Introduction: Transition of care from hospital to primary care has been associated with increased medication errors. This review article aims to examine the existing evidence on interventions to reduce medication discrepancies or errors in primary or ambulatory care setting during care transition from hospital to primary care. Methods: We systematically reviewed the articles in primary or ambulatory care setting on patients with care transition that involved medication safety, discrepancy, or error as outcome assessment. Primary research articles were selected. Interventions in nursing homes or long-term care facilities were excluded from the review. Results: We found 6 articles that met the inclusion criteria and 4 are prospective cohort study. The key players were pharmacists, nurse, and primary care physician. The interventions included care communication, medication reconciliation or review, and clarifying medication-related problems. Conclusion: There is evidence that interventions in primary care setting reduce medication discrepancies on patients with the transition of care from hospital to primary care setting. Only one randomized trial involving pharmacist-led medication reconciliation was done in an outpatient setting. More good-quality randomized controlled trials should be carried out to confirm the evidence.

Keywords: Medication discrepancies, medication errors, primary care, transition of care

A review on interventions to reduce medication discrepancies or errors in primary or ambulatory care setting during care transition from hospital to primary care

Kok Wai Kee¹, Cheryl Wai Teng Char², Anthony Yew Fei Yip²

¹National Healthcare Group Polyclinics, ²National Healthcare Group Pharmacy, Singapore

Abstract

Introduction: Transition of care from hospital to primary care has been associated with increased medication errors. This review article aims to examine the existing evidence on interventions to reduce medication discrepancies or errors in primary or ambulatory care setting during care transition from hospital to primary care. Methods: We systematically reviewed the articles in primary or ambulatory care setting on patients with care transition that involved medication safety, discrepancy, or error as outcome assessment. Primary research articles were selected. Interventions in nursing homes or long-term care facilities were excluded from the review. Results: We found 6 articles that met the inclusion criteria and 4 are prospective cohort study. The key players were pharmacists, nurse, and primary care physician. The interventions included care communication, medication reconciliation or review, and clarifying medication-related problems. Conclusion: There is evidence that interventions in primary care setting reduce medication discrepancies on patients with the transition of care from hospital to primary care setting. Only one randomized trial involving pharmacist-led medication reconciliation was done in an outpatient setting. More good-quality randomized controlled trials should be carried out to confirm the evidence.

Keywords: Medication discrepancies, medication errors, primary care, transition of care
patient’s self-reported intake of medications and medication history. Among the hospitalized elderly in a local study, the authors found that 23.3% had at least one actual unintentional medication discrepancy on discharge.\[6\]

Various interventions have been investigated to reduce the medication error or discrepancies during transition of care from one health-care institution to another. Intervention in the inpatient setting has been well investigated with electronic medication reconciliation, structured communication, and multidisciplinary team interventions were shown to be helpful in reducing errors.\[7,8\] However, there is relatively sparse evidence on intervention in the primary care. This review article aims to examine the existing evidence on interventions to reduce medication discrepancies or errors in primary or ambulatory care setting during care transition from hospital to primary care.

**Methods**

A PubMed and Embase search was done in January 2017 to identify suitable articles published from January 1, 1980 to December 31, 2016. The literature search strategy used was “[transition of care] AND [medication safety] OR [medication discrepancy] OR [medication error] AND [ambulatory care] OR [primary care].” Primary research articles in primary or ambulatory care setting on patients with care transition were included for review. Figure 1 illustrated the process of study selection in a flowchart.

Articles with medication safety, discrepancy, or error as outcome assessment were selected. Hand searches through reference lists of key articles were also undertaken. Full text from those abstracts that were considered relevant was assessed independently by two reviewers for their suitability for inclusion and any differences between the two reviewers were resolved by discussion with a third reviewer. Articles that involved interventions used in the nursing home or long-term care facilities were excluded.

Grading of level of evidence and strength of recommendation was done for the selected articles based on strength of recommendation taxonomy (SORT).\[9\] Levels of evidence from 1 to 3 for individual studies are used in SORT, where level 1 refers to good quality patient-oriented evidence; level 2 refers to limited quality patient-orientated evidence; and level 3 refers to other evidence such as consensus guidelines, extrapolations from bench research, usual practice, opinion, disease-oriented evidence (intermediate or physiologic outcomes only), or case series for studies of diagnosis, treatment, prevention, or screening.\[9\] The study characteristics and level of evidence of the included studies are shown in Table 1.

**Results**

**Search and study characteristics**

A total of 300 titles were identified at the initial electronic search, which subsequently yielded 23 potentially relevant articles after screening the titles and abstracts. Further assessment of the full text of these studies and hand searches led to a total of six primary research articles that fit the inclusion criteria for the review. Seventeen articles were excluded after screening the full text. Figure 1 described the steps involved in the search and selection process.

Table 1 outlined the key characteristics of the individual studies. This includes the first author, year the study was published, type of study, location of the study conducted, and level of evidence by SORT.\[9\]

**Study validity**

There was no published high-quality randomized controlled trial in primary care setting looking at the outcome of reducing medication errors or discrepancies for patients with care transition. Most of the studies included in this review are prospective cohort studies [Table 1]. The baseline characteristics and inclusion of all studies were clearly described. Exclusion criterion was not stated in one of the studies.\[10\] The sample size calculation was clearly described only in one of the studies.\[10\] Most of the studies are level 2 evidence by SORT.

Table 2 summarized the inclusion and exclusion criteria of the included studies. Three studies included patients aged 50 years or older and another three included all patients aged 18 years or older. Number of medications was considered as an inclusion criterion for 2 studies. The diagnosis on discharge was considered as an inclusion criterion for 3 studies.
who were unable to speak or understand English were excluded in 4 studies. The other details of the exclusion criteria were shown in Table 2.

### Intervention

The key player for the intervention is mainly the pharmacist who provides phone interview follow-up, home visit, or clinic-based consultation service. There is only one study where primary care physician contacted the patient for intervention. The consideration for patient selection included number of medication, age, and selected chronic disease diagnoses. The details of the interventions included care communication, medication reconciliation or review, and clarifying medication-related problems. These interventions were done through phone interviews, home visits, and face-to-face consultations in the clinic [Table 3].

### Study result

There was increased medication discrepancies identification or resolution in all the studies included in this review despite that the key player of the interventions was different. The presence of medication discrepancies among patients discharged from the hospital can be alarming, with studies showing 81%–94% of the patients in the intervention arm had at least one identified medication discrepancy. The factors or types of discrepancies were stated in 3 studies, where patient-level factors were the most common for 2 studies and system level factor was the most common for another study. The details of the results of the included studies are summarized in Table 4.

This review focused on intervention with aims of improving medication safety or reducing medication discrepancies or errors, hence the outcomes are not heterogeneous. However, one study also looked at the outcome on rehospitalization and emergency

| Reference | First author (year of publication) | Type of study | Location | Level of evidence by SORT |
|-----------|-----------------------------------|---------------|----------|--------------------------|
| (11)      | Setter et al. (2009)              | Prospective cohort study | Washington, US | 2                        |
| (15)      | Corbett et al. (2010)             | Unblinded randomized controlled trial | Inland Northwest, US | 2                        |
| (14)      | Lindquist et al. (2013)           | Prospective cohort study | Chicago, US | 2                        |
| (12)      | Hawes et al. (2014)               | Prospective, randomized, open-label, pilot study | North Carolina, US | 2                        |
| (10)      | Barker et al. (2016)              | Prospective cohort study | Massachusetts, US | 2                        |
| (13)      | Armor et al. (2016)               | Retrospective, Observational pilot study | Oklahoma, US | 3                        |

### Table 2: The inclusion and exclusion criteria of the included studies

| Study reference | First author (year of publication) | Patient cohort included (number of intervention subject) | Exclusion criteria |
|-----------------|-----------------------------------|------------------------------------------------------|-------------------|
| (11)            | Setter et al. (2009)              | 50 years or older, transitioning from hospital to home care, and had been diagnosed with at least one of the stated diseases, namely congestive heart failure, myocardial infarction, coronary artery disease, cardiac arrhythmia, diabetes mellitus, cerebrovascular accident, chronic obstructive pulmonary disease, peripheral vascular disease, and major orthopaedic surgery or fracture (n=110) | Impaired cognitive status (failing the MiniCog test), did not speak English, or did not receive skilled nursing services from the VNA - visiting Nurse Association |
| (15)            | Corbett et al. (2010)             | 50 years and older, were referred for home care services following hospital discharge, with at least 1 of the following diagnoses, namely cardiovascular conditions (congestive heart failure, myocardial infarction, coronary artery disease, cardiac arrhythmia), peripheral vascular disease, diabetes mellitus, cerebral vascular accident, chronic obstructive pulmonary disease (n=101) | Known terminal illness documented in medical record with life expectancy 6 months or less, unable to speak or understand English, not anticipated to receive skilled home nursing services |
| (14)            | Lindquist et al. (2013)           | 18 years and older admitted to adult medicine unit, being discharged to home, with 5 or more outpatient medications prior to hospitalisation. The patients recruited had primary care physicians from practices in the Research and education for Academic Achievement Practice-Based Research Network (n=27) | Unable to provide consent, severely vision impaired, reliant on caregiver or home aide services 8 hours or more per day, enrolled in hospice, unable to speak English or Spanish |
| (12)            | Hawes et al. (2014)               | 18 years and older, with 8 or more scheduled medications anticipated at discharge. During first year of recruitment, reason for admission (heart failure, chronic obstructive pulmonary disease, hyperglycemic crisis, stroke, Non ST elevation myocardial infarction and unstable angina) and number of hospitalisation (more than 3 in the past 5 years) were used as criteria in addition to number of medication (n=24) | Unable to communicate in English, absence of transportation to facilitate follow up visit, no telephone access, decisionally impaired, incarceration, not discharge to home or receiving care from a primary care physician |
| (10)            | Barker et al. (2016)              | Patients aged 50 or more and new to a primary care practice (n=103) | Not stated |
| (13)            | Armor et al. (2016)               | 18 years and older, discharged from hospital to family medicine center for follow up (n=43) | Pregnancy |
Department visit, which showed a significant reduction in the composite end point.\(^{[12]}\)

**Discussion**

**Key player and method of intervention**

This review indicated that considerable work can be executed by different health-care professional in primary care setting to reduce medication errors or discrepancies on patients with transition of care from hospital to primary care setting. The key player is the pharmacist, who ensures the best medication list, clarifies the medication problems and gives recommendation to the primary care physician. Different methods of execution, namely face-to-face, through phone, or home visit, were associated with favorable outcomes. The role of community pharmacists in both inpatient and outpatient settings were reported in the literature.\(^{[14]}\) The interventions by community pharmacists were found to improve drug-related problems after discharge. The influential elements of the intervention were found to be completeness, accuracy, and clarity in information.

| References | First author (year of publication) | Intervention | Key player | Methods |
|------------|-----------------------------------|--------------|------------|---------|
| (11)       | Setter et al. (2009)              | Pharmacist coordinator consulted nurse case manager to facilitate discrepancy resolution. Nurse case manager recorded resolution progress for each medication discrepancy | Nurse-Pharmacist team | Home visit |
| (15)       | Corbett et al. (2010)             | Nurse interventionist identified medication discrepancies between electronic discharge medication list and medications patients report taking at home. Medication discrepancy tool is used to document discrepancies and to guide resolution of discrepancy | Nurse | Home visit |
| (14)       | Lindquist et al. (2013)           | Primary care physician contacted patient within 24 hours of discharge to confirm medications and clarify any post hospital confusion. | Primary care physician | Phone |
| (12)       | Hawes et al. (2014)               | Clinic visit with pharmacist 72 hours post-discharge, before primary care provider visit, by performing a complete medication history, identifying and resolving medication discrepancies, creating a current medication list and counselling on appropriate medication use | Pharmacist | Face to face clinic setting |
| (10)       | Barker et al. (2016)              | Intervention subject received additional telephone call from pharmacist to obtain their current medication lists and drug allergies, address medication adherence, and to identify any medication issues. Chart review was done by the control group | Pharmacist | Phone |
| (13)       | Armor et al. (2016)               | Pharmacist conducted medication reconciliation service immediately prior physician follow up appointment or approximately 1 week prior to the follow up visit | Pharmacist | face to face clinic setting |

| Reference | First author (year of publication) | Result |
|-----------|-----------------------------------|--------|
| (11)      | Setter et al. (2009)              | Additional nurse facilitation in intervention group, associated with enhanced medication discrepancy resolution (67.0% vs. 54.6%, P=0.001). The total number and mean number of discrepancies identified in the control and intervention groups were similar |
| (15)      | Corbett et al. (2010)             | 94% of the patients in intervention arm, had at least 1 identified medication discrepancies. 69% participants had system level discrepancies where incomplete or inaccurate discharge instruction is the most common contributing factor |
| (14)      | Lindquist et al. (2013)           | Intervention arm had significantly reduced likelihood of medication discrepancies (OR=0.33, CI 0.11-0.97). Patient factors (70%) were more common than the system factors (30%) in contributing to discrepancies |
| (12)      | Hawes et al. (2014)               | Significant medication discrepancies resolved prior to first primary care physician visit (50% in intervention vs. 9% in control arm). Significant reduction in composite outcome of rehospitalisation or ED visits |
| (10)      | Barker et al. (2016)              | 71 and 79 medication recommendations were identified in the control and intervention groups. Intervention group had significantly more accepted recommendations on medication issue. (42% vs. 15%) |
| (13)      | Armor et al. (2016)               | A total of 124 adverse drug events (ADEs) or potential ADEs were identified with an average of 2.9 events per patient. The most common type was non-adherence (17.7%). Outcomes of resolution were documented in 49% of the ADEs, where 31% were resolved. A total of 171 medication discrepancies was identified, in 81% of study participants, for an average of 3.9 per patient |
exchanged, coordination of care which involved quality assessment, planning, and organization, communication in terms of personal and direct contact, accessibility and timeliness.[10]

**Timing of intervention**

The time of contact for the intervention ranged from within 24 h of discharge to the first visit of primary care physician in this review. Doing face-to-face interview in a separate appointment between the discharge and physician visit was found to be a challenge, with possible reasons of cost barrier, transportation barrier, or with overlapping home health service. This was resolved by conducting the medication reconciliation interview immediately before the physician follow-up appointment.[13] In a study examining frequency and patterns of rehospitalization, 19.6% of the 11,855,702 Medicare beneficiaries who had been discharged from a hospital were rehospitalized within 30 days, and 34% were rehospitalized within 90 days.[17] Thus, it is important to identify the ideal timing for intervention to reduce rehospitalization related to medication errors or discrepancies.

**Causes of medication discrepancies**

The causes of discrepancies identified can be at either the system[18] or patient level.[13,14] A different approach may be required to target different causes of discrepancies. A rule-based automated medication reconciliation algorithm had been experimented during care transitions to complement human medication reconciliation, especially in time-critical scenarios.[18] However, patient-level discrepancies might not be detected.

**Medication reconciliation**

The details of the interventions in this review included care communication, medication reconciliation or review, and clarifying medication-related problems. Medication reconciliation has been identified by the Ministry of Health’s National Medication Safety Committee as one of the medication safety priorities.[19] In Singapore, care coordinators under Aged Care Transition (ACTION) initiative provided transitional care to high-risk patients to reduce unnecessary readmission to acute hospitals. Through a program named pharmacist-outreach programme (POP), ACTION team and hospital pharmacist carried out medication management at home. Through this project, 75% of patients who were referred to POP had their drug-related problems resolved and at least 90% of them felt that they could better manage their medications after the program.[20]

Randomized controlled trials had been carried out in the hospital setting on medication reconciliation practices. In a meta-analysis, pharmacy-led medication reconciliation interventions were found to be an effective strategy to reduce medication discrepancies and had a greater impact when conducted at either admission or discharge but were less effective during multiple transitions in care.[11] However, this review is targeted at reduction of medication errors or discrepancies as outcome focusing on primary care as the site of intervention. There were interventions in the primary care setting, looking at outcomes of fall reduction of elderly, preventable drug-related morbidity, and hospital admission. However, the meta-analysis of these randomized controlled trials failed to demonstrate significant outcomes.[21] No studies with a higher SORT grading was found in the primary care setting.

**Limitations**

The search strategy of this review included two key databases and was supplemented by reviewing the references of the relevant studies. As the targeted outcome of this review was limited to medication errors, safety or reconciliation, clinical trials with better methodology looking at clinical outcomes of rehospitalization, improved laboratory parameters, and falls reduction were not included. We recognize that there are other prognostic factors or events which potentially influence the stated clinical outcomes.

While this review has showed a high number of medication discrepancies, there is limited evidence for pharmacist-led medication reconciliation to reduce the medication discrepancies. We only found one randomized trial involving pharmacist-led medication reconciliation done in an outpatient setting which showed 50% resolution of medication discrepancies.[15] Pharmacist-led medication reconciliation may reduce medication discrepancies but more studies need to confirm this finding.

**Conclusion**

There is evidence that interventions in primary care setting reduce medication discrepancies for patients with transition of care from the hospital to primary care setting. Only one randomized trial involving pharmacist-led medication reconciliation was done in an outpatient setting. More good-quality randomized controlled trials should be carried out to confirm the evidence.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

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