

## Impact of Clinical Pharmacist Intervention on Decreasing Incidence of Preventable Adverse Drug Events after Hospital Discharge

Osama H Mohamed Ibrahim\*

Faculty of Pharmacy, Pharmacy Building, University of Sharjah, Sharjah, United Arab Emirates

### Introduction

Drug Related Problems (DRP) including therapeutic failure and Adverse Drug Events (ADEs) are vital patient safety issues [1]. They are particularly frequent after hospitalization [2], when multiple changes to patients' medication regimens may be associated with poor patient education, no follow-up, and interruption of care [3-5]. These factors commonly result in inappropriate medication prescribing, discrepancies between prescribed and actual regimens, reduced adherence, and insufficient observation for adverse effects [6-9]. These problems may cause preventable ADEs and amplified health care utilization. An estimated 12% to 17% of general medicine patients experience ADEs after hospital discharge, more than half of them judged preventable or ameliorable (i.e. duration or severity could have been decreased) [10-12], up to 12% of ADEs result in Emergency Department (ED) visits and 5% in readmissions. A preventable ADE was defined as an undesired reaction to medication, which may have been prevented by appropriate drug selection or management [13].

Clinical pharmacists have the expertise to address DRPs during hospitalization and after discharge [14-15]. They can counsel patients at discharge, detect and resolve medication discrepancies, and screen for non-adherence and ADEs after discharge. Data revealed that counseling patients before discharge improves adherence and decrease misuse of medications [14-16]. Clinical pharmacist follow-up after discharge has a great impact on reducing Emergency Department (ED) visits, hospital readmissions, and costs [14-16].

### Objective

The objective of this study is to identify drug-related problems after discharge and to determine the impact of clinical pharmacist intervention on decreasing the incidence of preventable ADEs.

### Method

This is a randomized controlled study that was conducted at a major teaching hospital in Cairo, Egypt during the period from April 2009 till end of March 2010. Patients eligible for the study were patients admitted to the general medicine service then being discharged home and who could be followed up by phone 30 days after discharge. The study was approved by the teaching hospital ethical committee. Patients provided informed written consent before the commencement of the study. After providing consent, patients were randomized to receive usual care or the study interventions described in the following section. Clinical pharmacists carried out patient enrollment and assignment.

Randomization was performed through a computer-generated algorithm, and treatment assignments kept in sealed opaque envelopes which were opened after patient consent was obtained. Although patients and clinical pharmacists were not blinded to the treatment assignment, outcomes were assessed by research assistants who were blinded to treatment assignment. Patients assigned to usual care received routine review of medication orders by a ward-based pharmacist at the time of discharge. Discharge counseling typically focused on directions to use medications and may have included a discussion of indications or potential side effects, especially for new medications.

For patient randomized to the intervention group, the study intervention on the day of discharge consisted of several parts. First, discharge medication regimens were compared with preadmission regimens and all discrepancies were reconciled with the medical team's help. Patients were screened for previous DRPs, including non adherence, lack of efficacy, and side effects. The pharmacist reviewed the indications, directions for use, and potential adverse effects of each discharge medication with the patient. The intervention group also received a telephone follow-up 3-4 days after discharge during which the clinical pharmacist asked about medication adherence, possible ADEs, and adherence with scheduled follow-up visits and laboratory appointments.

For patients randomized to the intervention group, measurements included frequency of various DRPs detected by pharmacists (e.g. medication non-adherence, possible adverse effects) and recommended actions (e.g. changes to discharge medications) at discharge and follow up. All recommendations were recorded on a standardized form.

To assess the primary outcome, all patients in the trial were contacted 30 days after discharge ( $\pm 2$  days) by research assistants blinded to treatment assignment. The primary outcome was the presence of a preventable ADE in patients 30 days after hospital discharge. Secondary outcomes were patient satisfaction, medication adherence, and medication discrepancies.

Preventable ADEs were assessed with a modified version of the method developed by [16,17], Bates et al. [18]. Patients were asked a screening question for new or worsening symptoms since hospital admission. In the case of an affirmative response, follow-up questions to uncover details about these symptoms and their relation to medications. Case summaries were prepared from these answers and they also include medication lists at admission and discharge, the hospital discharge summary, any available outpatient visit notes, discharge summaries from ED visits or hospital readmissions, and any available laboratory test results in the month since discharge. From these summaries, a clinical pharmacist who is blinded to treatment group determined whether an ADE had occurred, using the Naranjo algorithm which is a validated scoring system to assess causality [19, 20]. The clinical pharmacist also evaluated ADE severity and preventability. For all hospital admissions or ED visits, the blinded clinical pharmacist assessed any relationship to medication use or preventability. Preventable medication-related

\*Corresponding author: Osama H Mohamed Ibrahim, Faculty of Pharmacy, Pharmacy Building, University of Sharjah City, University Road, (M23), Office # 123, Sharjah, 27272, United Arab Emirates; E-mail: [osos\\_husseini@hotmail.com](mailto:osos_husseini@hotmail.com)

Received February 18, 2012; Accepted May 12, 2012; Published May 14, 2012

Citation: Ibrahim OHM (2012) Impact of Clinical Pharmacist Intervention on Decreasing Incidence of Preventable Adverse Drug Events after Hospital Discharge. Adv Pharmacoeconom Drug Safety 1:111. doi:10.4172/2167-1052.1000111

Copyright: © 2012 Ibrahim OHM, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

ED visits or readmissions were considered to be preventable ADEs. If patients could not be contacted by telephone 30 days after discharge but had been readmitted to the hospital or visited the ED, case summaries were prepared and ADEs assessed as described in the previous paragraph but without the patients' responses. Satisfaction with hospitalization and discharge processes was assessed using a standard questionnaire. Medication adherence was assessed by asking patients whether they had taken each medication exactly as prescribed during the previous day and on how many days during the previous week. Medication discrepancies were determined by comparing the discharge medication regimen with the medications reported by each patient at 30 days. Differences not attributable to a physician's order or completion of a prescribed course of treatment were considered discrepancies.

### Statistical Analysis

Dichotomous outcomes (e.g. preventable ADEs) were assessed by Fisher exact test. Other variables such as patient satisfaction score and medication adherence score (adherent medication days divided by all possible medication days) were analyzed with the Wilcoxon rank sum test. Multiple regressions analysis was not used to analyze preventable ADEs because of the small number of events and concern for over fitting. All analyses followed the intention-to-treat principle. The study, with 125 patients per arm, had 80% power to detect an absolute difference in preventable ADEs of 11% (14% vs. 3%). Two-sided P values less than .05 were considered significant. SPSS statistical software, version 18 was used for all analyses.

The study enrolled 358 patients; after exclusions and refusal of filling the consent forms only 250 patients were included in the randomization. After randomization 125 received clinical pharmacist interventions and 125 received the usual care. (Figure 1) illustrates the flow of subjects through the trial. At baseline, there were no significant

differences between patients in the 2 study arms. Demographic data for patients are presented in (Table 1).

### Results

During the interventions, clinical pharmacists identified many types of DRPs. At discharge counseling (n=125), pharmacists discovered that the medical team had often misunderstood the patient's preadmission medication regimen and carried through these inaccuracies to the discharge medication orders. These included 34 missing medications, a different dose or frequency of a medication in 12 cases, and a different medication in the same class in 11 cases (Table 2); 53% of patients had 1 or more unexplained discrepancies in their discharge medication orders. During follow-up telephone calls 3 to 4 days after discharge, clinical pharmacists noted discrepancies between the discharge medication list and the patient's reported home regimen. Most discrepancies involved changes in dose or frequency or complete omission of a prescribed medication. In addition, possible medication side effects were noted in 39%, difficulty obtaining refills in 22%, and difficulty with medication costs in 27%. Thirty days after discharge, preventable ADEs had

Characteristic	Pharmacist Intervention (n=125)	Usual Care (n=125)
Sex, No. (%) female	59 (47.2%)	56 (44.8%)
Age, mean (SD), y	62.7 (18.3)	59.8 (16.8)
No. of medications at discharge, median (IQR)	7 (5.1-11)	7 (5-12)
Hospitalized in past year, No. (%)	110 (48)	104 (57)
Education, No. (%)		
<High school graduate	26 (21)	20 (16)
High school graduate but not college graduate	58 (46)	65 (52)
College graduate	41 (33)	40 (32)
Married No. (%)	64 (51.2)	69 (55.2)
Living with family, No. (%)	28 (22.4)	24 (19.2)
Have someone to help when returns home, No. (%)	34 (27.2)	32 (25.6)

IQR, inter quartile range.

\* P-value > 0.05 for all comparisons.

Table 1: Patients' demographics at the baseline.

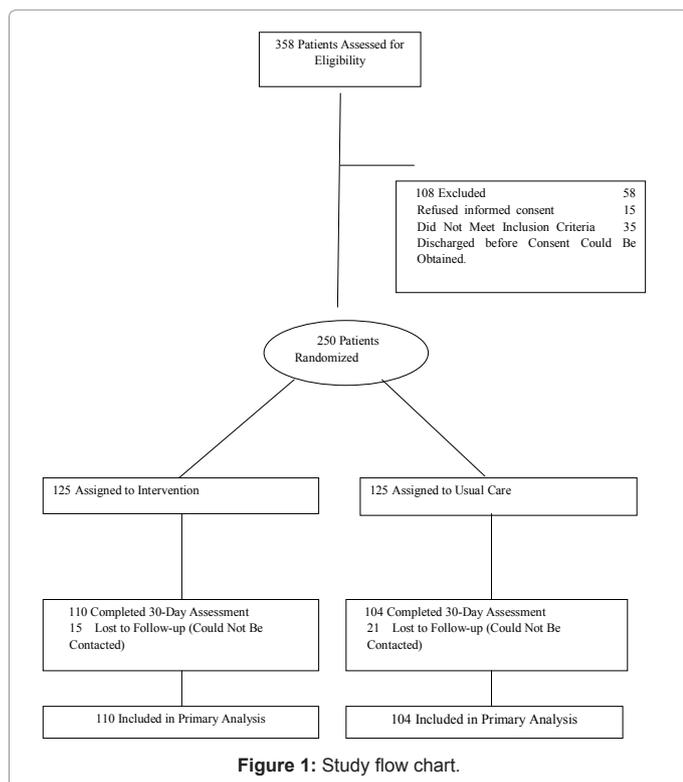


Figure 1: Study flow chart.

Problem	No. (%)
At discharge (n=125)	
Patients with ≥ 1 unexplained discrepancy between preadmission regimen and discharge medications	66 (53%)
Previously taking medication unknown to team	48*
Previously taking different dose or frequency	18*
Previously taking different medication in class	13*
Patients with previous problems with medications taken before admission	27 (21%)
During follow-up (n=110)	
Patients with ≥ 1 unexplained discrepancy between discharge medications and reported regimen	35 (32%)
Taking additional medication not on discharge medication list	8*
Not taking a medication on discharge medication list	16*
Taking different dose or frequency	13*
Taking different medication in the same class	7*
Patients with possible early medication side effects	43 (39%)
Patients non-adherent to medication regimen	31 (28%)
Patients with difficulty obtaining refills	24 (22)
Patients with difficulty with medication costs	16 (14%)

\*Total number of problems exceeds number of patients because patients may have had more than 1 type of problem or more than 1 medication per problem.

Table 2: Drug-Related Problems Detected by Pharmacists during Intervention.

Outcome	Pharmacist Intervention (n=125)	Usual Care (n=125)	P Value †
Adverse drug events; No. (%)			
All	25 (20%)	23 (18%)	NS
Preventable	4 (3%)	18 (14%)	0.01
Health care utilization, No. (%)			
Emergency department visit or readmission	30 (24%)	35 (28%)	NS
Medication related	8 (6%)	10 (8%)	NS
Preventable medication related	3 (2%)	11 (9%)	0.03
Patient satisfaction, No. (%)			
General ‡	111 (89%)	108 (86%)	NS
With instructions regarding discharge medications ‡	123 (98%)	118 (94%)	NS
Unexplained medication discrepancies, No. (%)			
Medication not taken by patient	61 (49%)	58 (46%)	NS
Additional medication taken without PCP's knowledge	21 (17%)	26 (21%)	NS
Any discrepancy in dose or frequency	33 (26%)	35 (28%)	NS
Any medication discrepancy	81 (65%)	84 (67%)	NS
Medication adherence			
Non-adherent with at least 1 medication, No. (%)	16 (13%)	30 (24%)	0.026

PCP, primary care physician. NS, Not Significant

†Using Fisher exact test for categorical variables and Wilcoxon rank sum test or adherence score

‡Score of 4 or higher on a 5-point scale

**Table 3:** Primary and Secondary Study Outcomes.

occurred in 3% of patients in the intervention group and 14% in the usual-care group ( $p$ -value <0.05) (Table 3). The rate of preventable medication-related ED visits or hospital readmissions was 2% in the intervention group and 9% in those assigned to usual care ( $p$ -value <0.05). The groups differ significantly with respect to medication non-adherence (Table 3). Preventable ADEs were due to a number of factors, including discrepancies and inappropriate prescribing before discharge, as well as lack of medication access, non-adherence, and inadequate drug monitoring after discharge

## Discussion

Medication review, discharge counseling, and telephone follow-up by clinical pharmacists were associated with a significantly lower rate of preventable ADEs 30 days after hospital discharge. Preventable, medication-related ED visits were similarly reduced. On the other hand, no differences were seen in total ADEs, or patient satisfaction. On the basis of the drug-related problems addressed by clinical pharmacists and the types of preventable ADEs seen among control patients, the lower rate of preventable ADEs in the intervention group may have been achieved due to resolution of medication discrepancies, improvement in medication appropriateness before hospital discharge, and improved access to medications after discharge. Medication discrepancies were common during and after hospital discharge. Discrepancies differ from problems of medication adherence because discrepancies are related to documentation rather than patient education or motivation. Discrepancies have serious consequences, including prolonged periods of over treatment or under treatment. The medication discrepancies problem has been demonstrated in recent studies [6, 21]. Our finding of discrepancies in 53% of patients is similar to the finding revealed from studies of general medical inpatients showing discrepancies on hospital admission in 53.6% and 54.4% of patients [10, 22].

Patients often incompletely understand their medication regimens, especially at hospital admission, when cognition may be impaired and medication lists, and knowledgeable family members may be unavailable. Unfortunately, medication information from primary care offices and community pharmacies is often unavailable, outdated, or underused.

When writing discharge medication orders, physicians may rely solely on the patient's current medication list rather than also referring to the preadmission list. At discharge, patients may not understand the discharge medication orders. After discharge, inaccuracies in the discharge medication list, formulary restrictions, and lack of communication among a patient's many providers may also contribute to the problem. Considering the types of preventable ADEs detected in the control group, our intervention may also have resolved discrepancies immediately after discharge, and may have improved short-term access and adherence to medications. We found no evidence that our intervention lessened the severity or duration of ameliorable ADEs, perhaps because one follow-up telephone call 3 to 5 days after discharge is insufficient to detect the development of ADEs as they arise.

Several studies have shown that pharmacists can successfully implement medication reconciliation, but many hospitals may find this impossible because of the expense. Whether pharmacists need to be involved in the entire process of medication reconciliation for every patient needs to be evaluated. It may be possible to design reconciliation processes dependent on physicians and nurses in most cases, using pharmacists for patients at particularly high risk or when medication regimens are most in doubt (e.g. older patients taking multiple medications [23]). Ideally, future studies should be large enough to evaluate total ADEs and allow for multivariable adjustment, subgroup analyses, and economic evaluation. The results of this study should be viewed in light of its limitations, including single-site design, and limited sample size.

## Conclusion

In conclusion, clinical pharmacist counseling and follow-up were associated with lower rates of preventable ADEs after discharge, likely through reduction in medication discrepancies and improve adherence to medication regimen. Greater roles for clinical pharmacists in hospital care should be considered, especially Greater roles for clinical pharmacists in hospital care should be considered, especially in case of patient at high risk to ADE. Future studies should focus on optimizing these interventions, identifying patients most likely to benefit from clinical pharmacist involvement, and studying and improving cost-effectiveness of clinical pharmacist interventions.

## References

1. Johnson JA, Bootman JL (1995) Drug-related morbidity and mortality: a cost-of-illness model. *Arch Intern Med* 155: 1949-1956.
2. Forster AJ, Murff HJ, Peterson JF, Gandhi TK, Bates DW (2003) The incidence and severity of adverse events affecting patients after discharge from the hospital. *Ann Intern Med* 138: 161-167.
3. Alibhai SM, Han RK, Naglie G (199) Medication education of acutely hospitalized older patients. *J Gen Intern Med* 14: 610-616.
4. Calkins DR, Davis RB, Reiley P, Phillips RS, Pineo KL, et al. (1997) Patient-physician communication at hospital discharge and patients' understanding of the postdischarge treatment plan. *Arch Intern Med* 157: 1026-1030.
5. Kripalani S, Phillips C, Basaviah P, Williams MV, Saint SK, et al. (2004) Deficits in information transfer from inpatient to outpatient physicians at hospital discharge: a systematic review. *J Gen Intern Med* 19: 135.
6. LaPointe NM, Jollis JG (2003) Medication errors in hospitalized cardiovascular patients. *Arch Intern Med* 163: 1461-1466.
7. Omori DM, Potyk RP, Kroenke K (1991) The adverse effects of hospitalization on drug regimens. *Arch Intern Med* 151: 1562-1564.
8. Cochrane RA, Mandal AR, Ledger-Scott M, Walker R (1992) Changes in drug treatment after discharge from hospital in geriatric patients. *BMJ* 305: 694-696.
9. Beers MH, Munekata M, Storrie M (1990) The accuracy of medication histories in the hospital medical records of elderly persons. *J Am Geriatr Soc* 38: 1183-1187.
10. Cornish PL, Knowles SR, Marchesano R, Tam V, Shadowitz S, et al. (2005) Unintended medication discrepancies at the time of hospital admission. *Arch Intern Med* 165: 424-429.
11. Rozich JD, Howard RJ, Justeson JM, Macken PD, Lindsay ME et al. (2004) Standardization as a mechanism to improve safety in health care. *Jt Comm J Qual Saf* 30: 5-14.
12. Forster AJ, Clark HD, Menard A, Dupuis N, Chernish R, et al. (2004) Adverse events among medical patients after discharge from hospital. *CMAJ* 170: 345-349.
13. Kucukarslan SN, Peters M, Mlynarek M, Nafziger DA (2003) Pharmacists on rounding teams reduce preventable adverse drug events in hospital general medicine units. *Arch Intern Med* 163: 2014-2018.
14. Al-Rashed SA, Wright DJ, Roebuck N, Sunter W, Chrystyn H (2002) The value of inpatient pharmaceutical counseling to elderly patients prior to discharge. *Br J Clin Pharmacol* 54: 657-664.
15. Lipton HL, Bird JA (1994) The impact of clinical pharmacists' consultations on geriatric patients' compliance and medical care use: a randomized controlled trial. *Gerontologist* 34: 307-315.
16. Dudas V, Bookwalter T, Kerr KM, Pautilat SZ (2001) The impact of follow-up telephone calls to patients after hospitalization. *Am J Med* 111: 26S-30S.
17. Schnipper JL, Kirwin JL, Cotugno MC (2003) The effect of pharmacist counseling and follow-up on patient outcomes following hospital discharge. Paper presented at: Society of General Internal Medicine Annual Meeting Vancouver, British Columbia.
18. Bates DW, Cullen DJ, Laird N, Petersen LA, Small SD, et al. (1995) ADE Prevention Study Group. Incidence of adverse drug events and potential adverse drug events: implications for prevention. *JAMA* 274: 29-34.
19. Gandhi TK, Weingart SN, Borus J, Seger AC, Peterson J, et al. (2003) Adverse drug events in ambulatory care. *N Engl J Med* 348: 1556-1564.
20. Leape LL, Brennan TA, Laird N, Lawthers AG, Localio AR, et al. (1991) The nature of adverse events in hospitalized patients: results of the Harvard Medical Practice Study II. *N Engl J Med* 324: 377-384.
21. Lau HS, Florax C, Porsius AJ, De Boer A (2000) The completeness of medication histories in hospital medical records of patients admitted to general internal medicine wards. *Br J Clin Pharmacol* 49: 597-603.
22. Gleason KM, Groszek JM, Sullivan C, Rooney D, Barnard C, et al. (2004) Reconciliation of discrepancies in medication histories and admission orders of newly hospitalized patients. *Am J Health Syst Pharm* 61: 1689-1695.
23. Gandhi TK, Burstin HR, Cook EF, Puopolo AL, Haas JS, et al. (2000) Drug complications in outpatients. *J Gen Intern Med* 15: 149-154.