Approaches for improving continuity of care in medication management: a systematic review

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Abstract

Purpose. Medication-related problems frequently occur during transitions and lead to patient harm, increased use of healthcare resources and increased costs. The objective of this systematic review is to synthesize the impact of approaches to optimize the continuity of care in medication management upon hospital admission and/or discharge.

Data sources. MEDLINE, EMBASE, CINAHL, IPA and the Cochrane Database of Systematic Reviews from 1995 through December 2010.

Study selection. Controlled, parallel-group trials.

Data extraction. Data were extracted by one researcher and checked by another. Both reviewers independently assessed the study quality.

Results. Thirty studies met the inclusion criteria, but only 14 reached the predefined minimum quality score. Most studies focused on discharge and targeted the patients, sometimes together with primary care providers. The majority of studies found improvements in process measures. Patient education and counseling provided upon discharge and reinforced after discharge, sometimes together with improved communication with healthcare professionals, was shown to reduce the risk of adverse drug events and hospital re-admissions in some studies, but not all. Heterogeneity in study population as well as in intervention and outcome reporting precluded meta-analysis and limited interpretation. Most studies had important methodological limitations and were underpowered to show significant benefits on clinical outcomes.

Conclusions. The evidence for an impact of approaches on optimization of continuity of care in medication management remains limited. Further research should better target high-risk populations, use multicentered designs and have adequate sample size to evaluate the impact on process measures, clinical outcomes and cost-effectiveness.

Keywords: continuity of patient care, medication therapy management, quality improvement, medication errors, systematic review

Introduction

Continuity of care, including the medication-related aspects, is an essential component of quality of care. Problems are particularly common around hospitalization [1], when changes in medication regimens are frequent and may be accompanied by insufficient education of patients and information to healthcare professionals (HCPs). This can lead to adverse drug events (ADEs), increased use of healthcare resources and increased costs [2–7]. Because more than half of these problems are preventable, an important body of evaluative research has been performed over the last 15 years. In parallel, national initiatives have been developed to improve continuity of care with regard to medications.

Previous systematic reviews on approaches to improve continuity of care in medication management had a narrow focus relative to the type of intervention, HCPs involved or setting of transition [8–11]. We, therefore, examined the effects of different approaches to optimize continuity of care

in medication management, when compared with usual care, both on admission and at discharge from hospital.

Methods

Data sources

We conducted a systematic review of the literature for studies published from 1 January 1995 through 31 December 2010, by searching MEDLINE (Ovid), EMBASE, CINAHL, IPA and the Cochrane Database of Systematic Reviews. The search used both Medical Subject Headings and keywords in a Boolean search strategy (full details available upon request). Basically, terms referring to transition between settings of care (e.g. continuity of patient care, patient admission and patient discharge) were combined with terms referring to medications (e.g. drug therapy, prescriptions, medication errors and medication reconciliation), and optionally with terms referring to the outcome of the intervention (e.g. outcome assessment). Additional studies were identified from reference lists, previous systematic reviews and meta-analyses and personal databases. Because the study was originally made upon contract with the Belgian Health Care Knowledge Center, search was restricted to articles published in English, Dutch and French.

Study selection

Studies needed to comply with the following inclusion criteria: (i) inclusion of patients admitted to and/or discharged from hospital; (ii) being (quasi)-experimental and (iii) having a focus on medications. The following exclusion criteria were applied: (i) studies where the focus of the intervention was broader than medications and without specific measure to evaluate the effect of the intervention on the medication component; (ii) studies where the intervention focused on medications but with a scope that was broader than continuity of care (e.g. clinical pharmacists doing admission histories and discharge counseling along with interventions to improve prescribing during hospital stay) and without specific measure to evaluate the effect of the intervention on the continuity of care component; (iii) studies with no control group or 'before-after studies' with no control group (i.e. in which the control group is an historical group) and (iv) studies with <30 patients per group. Systematic reviews and meta-analyses on related topics were not included as such, but the list of articles included in the corresponding reviews was checked for eligibility.

The selection process was made independently by two researchers. Papers that did not meet the inclusion criteria were first eliminated based on their title and/or abstract. All abstracts identified as being potentially relevant were provisionally included. Final inclusion was decided after retrieving full texts.

Data extraction

One researcher abstracted the following study information, using a pre-piloted form: research setting, study population, focus of transition, study design, objectives, type and characteristics of intervention, outcome measures and main findings. A second researcher checked this information for accuracy. Disagreements were resolved by consensus.

Studies that met the inclusion criteria were further evaluated for quality, using a pre-piloted five-item grid that was derived from existing tools (Appendix Table 1) [12, 13]. The five items were selected based on their applicability and discriminatory capacity, after a pilot phase of evaluation. This was performed independently by two researchers. Disagreements were resolved by consensus. A cutoff score of 3 and above was used for final inclusion in the synthesis of evidence.

After data extraction and quality appraisal, all research members analyzed and compared the pertinent features of all studies, and performed an iterative review until consensus was reached about key messages and conclusions. No meta-analyses were performed owing to the heterogeneity of study populations, interventions and outcomes.

Results

The literature review identified 1490 potentially relevant, non-duplicate citations. Eighty-five additional references were added after checking original studies from previous systematic reviews [8–11, 14–17] and personal databases. At the end of the selection process, 31 publications—all in English—were selected, representing 30 different studies (Fig. 1). Table 1 summarizes their characteristics and main results. Studies were categorized according to the focus of transition (admission, discharge or both). Discharge studies were further categorized according to the beneficiary of the intervention (HCP, patient or both) and the moment of intervention (intervention provided before and/or after discharge). Fourteen studies had a quality score ≥3/5 (Appendix Table 1) and are discussed below.

Interventions focusing on admission

Two studies evaluated the impact of medication histories conducted by pharmacists, and one met the quality criteria. This large Canadian study evaluated the impact of medication histories conducted by pharmacists (including, if needed, a contact with the general practitioner (GP) and the community pharmacist) compared with histories conducted by nurses. The authors [18] found a significant decrease in postoperative medication discrepancies that had a potential of causing possible or probable harm but their impact on clinical outcomes was not evaluated.

Interventions focusing on discharge

Communication of discharge information to primary care providers. Five studies were identified, and two met the quality criteria.

One Canadian study evaluated the impact of sending a medication discharge plan to the community pharmacist and the GP. The authors [19] found no difference in the rate of medication discrepancies. However, the control group
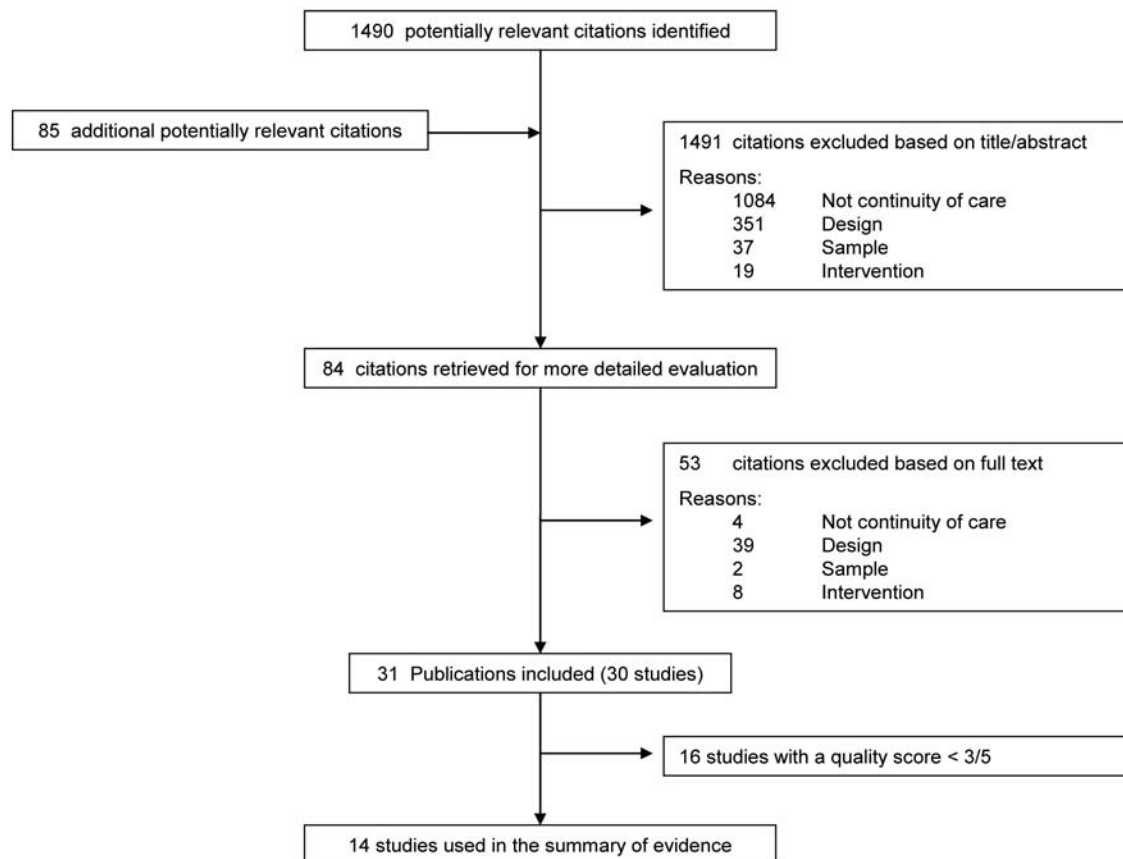
Figure 1 Flowchart of the study selection process.

received routine pharmaceutical care as provided in Canadian hospitals, including medication history taking on admission and discharge counseling (the latter was provided to 79% of intervention patients and 66% of control patients), and this— together with the small sample size ($n = 83$)—could have diluted the effect of the intervention.

Chen et al. [20] examined the effectiveness of delivering computer-generated discharge summaries to the GP by email, fax, post or patient hand delivery. They found that receipt of discharge summaries was higher with fax or email than with post or patient hand delivery. More than a quarter of the randomly assigned group was lost to the follow-up due to incorrect or unavailable GP contact details.

Patient education and counseling before discharge. Four of the six studies that evaluated the impact of educating patients before discharge from hospital were selected after quality appraisal.

A small trial with elderly patients discharged from emergency departments (EDs) reported greater knowledge of medication for patients receiving discharge instructions specifically designed for elderly people compared with usual discharge instructions [21]. Medication adherence was not evaluated and the sample consisted of voluntary elderly people who were taking few medications. This limits the validity and generalizability of the results.

Voirol et al. [22] found mixed results of the effect of a proactive discharge program for caregivers of pediatric

patients on the capabilities of caregivers to manage medications. The baseline level of discharge management was high (86% of caregivers in the control group stated that they received information on medications before discharge), and there was insufficient power to detect significant differences.

Manning et al. [23] evaluated the effect of a redesigned patient education discharge tool with durable display in patients discharged home with at least three medications. They reported greater understanding of prescribed medications, but there was no significant difference in self-reported medication errors and patient satisfaction. Limitations included a high dropout rate (48%) and a lack of data on the validity of the measures used.

Finally, a study with geriatric patients found mixed results of the effect of patient counseling associated with a self-administration program, when compared with administration by a nurse, on compliance and medication knowledge after discharge [24].

Patient education and counseling before and after discharge. Three studies evaluated the effect of patient and counseling after discharge, but none met the quality criteria. In contrast, the two studies where this intervention was provided before as well as after discharge were selected after quality appraisal.

A Spanish study evaluated the effect of a 1-year pharmaceutical care program involving discharge counseling and post-discharge telephone calls in patients admitted for heart

Table 1 Characteristics and main results of included studies ($n = 30$)

Study	Design	Participants and setting	Intervention	Control	Follow-up	Outcome measures and results	QS
A. Interventions focusing on admission							
Nester et al. [44]	CT	100 patients admitted to a tertiary-care referral hospital, USA	Structured pharmacist medication history	Nurse-conducted medication histories	Hospital stay	P: more clinical interventions performed by pharmacists ($P < 0.001$); more patients indentified as taking herbal preparations, non prescription medications ($P < 0.001$)	2
Kwan et al. [18]	RCT	464 patients with preadmission clinic appointment before surgical procedures in one tertiary-care teaching hospital, Canada	Structured pharmacist medication history interview and generation of a post-operative medication order form	Nurse-conducted medication histories and surgeon-generated medication orders	Post-operative period	P: less patients with ≥ 1 post-operative medication discrepancy related to home medications ($P < 0.001$), including for discrepancies with the potential to cause harm ($P < 0.001$)	4[a]
B. Interventions focusing on discharge							
1. Communication of discharge information to primary care providers							
Kunz et al. [45]	Cluster RCT	178 primary care practices, patients prescribed new medications at discharge, Germany	One-sentence evidence summaries appended to discharge letters for GPs	Discharge letter without evidence summary	≥ 100 days	P: decrease in non adherence to discharge medication ($P = 0.039$) H: most GPs enthusiastic but few felt the summary provided new information	2
Duggan et al. [46]	CT	501 general medical patients in one teaching hospital, UK	Copy of the discharge drug information given to patient for community pharmacist	Usual care: no letter for community pharmacist	10 weeks	P: lower rate of unintentional drug discrepancies ($P < 0.001$), including discrepancies with a definite adverse effect ($P < 0.01$)	0
Gutschi et al. [47]	RCT	135 post-cardiac surgery patients at a University Institute, Canada	Discharge letter given to patient for community pharmacist $\pm$ GP	Hospital pharmacist counseling	3 months	P: NS difference in pneumococcal or influenza vaccination rates 3 months after discharge	0
Lalonde et al. [19]	RCT	83 patients discharged from a geriatric, family medicine or psychiatric ward (urban hospital) with	Medication discharge plan (MDP) sent to community pharmacist and GP	Routine pharmaceutical care; MDP completed but not given to patients, GP	1 week	P: NS difference in the rate of medication discrepancies	3[a]

		≥2 treatment changes, Canada		and community pharmacist			
Chen et al. [20]	RCT	168 patients discharged from an acute geriatric ward of a teaching hospital, Australia	Discharge summary for GP sent by email, by post or given to patient	Discharge summary sent by fax	1 week	P: receipt rates for email and fax significantly higher than for post and patient hand delivery	3[a]

2.1. Patient education and counseling before discharge

Hayes et al. [21]	RCT	60 elderly patients discharged home from three rural ED, USA	Individualized computer-generated discharge instructions designed within a geragogy framework	Usual preprinted discharge instructions with handwritten medication information	2–3 days	P: greater knowledge of medication ($P = 0.016$)	5[a]
Al Rashed et al. [48]	Cluster RCT	83 elderly patients on two care of the elderly wards and discharged home on ≥4 drugs, with medication problems, UK	Pre-discharge pharmaceutical counseling	Usual care: medication and discharge summary, and explanations by a nurse	3 months	P: better medication knowledge ($P < 0.01$) and compliance ($P < 0.001$) C: fewer unplanned visits to GP and hospital re-admissions ($P < 0.05$)	1
Voirol et al. [22]	RCT	291 patients admitted to a general academic pediatric ward and discharged on ≥1 new medication, USA	Proactive program of discharge planning by the pharmacy team	Usual care (assistance from the pharmacy team only upon request)	Median 12 days	P: increased caregivers' probability to obtain prescribed medications within 24 h ($P = 0.027$; but NS in the MV model); NS difference in caregivers' knowledge of how to correctly administer medications	4[a]
Manning et al. [23]	RCT	337 patients discharged home from four medical units in a teaching hospital with >3 medications, USA	3D: durable display at discharge	Medication list and schedule generated electronically by the nurse and given to the patient	7–14 days	P: greater understanding of prescribed medication ($P = 0.03$) C: NS difference in self-reported medication errors H: NS difference in patient satisfaction	3[a]
Lowe et al. [49]	Cluster RCT	88 patients discharged home from two pairs of medical wards at a general hospital, UK	Hospital self-medication program	Discharge information given by a nurse	10 days	P: better compliance score ($P < 0.02$) and knowledge of the purpose of their medicines ($P < 0.001$)	2
Pereles et al. [24]	RCT	107 patients admitted to geriatric assessment and rehabilitation program in	Three-stage self-medication program	Standard care: medications administered by the nursing staff	40 days	P: NS difference in ability to self-medicate and medication knowledge, better medication	3[a]

(continued)

Continuity of care in medication management

Table 1 Continued

Study	Design	Participants and setting	Intervention	Control	Follow-up	Outcome measures and results	QS
		two geriatric units and discharged home, Canada				compliance 1 month after discharge ($P < 0.001$) H: NS difference in morale score	

2.2. Patient education and counseling AFTER discharge

Study	Design	Participants and setting	Intervention	Control	Follow-up	Outcome measures and results	QS
Dunn et al. [50]	RCT	204 patients discharged from a geriatric hospital to their homes, UK	Home visit by a health visitor 3 days after discharge to evaluate and improve medication management	Normal post-discharge care (no visit)	28 days	P: less tendency to start drugs C: Increased rate of re-admission or transfer to a nursing or residential home; no difference in survival, cognitive and physical function, services requested and supplied	1
Dudas et al. [51]	RCT	221 medical inpatients discharged home with pharmacy-facilitated discharge; one service, one teaching hospital, USA	Follow-up phone call by a pharmacist 2 days after discharge	Usual care (pharmacy-facilitated discharge) – no phone call	30 days	H: more patients satisfied with medication discharge instructions 15 days after discharge ($P = 0.007$) C: decreased rate of visits to ED ($P = 0.005$) and hospital re-admission ($P = 0.07$) 30 days after discharge E: total cost savings $11 910 P: resolution of medication-related problems	0
Vuong et al. [52]	RCT	316 patients ≥55 years discharged home from two acute-care tertiary teaching hospitals at risk of drug-related problems, Australia	Home visit from a community liaison pharmacist within 5 days after discharge (+report to GP and community pharmacist)	Standard care (discharge counseling, compliance aids and communication with primary healthcare providers when necessary)	8–12 weeks	P: NS difference in number of medications taken ($P = 0.662$); better self-perceived medication understanding ($P < 0.001$); improvements in adherence in both groups ($P = 0.028$)	2

2.3. Patient education and counseling BEFORE and AFTER discharge

Study	Design	Participants and setting	Intervention	Control	Follow-up	Outcome measures and results	QS
Cabezas et al. [25]	RCT	134 patients admitted for heart failure in two	Pharmaceutical care: discharge counseling +	Usual care	1 year	C: fewer hospital re-admissions and days in	4[a]

		hospitals and discharged home, Spain	post-discharge telephone calls (monthly for 6 months then every 2 months for 6 months)			hospital (significant at 2 and 6 months, NS at 12 months), fewer deaths (P = 0.017) P: better patient compliance E: saving in hospital costs 578€/patient H: no difference in quality of life, higher patient satisfaction (P = 0.026)	
Schnipper et al. [26]	RCT	178 patients discharged home from a general medicine service at a large teaching hospital, USA	Pharmacist: medication review, patient counseling at discharge and follow-up telephone call 3–5 days later (+communication to GP)	Usual care: routine review of medication orders by a ward-based pharmacist and medication counseling by a nurse	30 days	C: lower rate of preventable ADEs (P = 0.01) and of preventable, medication-related ED visits or hospital re-admission (P = 0.03); NS difference in total ADEs, health-care utilization P: NS difference in medication adherence H: NS difference in patient satisfaction	3[a]
3.1. Interventions targeting both patients and primary care providers, provided BEFORE discharge							
Smith et al. [53]	RCT	66 elderly patients discharged home from one hospital, likely to experience difficulties with their medication, UK	Normal discharge information + verbal and written counseling by pharmacist + instruction to show to doctor and pharmacist.	Normal discharge information	7–10 days	P: better compliance (P < 0.01); less patients with therapeutic management not maintained after discharge (75 vs 96%)	1
Shaw et al. [54]	RCT	97 patients from two adult and one care of the elderly acute admission wards at one psychiatric hospital, UK	Pharmacy discharge planning, patient education, discharge plan sent to community pharmacist	Usual care	12 weeks	C: NS decrease in hospital re-admission (P = 0.065); P: NS difference in medication knowledge; fewer medication problems and non-compliance	2
3.2. Interventions targeting both patients and primary care providers, provided AFTER discharge							
Hugtenburg et al. [55]	Cluster CT	715 patients registered in 37 community pharmacies, discharged from hospital to the community, using	Comprehensive pharmaceutical care at discharge: medication review and reconciliation, home	Usual care	9 months	P: more changes in drug therapy C: no difference in mortality E: reduced medication	1

(continued)

Table I Continued

Study	Design	Participants and setting	Intervention	Control	Follow-up	Outcome measures and results	QS
		≥5 prescribed medicines, The Netherlands	visit, medication scheme, GP informed			costs H: increased patient satisfaction about drug counselling ($P < 0.001$)	

3.3. Interventions targeting both patients and primary care providers, provided BEFORE and AFTER discharge

Study	Design	Participants and setting	Intervention	Control	Follow-up	Outcome measures and results	QS
Nazareth et al. [27]	RCT	362 patients ≥75 years discharged from three acute general and one long-stay hospital on ≥4 medicines, UK	Pharmaceutical discharge plan by a hospital pharmacist, given to patient, caregivers and professionals; home visit by a community pharmacist 1–2 weeks after discharge	Usual care: discharge letter to the GP listing current medications	6 months	C: NS difference in hospital re-admission 3 and 6 months after discharge, mortality, care utilization P: NS difference in medication knowledge and adherence H: NS difference in patient general well-being and satisfaction	3[a]
Crotty et al. [28]	RCT	110 older inpatients (3 metropolitan hospitals) awaiting transfer to a long-term care facility, Australia	Medication management transfer summary for GP and community pharmacist, medication review by community pharmacist and multidisciplinary case conferences	Usual care: standard hospital discharge summary	8 weeks	P: lower scores of inappropriate prescribing (MAI) at the follow-up ($P = 0.007$); C: better pain control ($P = 0.023$) and lower hospital use ($P = 0.035$); NS difference in ADEs, falls/mobility, behavior/cognition	3[a]
Jack et al. [29]	RCT	749 medical patients admitted to a medical teaching service and discharged to the community, USA	Patient education and comprehensive discharge planning by a discharge nurse, summaries faxed to PCP, post-discharge telephone reinforcement 2–4 days after discharge by a clinical pharmacist	Usual care	30 days	C: lower rate of hospital utilization 30 days after discharge ($P = 0.009$) and higher rate of primary care follow-up visits ($P < 0.001$) P: better self-reported preparedness for discharge ($P = 0.013$) E: 33.9% lower observed cost ($412)	3[a]
Walker et al. [30]	(Q)RCT	724 medical patients discharged home and at high-risk for	Pharmacist: medication therapy assessment and reconciliation, evaluation of	Usual care: discharge instruction, medication information, printed	30 days	C: NS difference in re-admission and ED visits at 14 and 30 days	4[a]

			medication-related problems, USA	adherence, patient counseling and education, post-discharge telephone follow-up	medication list and post-discharge telephone call by a nurse		P: less discrepancies between admission and discharge medications (P < 0.001)	
C. Interventions focusing on both admission and discharge								
Stowasser et al. [56]	RCT	240 patients admitted to eight acute wards and one orthopedic preadmission clinic at two hospitals, discharged to the community, Australia	Drug history by a clinical pharmacist on admission (+confirmation by GP and community pharmacist) + discharge plan communicated to GP and community pharmacist	Clinical pharmacist: medication history on admission; standard discharge summary (routine clinical pharmacy service)	30 days		P: more clinical pharmacy interventions and changes in drug therapy (P < 0.05) C: NS effect on length of stay, mortality, re-admission (P = 0.055); fewer HCP visits per patient (P < 0.05) H: NS difference in change of functional health status	2
Bolas et al. [57]	RCT	243 medical inpatients ≥55 years, taking ≥3 regular drugs, discharged to the community, Northern Ireland	Comprehensive drug history on admission, discharge counseling, and information to GP and community pharmacist	Standard clinical pharmacy service (no discharge counseling)	3 months		P: less discrepancies between discharge prescription and home medication (significant for drug names and dosage frequencies) P: better knowledge of drug therapy (P < 0.001)	1
Computer-based interventions								
Smith et al. [58]	Cluster RCT	348 inpatients of an acute medical service of a university-affiliated medical centre, USA	Computer-generated drug list to cancel or renew previous outpatients prescriptions, or to prescribe new medications	No canceling outpatient drugs; writing all medications on individual prescriptions	Hospital stay		P: fewer prescriptions on admission and at discharge, but NS difference in the increase from admission to discharge (P = 0.87)	2
Vanderkam et al. [59]	Prospective cohort	139 patients admitted in one hospital and cared for by a participating GP, The Netherlands	Electronic communication between GP and local pharmacy to transfer data about prescriptions	Paper-based communication	10 days		P: better agreement between the GP and community pharmacist on current medication of the patient, but insufficient	0

(continued)

Table 1 Continued

Study	Design	Participants and setting	Intervention	Control	Follow-up	Outcome measures and results	QS
Schnipper *et al.* [31]	Cluster RCT	322 general medical inpatients (14 medical teams, two academic hospitals), USA	Computerized medication reconciliation tool and process redesign involving physicians, nurses and pharmacists and supported by IT	Usual care	30 days	P: significantly lower rate of unintentional discrepancies between preadmission medications and admission or discharge medications that had potential for harm; C: NS decrease in hospital re-admission or ED visit	4[a]

ADE, adverse drug event; C, clinical outcome measure; CT, controlled trial; E, economic outcome measure; ED, emergency department; GP, general practitioner; H, humanistic outcome measure; IT, information technology; MAI, medication appropriateness index; MV, multivariate; NS, no significant; P, process outcome measure; PCP, primary care provider; QS, quality score (/5); (Q)RCT, (quasi)randomized controlled trial.

[a]Publication selected for the synthesis of evidence (QS ≥ 3/5).

failure and discharged home [25]. They found fewer hospital re-admissions at 2-, 6- and 12-month post-discharge (self-calculated numbers needed to treat (NNTs) were at Month 2: 7.3; at Month 6: 5.6; adjusted hazard ratio at Month 12: 0.56 (0.32–0.90)), and significantly fewer deaths. In addition, significant differences in patient adherence and satisfaction were found, but there was no difference in quality of life. The study population had a low educational level, and care-giver involvement was therefore essential. Because these patients potentially consult more easily EDs, the effect on re-admissions cannot be generalized to a population with a higher educational level.

A trial performed in a large US teaching hospital evaluated the impact of pharmacists providing patient counseling at discharge and 3–5 days post-discharge [26]. Patients took a median number of eight medications. The researchers found a significant reduction in the rate of preventable ADEs (un-adjusted odds ratio (OR) 0.10, 95% confidence interval (CI) 0.013–0.86, self-calculated NNT = 10) and in the rate of preventable medication-related visits to the ED or hospital re-admissions (self-calculated NNT = 14). This was observed despite a high rate of discrepancies in both groups between the discharge medication regimens and self-reported medications 30 days after discharge. There was no difference for the other secondary outcomes such as total ADEs, healthcare utilization, medication adherence and patient satisfaction.

Interventions targeting both patients and primary care providers. In the four controlled trials reported below, interventions were provided before and after discharge, and their impact was evaluated on outcome measures in addition to process measures [27–30]. These four trials met the predefined quality criteria.

A trial performed in the UK with elderly patients found no impact of a comprehensive and time-consuming intervention (involving pharmaceutical discharge planning, communication with carers and HCPs and home visit by a community pharmacist) on hospital re-admission (primary outcome measure), mortality, care utilization, medication knowledge and adherence, patient general well-being and satisfaction [27]. The authors provide limited explanation for the absence of impact.

An Australian study focused on elderly patients discharged to a long-term care setting, and evaluated the effect of a pharmacist transition coordinator [28]. Multidisciplinary case conferences after discharge were part of the intervention but took place in only 14.3% of intervention patients. Despite this, the authors found significant improvements in appropriateness of prescribing (primary outcome measure), as well as in pain control and hospital use (ED visits and re-admissions). The study was, however, underpowered to detect differences in secondary outcomes. No significant differences were found in ADEs, falls and mobility, behavior and cognition.

A large US study evaluated the impact of a multilevel and multidisciplinary intervention [29]. The research staff was blinded to treatment allocation. The authors found significantly lower rates of hospital utilization 30 days after discharge and less primary care follow-up visits (self-calculated NNT = 5.6), better self-reported preparedness for discharge and lower costs. The intervention was most effective in the subgroup of patients with a hospital admission in the previous 6 months.

Finally, another large US study found no effect of a pharmacy-facilitated discharge program on hospital re-admission 14 and 30 days after discharge and on ED visit, despite lower rates of medication discrepancies in the intervention group [30]. Among the subjects who received a post-discharge telephone call (43 and 30% of intervention and of control patients, respectively), intervention patients had an adjusted OR of 0.46 of being re-admitted to the hospital within 14 days compared with controls ($P = 0.03$).

Interventions focusing on both admission and discharge

One of the five studies that focused on both admission and discharge was selected after quality appraisal.

Schnipper *et al.* [31] evaluated the effect of a computerized medication reconciliation tool and process redesign involving physicians, pharmacists and nurses in two hospitals. The NNT to prevent one unintentional discrepancy that had potential for harm (potential ADE (PADE)) was 2.6. The CI was wide and close to non-significance. Subgroup analyses showed that the effect was greater in patients at higher risk, that the reduction in PADE was significant at discharge but not on admission, and that the intervention was effective in one hospital only. The two hospitals differed in the extent of the integration of the medication reconciliation tool into computerized provider order entry applications at discharge. Due to insufficient power, no significant differences in healthcare use could be demonstrated despite a slightly lower rate of hospital re-admission or ED visits in the intervention group.

Discussion

Various approaches targeting admission or discharge, patients and/or HCPs, have been tested. The majority of studies reported improvements in process measures of continuity of care such as medication discrepancies. Patient education and counseling provided upon discharge and reinforced after discharge—sometimes together with improved communication with HCPs—was shown to reduce the risk of ADEs and hospital re-admissions in some studies, but not all. Heterogeneity in study population, intervention and outcome reporting precluded meta-analysis and limited interpretation.

Only 14 of 30 studies were of sufficient quality for inclusion in the synthesis of evidence. Items most often rated as negative were sample size, blinding and confounders. Furthermore, the 14 remaining studies frequently had methodological problems and several of them were underpowered to detect significant improvements in clinical outcomes. A minority (30%) of studies were multicentered, and these generally involved no more than three hospitals. This limits the generalizability of the findings. Previous systematic reviews dealing with continuity of care also highlighted the low methodological quality of the studies included [10, 11, 17, 32]. Importantly, this paucity of high-quality research remains disproportionate to the magnitude of the problem of discontinuity of care [2].

All studies used process measures of evaluation such as medication discrepancies, treatment knowledge or quality of prescribing. Process measures are particularly well suited for measuring continuity of care [33], but the measures used in the studies included were heterogeneous. Medication discrepancy is probably the most sensitive measure relative to continuity of care in medication management. Ideally, this should be measured using a validated instrument, and the researchers should report unintentional and intentional discrepancies separately, together with the causes of these discrepancies. The Medication Discrepancy tool, for example, enables this [34], but was not used in the studies evaluated in our systematic review.

Several studies, but not all, reported a positive impact on important outcome measures such as ADEs and re-admissions [26, 28, 29]. Unfortunately, many studies lacked power to detect significant differences on such outcomes. Among studies that reported humanistic outcome measures, very few found positive significant findings. These measures were never primary outcome measures, and there were many potential confounders. No conclusion can therefore be drawn on this point. Economic measures were reported in only two studies [25, 29], and the economic analysis suffered from important methodological limitations. In line with the results of a related review [35], it is not possible to draw robust conclusions on the cost-effectiveness of approaches for improvement.

Most studies included patients discharged from the hospital irrespective of the presence of risk factors for experiencing problems during transition. Furthermore, even in some studies that aimed to select patients at risk, the selection criteria might have been too broad [36]. The goal of risk identification is to ensure that those patients who will most likely benefit from the service are identified, thereby enhancing the cost-effectiveness of interventions [2]. From our review, and in line with previous reviews, this is still not the case [30]. Studies commonly excluded vulnerable patients, including those with language difficulties, unable to communicate, cognitively impaired or discharged from psychiatric wards. Furthermore, there are limited data on patients transferred to post-acute-care settings or newly transferred to long-term care, while these are increasingly frequent situations [28]. These transitions carry a high risk of problems, because previous medical records are not available and patients' GPs might not practice in these settings [33].

Only a limited number of studies investigated the effect of information technology (IT) interventions, although this is considered to be a key element in facilitating the transfer of information across settings [2]. Several observational studies have reported positive effects of IT approaches on process measures [32, 37]. However, even though many hospitals and GPs have access to an electronic health information system, few have a system with a connection beyond their own setting [33]. A recent review found that IT has been used to facilitate medication reconciliation activities, mainly to obtain medication information, and that promising applications are being developed to support the entire medication reconciliation process [38].

This systematic review has several limitations. First, the lack of structured thesauri (MeSH and EMTREE) specific to the problematic of continuity of care has made effective retrieval of all pertinent publications uncertain. However, comparison with a recent systematic review of interventions to reduce 30-day re-admission confirms that our search was extensive. In fact, several good quality studies included in the present review were not identified by the authors of this recent review, although they fitted their inclusion criteria [39]. Secondly, the search was done until the end of 2010, and our review, therefore, does not include more recent publications. This, however, does not invalidate our findings, as other recent studies and reviews related to similar topics have come to similar conclusions. These are that (i) various interventions improve process measures such as medication discrepancies, but the effect on clinical outcomes such as ADEs and medication errors is inconsistent; (ii) it is important to target patients at greatest risk of adverse outcomes and (iii) rigorously designed studies are scarce [40]. Thirdly, the selection process excluded experimental studies focusing on continuity of care where we could not specifically analyze the impact on the medication component. We also excluded medication-specific interventions in which the continuity of care component could not be evaluated separately. Several large-scale studies had to be excluded on this basis [41, 42]. Fourthly, we used only studies published since 1995. However, specific research on continuity of care in medication management is a recent domain, making unlikely for relevant studies to be published at an earlier date. Fifthly, we applied language exclusions, which may have precluded the identification of studies performed in many countries. However, one could expect that such studies—if they met minimum quality standards—would have been published in English. Finally, our review looked at studies from different countries and different periods of time, which limits generalizability of study findings. Differences in patient safety culture or access to medication information across countries, as well as improvements in usual care over time secondary to local or national campaigns, might have an effect on the success of implementation efforts [40, 43].

Conclusions

Despite the fact that medication-related discontinuity of care is an important public health issue, the evidence on the effect of approaches for optimization remains limited. Patient education and counseling that is provided upon discharge and reinforced after discharge—sometimes together with improved communication with HCPs—has been shown to reduce the risk of ADEs and hospital re-admissions in some studies but not all. Further research should better target high-risk populations, use multicentered designs and have adequate sample size to evaluate the impact on process measures (and preferably medication discrepancies), clinical outcomes (such as preventable ADEs and hospital re-admissions) as well as cost-effectiveness. Whenever possible, such studies should fit within or inspire initiatives that are promoted at the regional or national levels and carefully consider the key success factors.

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Conflict of Interest statement

None declared.

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Appendix 1 Quality rating

Study	Randomisation	Blinding	Sample size	Statistics	Confounders	Total score
Al-Rashed 2002	1	0	0	0	0	1
Bolas 2004	1	0	0	0	0	1
Cabezas 2006	1	0	1	1	1	4
Chen 2010	1	1	1	0	0	3
Crotty 2004	1	1	0	1	0	3
Dudas 2001	0	0	0	0	0	0
Duggan 1998	0	0	0	0	0	0
Dunn 1995	0	0	1	0	0	1
Gutschi 1998	0	0	0	0	0	0
Hayes 1998	1	1	1	1	1	5
Hugtenburg 2009	0	0	0	1	0	1
Jack 2009	1	1	0	1	0	3
Kunz 2007	1	0	0	0	1	2

(continued)

Continued

Study	Randomisation	Blinding	Sample size	Statistics	Confounders	Total score
Kwam 2007	1	0	1	1	1	4
Lalonde 2008	1	0	1	1	0	3
Lowe 1995	1	0	0	1	0	2
Manning 2007	1	1	0	1	0	3
Nazareth 2001	1	1	0	1	0	3
Nester 2002	1	0	0	1	0	2
Pereles 1996	0	0	1	1	1	3
Schnipper 2006	1	1	0	1	0	3
Schnipper 2009	1	1	0	1	1	4
Shaw 2000	1	0	0	1	0	2
Smith 1997	0	1	0	0	0	1
Smith 1996	1	0	0	1	0	2
Stowasser 2002	1	0	0	1	0	2
Vanderkam 2001	0	0	0	0	0	0
Voirol 2004	1	1	0	1	1	4
Vuong 2008	1	0	0	1	0	2
Walker 2009	1	0	1	1	1	4

Scoring rules

– Randomization: 1 if allocation of patients was randomized; 0 if allocation was not at random, or if question not relevant:
– Blinding: 1 if the evaluation of outcome measures was blinded (or more); 0 if evaluation of outcome measures was open:
– Sample size: 1 if sample size was calculated a priori and reached; 0 if no sample size calculation was reported, or if the minimum sample calculated a priori was not reached:
– Statistics: 1 if statistical tests used to assess the main outcomes appropriate and confidence interval reported; 0 if not appropriate:
– Confounders: 1 if confounders addressed and correction made when necessary; 0 if potential confounders not addressed, or addressed but without adjustment when confounding present: