized controlled trial. *J Gen Intern Med* 2009;24:995-1001.
9. O'Leary KJ, Liebovitz DM, Feinglass J, et al. Outpatient physicians' satisfaction with discharge summaries and perceived need for an electronic discharge summary. *J Hosp Med* 2006;1:317-20.
10. Geurts MM, van der Flier M, de Vries-Bots AM, et al. Medication reconciliation to solve discrepancies in discharge documents after discharge from the hospital. *Int J Clin Pharm* 2013;35:600-7.
11. Grimes TC, Duggan CA, Delaney TP, et al. Medication details documented on hospital discharge: cross-sectional observational study of factors associated with medication non-reconciliation. *Br J Clin Pharmacol* 2011;71:449-57.

12. Boso-Ribelles V, Montero-Hernandez M, Font-Noguera I, et al. Evaluation of a plan for cardiology medication reconciliation on admission, and patient information at discharge, in a teaching hospital. *EJHP Practice* 2011;17:26-30.
13. Wong JD, Bajcar JM, Wong GG, et al. Medication reconciliation at hospital discharge: evaluating discrepancies. *Ann Pharmacother* 2008;42:1373-9.
14. Kripalani S, Roumie CL, Dalal AK, et al. Effect of a pharmacist intervention on clinically important medication errors after hospital discharge: a randomized trial. *Ann Intern Med* 2012;157:1-10.
15. Showalter JW, Rafferty CM, Swallow NA, et al. Effect of standardized electronic discharge instructions on post-discharge hospital utilization. *J Gen Intern Med* 2011;26:718-23.
16. Finn KM, Heffner R, Chang Y, et al. Improving the discharge process by embedding a discharge facilitator in a resident team. *J Hosp Med* 2011;6:494-500.
17. Legrain S, Tubach F, Bonnet-Zamponi D, et al. A new multimodal geriatric discharge-planning intervention to prevent emergency visits and rehospitalizations of older adults: the optimization of medication in AGEd multicenter randomized controlled trial. *J Am Geriatr Soc* 2011;59:2017-28.
18. Coleman EA, Parry C, Chalmers S, et al. The care transitions intervention: results of a randomized controlled trial. *Arch Intern Med* 2006;166:1822-8.
19. Arora VM, Prochaska ML, Farnan JM, et al. Problems after discharge and understanding of communication with their primary care physicians among hospitalized seniors: a mixed methods study. *J Hosp Med* 2010;5:385-91.
20. Feldman LS, Costa LL, Feroli ER, et al. Nurse-pharmacist collaboration on medication reconciliation prevents potential harm. *J Hosp Med* 2012;7:396-401.

Supplementary File 5 Overview of included studies.

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Al-Damluji *et al*, 2015[67]	USA	Discharge summary	To determine the association between discharge summary quality and readmission	Observational	CHF Patients	1640 (dis-charge summar ies)	Quality of discharge summary in 3 domains: timeliness (days between discharge date and preparation date), transmission (any notation that the summary was sent to any of the clinicians listed) and content (number of content items included that were mandated by the Joint Commission and the number of content items included that were recommended by the Transitions of Care Consensus Conference)	Readmissions within 30 days	Patient interviews, and review of office charts and hospital record	Summaries transmitted to any outpatient clinician were associated with lower odds of readmission after adjustment for patient and hospital characteristics (adjusted OR=0.53, 95% CI 0.32–0.90, *P*=0.02), as were summaries including more Transitions of Care Consensus Conference content elements (adjusted OR=0.67, 95% CI, 0.46–0.97, *P*=0.03) Preparing summaries on discharge day (adjusted OR=1.01, 95% CI 0.60–1.69, *P*=0.88) and inclusion of The Joint Commission elements (adjusted OR=0.91, 95% CI 0.65–1.27, *P*=0.36) were not associated with readmission risk
Al-Rashed *et al*, 2002[63]	UK	Drug-related problems at hospital discharge	To evaluate the impact of pre-discharge counseling about medicines and compliance by a pharmacist on patient's therapeutic management post-discharge	Interventional (controlled)	Patients (age >65 years) in elderly wards	83 (I=43, C=40)	Pharmaceutical counseling pre-discharge in combination with medication and information discharge summary and a medicine reminder card	Unplanned visits to the GP and readmission to hospital 15–22 days and at 3 months post-discharge	Data collected during post-discharge visits by patient interview but not clearly described for readmissions	Unplanned visits to the doctor at 15–22 days: intervention 19/43 (44.2%) vs. control 27/40 (67.5%) (*P*<0.05); unplanned visits to the doctor at 3 months: intervention 24/43 (55.8%) vs. control 32/40 (80.0%) (*P*<0.05); readmissions at 15–22 days: intervention 5/43 (11.6%) vs. control 13/40 (32.5%) (*P*<0.05); readmissions at 3 months: intervention 3/43 (7.0%) vs. control 15/40 (37.5%) (*P*<0.05)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Anderson *et al*, 2005[65]	USA	Transition from hospital to home (coordination between inpatient and outpatient care)	To evaluate a targeted inpatient CHF education program with comprehensive discharge planning and immediate outpatient reinforcement through a coordinated, nurse-driven home health care program	Interventional (controlled)	CHF patients	121 (I=44, C=77)	Comprehensive community hospital-based HF program coupling targeted inpatient education and discharge planning with subsequent coordinated home care and telephone follow-up	6-month readmission rates	Patient interviews	Intervention subjects had an 11.4% readmission rate within 6 months, compared with a 44.2% readmission rate in control subjects (*P*=0.01)
Balaban *et al*, 2008[61]	USA	Transition from hospital to home (communication between inpatient and outpatient care teams)	To evaluate a discharge-transfer intervention designed to improve communication between inpatient and outpatient care teams and to promptly reconnect discharged patients with their "medical home"	Interventional (RCT)	Medical-surgical patients	96 (I=47, C=49)	Discharge-transfer intervention in 4 steps: (1) a comprehensive, user-friendly Patient Discharge Form provided to patients; (2) the electronic transfer of the Patient Discharge Form to the RNs at the patient's primary care site; (3) telephone contact by a primary care RN to the patient; and (4) PCP review and modification of the discharge-transfer plan	No outpatient follow-up within 21 days, readmission within 31 days, ED visit within 31 days and failure to complete an outpatient workup recommended by a hospital doctor	Electronic medical record and hospital progress notes	No follow-up within 21 days: intervention 7/47 (14.9%) vs. control 20/49 (40.8%) (*P*=0.005); readmission within 31 days: 4/47 (8.5%) vs. control 4/49 (8.2%) (*P*=0.96); ED visit within 31 days: intervention 1/47 (2.1%) vs. control 1/49 (2.0%) (*P*=0.97)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Bell *et al*, 2009[54]	Canada	Transition from hospital to home	To determine whether PCP knowledge of their patient's hospital admission, receipt of a discharge summary, and direct communication with the inpatient medical team are associated with 30-day composite patient outcomes	Observational	General medical patients	1078	Communication between hospital-based physicians and primary care providers: PCP aware of their patient's hospitalization, direct communication with inpatient medical team, availability of discharge summary	30-day composite patient outcomes of mortality, hospital readmission, and ED visits, 30-day readmission, 30-day ED visit, 30-day death	Follow-up telephone survey (30 days after discharge, patients or their proxies, readmissions and ED visits) and National Death Index search	PCP awareness of their patient's index admission to hospital not associated with the composite outcome (adjusted OR=1.08, 95% CI 0.73–1.59); similarly non-significant differences in adjusted 30-day composite outcomes if the PCP communicated directly with the hospital team (adjusted OR=0.87, 95% CI 0.56–1.34) or if the PCP saw a discharge summary (adjusted OR=0.84, 95% CI 0.57–1.22)
Dedhia *et al*, 2009[66]	USA	Transition from hospital to home	To estimate the feasibility and effectiveness of a multifaceted discharge planning intervention	Interventional (quasi-experimental pre-post design)	General medical patients (age ≥65 years)	422 (I=185, C=237)	Multidisciplinary, comprehensive, multifaceted, hospital-based initiative with five core components: (1) admission assessment highlighting geriatric principles and values; (2) notification of PCP about admission; (3) multidisciplinary team coordination; (4) physician-pharmacist collaborative medication reconciliation; (5) scheduled discharge meeting	ED visits or readmissions within 1 week, 30-day readmission, 30-day ED visits	Patients	Follow-up within 1 week returned to the ED or readmitted to the hospital: crude OR=0.28, 95% CI 0.11–0.71; follow-up at 30 days returned to the ED: crude OR=0.61, 95% CI 0.36–1.03; follow-up at 30 days readmitted to the hospital: crude OR=0.59, 95% CI 0.34–0.97

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Dudas *et al*, 2001[59]	USA	Drug-related problems at hospital discharge	To evaluate the impact of a follow-up telephone call made by pharmacists within 2 days of discharge after pharmacy-facilitated discharges	Interventional (RCT)	General medical service patients	145 (I=71, C=74)	A follow-up telephone call made by pharmacists within 2 days of discharge for patients discharged to home from an inpatient hospital-based medical service after pharmacy-facilitated discharges	ED visits and readmissions to the hospital within 30 days of discharge	Hospital records	ED visits within 30 days: 10% phone call vs. 24% no phone call, (*P*=0.005); hospital readmissions within 30 days: 15% phone call vs. 25% no phone call (*P*=0.07)
Grafft *et al*, 2010[55]	USA	Continuity of care after hospital discharge	To examine the effect of documented follow-up arrangements at hospital discharge on hospital readmission, ED visits and mortality	Observational	General medical patients	4989 (dis-missal summar ies)	Follow-up visits: documented hospital follow-up appointment arrangements in dismissal summaries scheduled prior to discharge	Hospital readmission, ED visits and mortality at 30 and 180 days after discharge and two composite end points	Administrative data	Rehospitalizations or ED visits at 30 days: patients with vs. without follow-up appointments (HR=1.05, 95% CI 0.93–1.18, *P*=0.42); rehospitalizations or ED visits at 180 days: patients with vs. without follow-up appointment arrangements (HR=1.10, 95% CI 1.01–1.20, *P*=0.03)
Hernandez *et al*, 2010[50]	USA	Continuity of care after hospital discharge	To examine associations between outpatient follow-up within 7 days after discharge from a HF hospitalization and readmission within 30 days	Observational	Patients (age ≥65 years) hospitalized for HF	30,136	Timing of outpatient follow-up after discharge	All-cause readmission within 30 days after discharge and 30-day mortality	Administrative data	Inverse relationship between early follow-up and the hazard of 30-day readmission: compared with patients whose index hospitalization occurred in a hospital in the lowest quartile of early follow-up, the risk-adjusted hazard of 30-day readmission was significantly lower in the second quartile (risk-adjusted HR=0.85, 95% CI 0.78–0.93; non-significant difference in the 30-day mortality by quartile of early follow-up

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Jack *et al*, 2009[62]	USA	Transition from hospital to home	To evaluate a complex peridischarge intervention on hospital utilization after discharge	Interventional (RCT)	General medical patients	749 (I=373, C=376)	Complex peri-discharge intervention with a package of discharge services including patient-centered education, comprehensive discharge planning and post-discharge telephone reinforcement by a clinical pharmacist	ED visits, readmissions and rate of primary follow-up visits within 30 days of discharge; combined end-point of ED visits and readmissions within 30 days of discharge	Hospital's electronic medical records and participant report	Combined ED visits and readmissions: intervention (*n*=116) vs. control (*n*=166) (*P*=0.009); ED visits: intervention (*n*=61) vs. control (*n*=90) (*P*= 0.014); readmissions: intervention (*n*=55) vs. control (*n*=76) (*P*=0.090); visited PCP: intervention (*n*=190) vs. control (*n*=135) (*P*<0.001)
Jha *et al*, 2009[31]	USA	Discharge instructions (as noted in the medical records)	To examine the association between performance, based on two measures of discharge planning (adequacy of documentation in the chart that discharge instructions were provided to patients with congestive heart failure, and patient-reported experiences with discharge planning) and rates of readmission for CHF and pneumonia.	Observational	Patients with CHF	252,266	Compliance with required discharge instructions for CHF patients	All-cause 30-day readmission rate for CHF	HCA database	No association found between performance on the chart-based measure and readmission rates among patients with CHF: readmission rates among hospitals performing in the highest quartile vs. the lowest quartile, 23.7% vs. 23.5% (*P*=0.54)
Kashiwagi *et al*, 2012[56]	USA	Continuity of care after hospital discharge	To evaluate time to follow-up after hospital discharge and readmissions in general medical patients	Observational	General medical patients	1044	Timing of outpatient scheduled follow-up appointments after discharge	30-day unplanned readmission	Database (study institution's electronic medical record)	30-day readmission follow-up ≤14 days 57/518 (11%) vs. follow-up ≥15 days 8/52 (15%) (*P*=0.36); 30-day readmission follow-up ≤14 days 57/518 (11%) vs. no follow-up 47/474 (10%) (*P*=0.75); 30-day readmission follow-up ≥15 days 8/52 (15%) vs. no follow-up 47/474 (10%) (*P*=0.25)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Li *et al*, 2013[58]	Australia	Discharge summary	To determine the relationship between the readmission rate of general medical patients to either the existence of a discharge summary or the timeliness of its dispatch	Observational	General medical patients	16,496 (patient admissions)	Existence of a discharge summary or timeliness of its dispatch: (1) within 7 days after discharge; (2) after more than 7 days; (3) not completed	Readmission rate within 7 or 28 days of discharge	Patient databases (inpatient database and ED database)	Significant association between delayed transmission or absence of a discharge summary and readmission rate at 7 (P<0.001) or 28 (P<0.001) days after discharge. Delay <7 days: number of summaries=13,099 (79.4%); readmission rate <7 days=2.9%; readmission rate <28 days=7.2%. Delay >7 days: number of summaries=1899 (11.5%); readmission rate <7 days=4.6%; readmission rate <28 days=9.5%. Never: number of summaries =1498 (9.1%); readmission rate <7 days=5.5%; readmission rate <28 days=10.3%
Moore *et al*, 2003[52]	USA	Continuity of care after hospital discharge	To determine the prevalence of medical errors related to the discontinuity of care from an inpatient to an outpatient setting, and to determine if there is an association between these medical errors and adverse outcomes	Observational	General medical patients who had a subsequent visit with an outpatient PCP within 2 months after discharge	86	Medical errors related to the discontinuity of care from the inpatient to the outpatient setting: work-up errors, medication continuity errors, test follow-up errors	Re-hospitalization within 3 months after the initial post-discharge outpatient primary care visit	Hospital's administrative database	Patients with at least 1 work-up error were 6.2 times (95% CI 1.3–30.3) more likely to be rehospitalized within 3 months after the first post-discharge PCP visit compared to patients with no work-up errors; not statistically significant association between medication continuity errors (OR=2.5, 95% CI 0.7–8.8) or test follow-up errors (OR=2.4, 95% CI 0.3–17.1) with rehospitalizations
Schnipper *et al*, 2006[60]	USA	Drug-related problems at discharge	To identify drug-related problems during and after hospitalization and to determine the effect of patient counseling and follow-up by pharmacists on preventable adverse drug events	Interventional (RCT)	General medical patients	176 (I=92, C=84)	Pharmacist intervention: medication review, discharge counseling and a follow-up telephone call 3–5 days after discharge by pharmacists	ED visits or readmissions to the hospital within 30 days of discharge	Survey questions (patients) and hospital administrative data	ED visit or readmission within 30 days: intervention 28/92 (30%) vs. control 25/84 (30%) (P>0.99)

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Soong *et al*, 2014[68]	Canada	Continuity of care after hospital discharge	To determine the impact of post-discharge phone calls on the patient experience and on hospital utilization	Interventional (cluster-randomized control trial)	General medical patients	328 (I=165, C=163)	A post-discharge phone call within 3 days following discharge from hospital: a standardized intervention phone script designed to solicit information on general health status post-discharge, comprehension of discharge instructions, and to reinforce instructions provided	30-day ED visit and readmission	Patient self report and/or available electronic medical records	30-day ED visit: OR=1.20, 95% CI 0.61–2.37; 30-day readmission: OR=1.18, 95% CI 0.53–2.61
VanSuch *et al*, 2006[51]	USA	Discharge instructions as reflected in the medical records	To determine whether documentation of compliance with any or all of the six required discharge instructions was correlated with readmissions to hospital or mortality	Observational	Patients with CHF	782	Compliance with required discharge instructions (discharge information and patient education) for CHF patients: activity, worsening symptoms, weight, drugs, follow-up appointment and diet	Time to death and time to readmission for HF or readmission for any cause and time to death	Administrative and medical record data	Patients who received all instructions were significantly less likely to be readmitted for any cause (*P*=0.003) and for HF (*P*=0.035) than those who missed at least one type of instruction; no association between documentation of discharge instructions and mortality (*P*=0.52)
Van Walraven *et al*, 2004[53]	Canada	Continuity of care after hospital discharge	To determine whether outcomes changed when physicians who cared for patients during hospitalization saw them in follow-up	Observational	Medical or surgical patients	938,833	Follow-up by hospital physicians or regular community doctors after discharge	30-day death or non-elective readmission to hospital	Discharge Abstract Database (re-admissions) and Registered Patients Database (deaths)	Patients significantly less likely to die or be readmitted if they were seen in follow-up by a hospital physician rather than a community physician (HR= 0.95, 95% CI 0.95–0.96); relative risk of death or readmission decreased by 5% (95% CI 2--4%) when patients followed up with a hospital rather than a community physician

Supplementary File 5 (Continued)

Author, Year	Country	Hospital-discharge process (and subsequent continuity of care) component	Objective(s)	Study design	Study population	Sample size	Description of the intervention or perspective investigated (for observational studies)	Adverse health outcomes	Data collection	Major results
Van Walraven *et al*, 2010[57]	Canada	Continuity of care after hospital discharge	To measure the independent association of several provider and information continuity measures on death or urgent readmission after hospital discharge	Observational	Medical or surgical patients with ≥2 physician visits prior to one of the study's outcomes or the end of patient observation	3876	Provider continuity (post-discharge physician) and information continuity (discharge summary, post-discharge visit information)	Time to all-cause death or urgent readmission 6 months post-discharge	Collected by phone (patient or principal contacts) and Office of the Provincial Registrar if the patient's vital status remained unclear	Death: adjusted HRs: post-discharge physician=0.97 (95% CI 0.89–1.06); discharge summary=0.96 (95% CI 0.89–1.04); post-discharge information=1.01 (95% CI 0.94–1.08). Readmission: adjusted HRs: post-discharge physician=0.98 (95% CI 0.95–1.01); discharge summary=1.01 (95% CI 0.98–1.04); post-discharge information=1.00 (95% CI 0.97–1.03)
Walker *et al*, 2009[64]	USA	Drug-related problems at hospital discharge	To characterize medication discrepancies at hospital discharge and test the effects of a pharmacist intervention on healthcare utilization following discharge	Interventional (alternating month quasi-experimental design)	General medical patients	724 (I=358, C=366)	Pharmacist intervention: medication therapy assessment, medication reconciliation, screening for adherence concerns, patient counseling and education, and post-discharge telephone follow-up by a pharmacist	14- and 30-day readmission rates, ED visits within 72 hours, 14 days and 30 days after discharge, combined end-point of readmissions and ED visits within 30 days of discharge	Patients' medical records; clinical and administrative databases	Readmission at 14 days: intervention 45/358 (12.6%) vs. control 42/366 (11.5%) (*P*=0.65); readmission at 30 days: intervention 79/358 (22.1%) vs. control 66/366 (18.0%) (*P*=0.17), ED at 72 hours: intervention 10/358 (2.8%) vs. control 8/366 (2.2%) (*P*=0.60), ED at 14 days: intervention 22/358 (6.2%) vs. control 27/366 (7.4%) (*P*=0.51), ED at 30 days: intervention 34/358 (9.5%) vs. control 45/366 (12.3%) (*P*=0.23); composite end point all readmissions and ED visits at 30 days: intervention 98/358 (27.4%) vs. control 94/366 (25.7%) (*P*=0.61)

C, control; CI, confidence interval; CHF, congestive heart failure; ED, emergency department; GP, general practitioner; HF, heart failure; HQA, Hospital Quality Alliance; HR, hazard ratio; I, intervention; OR, odds ratio; PCP, primary care provider; RCT, randomized controlled trial; RN, research nurse.