Study of medication appropriateness during hospital stay and revisits in medicine department of tertiary care hospital

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Abstract: *The primary objective was to identify the medication reconciliations among elderly, based on Lund integrated medicines management (LIMM), during their admission and discharge from hospitals. The secondary objective was to study the impact of LIMM based patients within 6 months of their hospital discharge and revisits. It was a prospective surveillance study in which 120 patients aged ≥65 years or old intervention patients, received LIMM model. The control patients received standard care medication reconciliation at discharge by the help of medication appropriateness index (MAI). This study evaluated the appropriateness on admission and discharge, and assessed, whether the drug related problem was the reason of readmission or visiting to hospital within 6 months of discharge. It was observed that there was a significant decrease in the number of inappropriateness drugs in the intervention group as compared to control group. Hence, there was a significant inappropriateness observed in elderly patients which indicates the medication reconciliation and review according to LIMM and reduce the number of inappropriate drug and number of revisits.*

Keywords - *Medication appropriateness index; Medication inappropriateness in elderly; Drug-drug interaction; Medication review; LIMM model.*

I. Introduction

Drug treatment is a key necessity of medical care for the elderly patients and has the potential to reduce morbidity and mortality in order to ensure good health. However, problems related to drug treatment are common among elderly hospitalized patients, who further interfere with desired health outcomes [1-2]. Drug-related problems (DRP) are the world's fourth leading causes of death [3-5]. Possible underlying causes of drug-related hospital admissions have been identified; as an instance due to medication errors, suboptimal prescription, poor patient compliance, polypharmacy, insufficient monitoring and follow-up and lack of information among patients [6-7]. Thus, it becomes very important to study, identify the root cause and correct the medication errors. As an integrated medicines management approach, various methods have been widely used in several countries in order to find the reason for medication inappropriateness to improve the health care deliver [8-9]. It is the need of an hour to implement rationale use of standard and accurate medication systems at the time of admission, to prevent medication errors and other drug reactions during the hospital stay and at discharge [10-11]. Incorporating pharmacist recommendations, use of computerized alerts, review of patient's medication list and patient education systems can be used to study medication inappropriateness, which is supported by controlled trials, thus providing a higher level of evidence to support [12]. Review of patient's medication list is the widely used tool to assess medication inappropriateness (MI) using MAI scoring method [13]. Medication appropriateness was effectively used by Lund integrated medicines management (LIMM) model [14]. LIMM model offers a systemic approach for individualizing and optimizing drug treatment in elderly patients [14-19]. Since for past 10 years, this model has been widely used in many Swedish hospitals to assess MI. The key principle underlying this model is to access a clinical intervention that can reduce the chances of medication errors. These interventions are supposed to be given at the time of hospital admission, team interventions for medication reviews and monitoring during the hospital stay [20] [21-23] [24-27]. The model covers various aspects of the use of medications from appropriate prescriptions to the way in which drugs have to be taken or not taken by the patients. It is a validated instrument to study medication inappropriateness by ensuring that the medication regimen is appropriate, safe, cost effective and correct use [25]. Earlier studies showed positive effects on the appropriateness of drug therapy using LIMM model, and this model is widely used by many medical scientists. However, this model is associated with certain limitations when used in India, due to improper maintenance of patient's records, insufficient administrative services, absence of clinical pharmacist in hospitals and standard medication lists. The present work was carried out mainly to study and identify the medication reconciliations among elderly, based on LIMM, during their admission and discharge from hospitals. The secondary objective was to examine the impact of LIMM based patients within 6 months of their hospital discharge and revisits.

II. Methods

It was a prospective surveillance study. Comparison of patients receiving LIMM-based medication reconciliation upon admission and discharge and medication reviews during the hospital stay (intervention group) and LIMM–based discharge medication reconciliation (control group). **Inclusion criteria:** Patients, aged ≥ 65 years of either gender hospitalized in IPD in medicine ward and willing to participate in the study, patients who were prescribed at least 1 drug for regular use and the patients revisiting to medicine OPD were enrolled in the study.

Exclusion criteria: Patients visiting to other OPD/IPD of other than medicine ward, patients who had been staying in study wards during one of previous inclusion dates were excluded from the study.
The study was approved by Institutional ethics committee and issued ethical clearance certificate for the same.

2.1 Medication appropriateness index (MAI) based on LIMM model

The 10 parameters constituting the MAI are-medication requiring therapeutic drug monitoring, inappropriate medication, improper handling of medication, drug-drug interaction, medication or dose not adopted to patient characteristics, unnecessary drug treatment, untreated symptom or disease, medication which changes the lab value, generic or analogue substitution according to regional interchangeable medication list, DRP's identified during the medication reconciliation and interview.

These parameters were accessed by Medication Appropriateness Index (MAI) scale as shown in Table 2. In this scale, scoring was given as appropriate (A), moderately appropriate (B) and in appropriate (C). A score of zero was given for a drug which is appropriate or marginally appropriate. MAI criteria that were considered to be inappropriate were scored 1, 2 or 3 for each drug. For indication and effectiveness a weight of three was assigned. A weight of two was assigned to dosage, practical directions, correct directions and drug-drug interaction. A weight of one was given to drug-disease interactions, expense, duplication and duration. This resulted in a total combined score of 0 to 18 (0 representing that the drug is appropriate and 18 representing maximal inappropriateness). MAI scores were combined for each prescribed drug to yield score for each patient.

2.2 Timeline for study procedure

Data was collected for initial three months for assessment of appropriateness of drug therapy and thereafter interventions was planned and adopted. Then, for next three months cases were reviewed subsequently to observe the post intervention change in behavior and rationality of drug therapy in elderly patients. Data analysis, drafting and submission of manuscript were done in next four months.

2.3 Intervention

The standard patient medication list was identified and preserved. The standard medication list was compared with the prescriptions in case of any problem in the prescription, which was brought to the notice of physician changes in the prescription. Data collection was done under LIMM model. Complete wellbeing of patient was confirmed by telephonic means. Revisits were advised if the patient was not recovered. Obtained data were segregated and recorded in tabular form. Number of revisits was recorded. Review of drug therapy post discharge was done.

Drug therapy was reviewed by investigator at the time of discharge. Drugs, advised by concerned physician were subjected to review for appropriateness as per Beer's criteria [29-31] and patients were advised based on that considering the type of medication, dose, frequency and duration of therapy.

2.4 Data interpretation

Data was analyzed using Student's t-test at the end of study. Medical charts were reviewed for treatment regimen, number of drug, and duration of hospital stay. The median length of stay in hospital was 15 days in intervention group and 8-12 days in control group.

III. Results

Out of 143 patients eligible for inclusion, 120 were enrolled in the study. Gender, age and number of patient admission were same in both groups. The characteristics of study population are summarized in Table 1.

The median length of stay in hospital was 15 days in intervention group and 8-12 days in control group (p= 0.0097). A comparison of study population in both groups is shown in Table 1.

Table 1 Characteristics of study population

Characteristics	Intervention group	Control group
Gender	60	60
Male (57%)	35	29
Female (43%)	25	31
Age in years	≥65	≥65
65-70	20	25
70-75	15	19
75-80	14	10
80-85	8	4
85-90	3	2
No. of drug in continuous use	6	7
No. of drugs on demand	1	1

3.1 Intervention and MAI Score

MAI scores were given for individual parameters of individual patients. The summation of each parameter of all patients is tabulated in Table 2.

It was found that there was more inappropriateness observed in indication, expense and drug- disease interaction. However, there was no difference observed in other parameters like dosage, duration, practical direction, drug-drug interaction, duplication, effectiveness and correct directions. Overall assessment of MAI score showed significant decrease in intervention group when compared to that of control group.

Table 2 MAI score of patients

MAI criteria	Intervention group		Control group	
	Admission	Discharge	Admission	Discharge
Indication	36	6	36	27
Expense	36	6	32	24
Duration	30	7	28	24
Drug-disease interaction	24	6	28	18
Dosage	18	6	18	14
Practical direction	12	6	16	14
Drug-drug interaction	12	5	12	10
Duplication	6	4	8	4
Effectiveness	6	3	4	2
Correct directions	3	0	4	1
Overall	183	42	186	138

3.2 Drug related revisits

During six months of the study, there were 38 revisits in intervention group and 46 in control group. From these revisits, there were 37 casual follow-up of the medication with one revisits due to drug related problem in intervention group. In control group there were 40 casual follow-up revisits with six revisits due to drug related problem. Summary of data is shown in Table 3.

Table 3 Analysis of hospital related revisits

Group	Diagnosis at admission	Drug involved	Type of revisit
Control	Hypotension	Amitriptyline/10mg (1-0-1)	ADR (drug stopped)
Control	Blood in urine and painful urination	Tab-pioglitazone 15mg (1-0-1)	Therapeutic failure (discontinuation)
Control	Respiratory distress	Furesemide	Therapeutic failure
Control	Hyperkalemia	Spironolactone	ADR
Control	Pedal edema	Pioglitazone	ADR
Control	Trachycardia with Atrial fibrillation	Digoxin	Therapeutic failure
Control	Hyotension	Cap. Nefidipine	Therapeutic failure(dose reduction)
Intervention	Dry mouth	Tab parkin 2mg	Therapeutic failure

IV. Discussion

Based on overall MAI scoring, significant difference (p = 0.0097) between interventions (76.67%) and control group (25.81%) was observed. The clinical observation of patients, suggested that the medication inappropriateness due to indication, expense and practical directions was reduced due to intervention. The study recommended the use of generic drugs which could significantly decrease the expense. The results of this study showed that intervention of patient on admission, during stay and discharge, as per the LIMM model, resulted in significant decrease in the number of medication inappropriate drugs consumed by elderly hospitalized patients. Overall % of MAI scoring was decreased in intervention group (76.67%) when compared to that of control group (25.81%). Bergkvist et al. demonstrated a multi-intervention study using LIMM model, corroborates with the results obtained in our study. It suggested that intervention of patients during admission and discharge leads to decrease in medication inappropriateness. Burnett KM et al. observed similar results over pharmaceutical care, integrated medicines management or other collaborative approaches in hospitalized patients have also shown improvements in the appropriateness of medications (decrease in the MAI scores). In view of this, one could avoid summing or subtracting scores, which is generally not recommended when dealing with ordered categorical data (i.e. the MAI scores A, B and C) [12]. Results are shown in the form of MAI scores in order to facilitate comparison with previous studies. Study presented herein showed that the average patient MAI score in the intervention group at discharge was lower than that in most other studies (indicating more appropriate prescribing). Moreover, the number of patients during admission was same and MAI scores were also close with no significant difference. This similarity in both control and intervention group led to convenient comparison of MAI scores after intervention. Hellström L et al. showed the validity of the MAI which indicates that this tool can reliably predict clinical patient outcomes. Lund et al. showed that inappropriate prescribing, according to a modified MAI score, is associated with adverse drug events in older men, and Schmader et al. demonstrated an association between worse MAI scores and poorer blood pressure control and use of more health services. Their study population was similar to our study population. Study presented revealed that excess and unwanted diagnostic tests were recommended which led to increase in MAI score of indication and expense. After intervention it was found that both these parameters were improved by 83.33%. Although the number of patients was statistically significant, large scale randomized studies need to be done to estimate the true incidence of inappropriate medication. Blinded assessment of medication inappropriateness using LIMM model with more number of patient could be helpful to validate our findings.
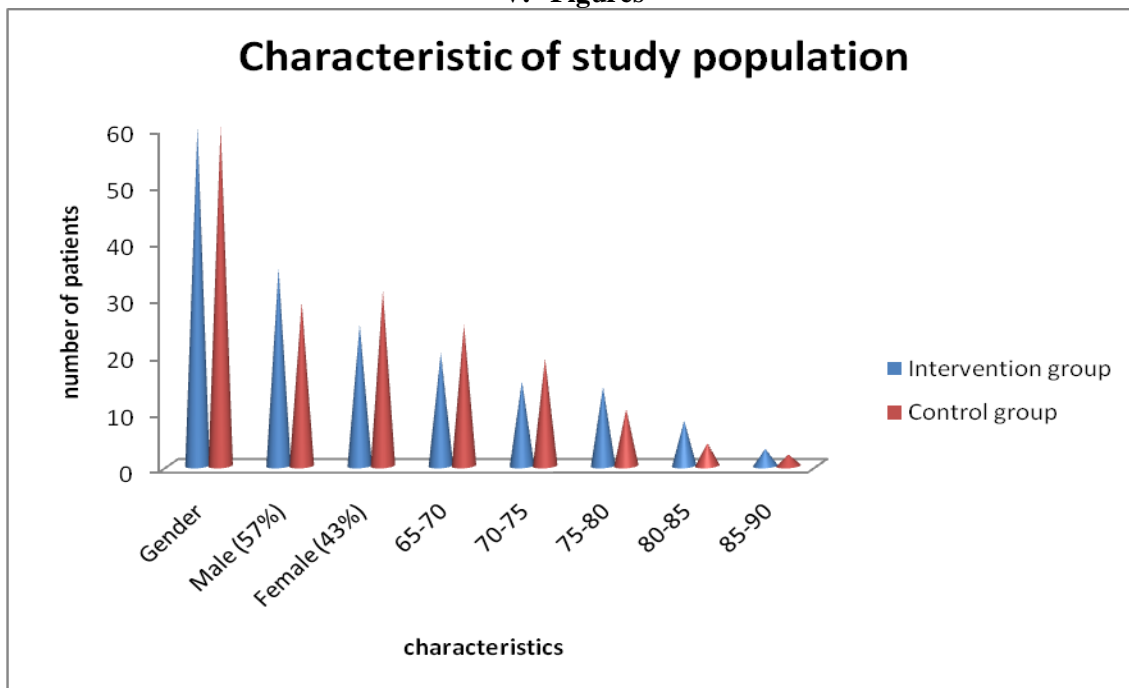
V. Figures

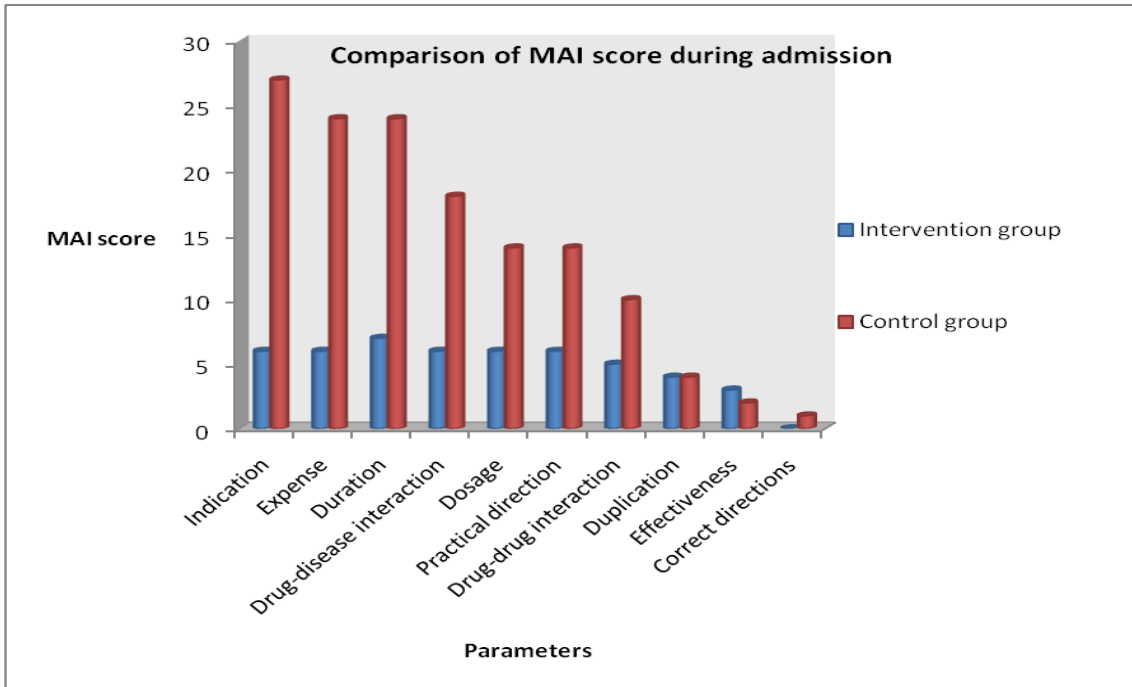**Figure 1:** Graphical presentation of characteristics of study population.

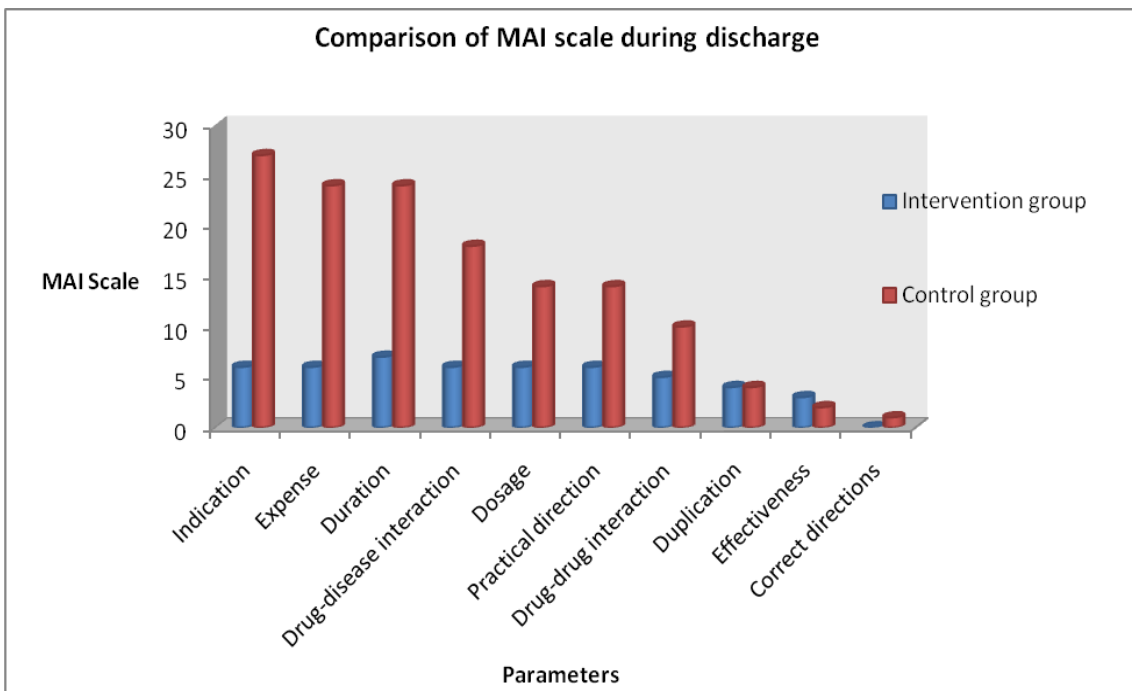**Figure 2:** Comparison of MAI scores during admission
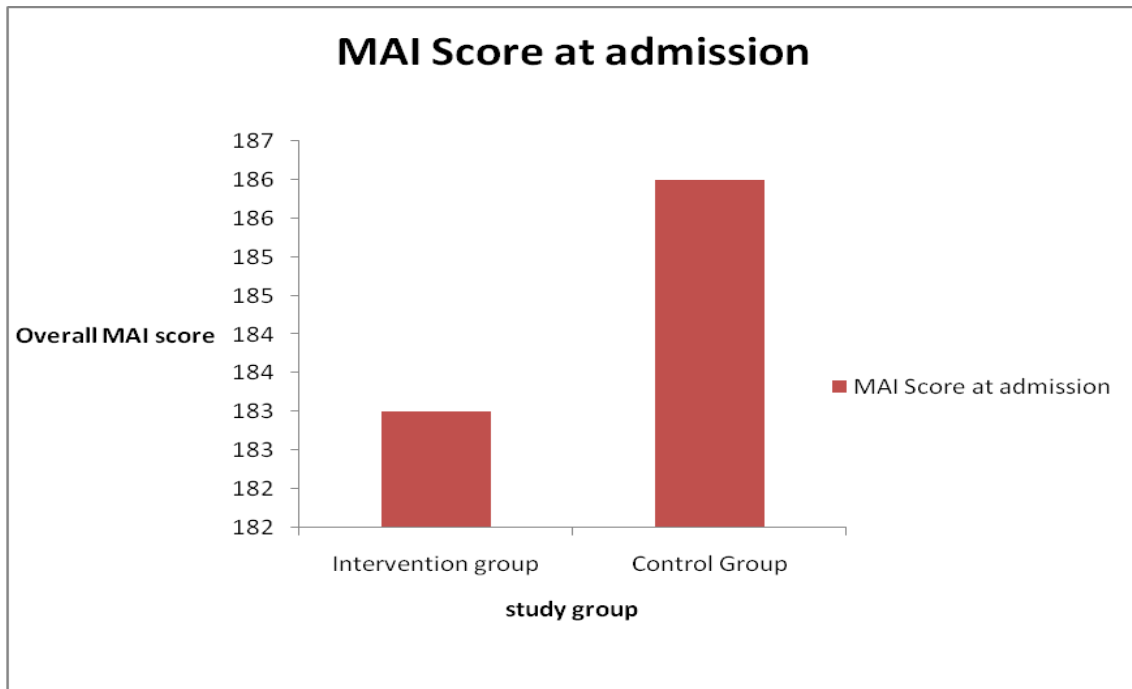

Figure 3: Comparison of MAI scores during admission

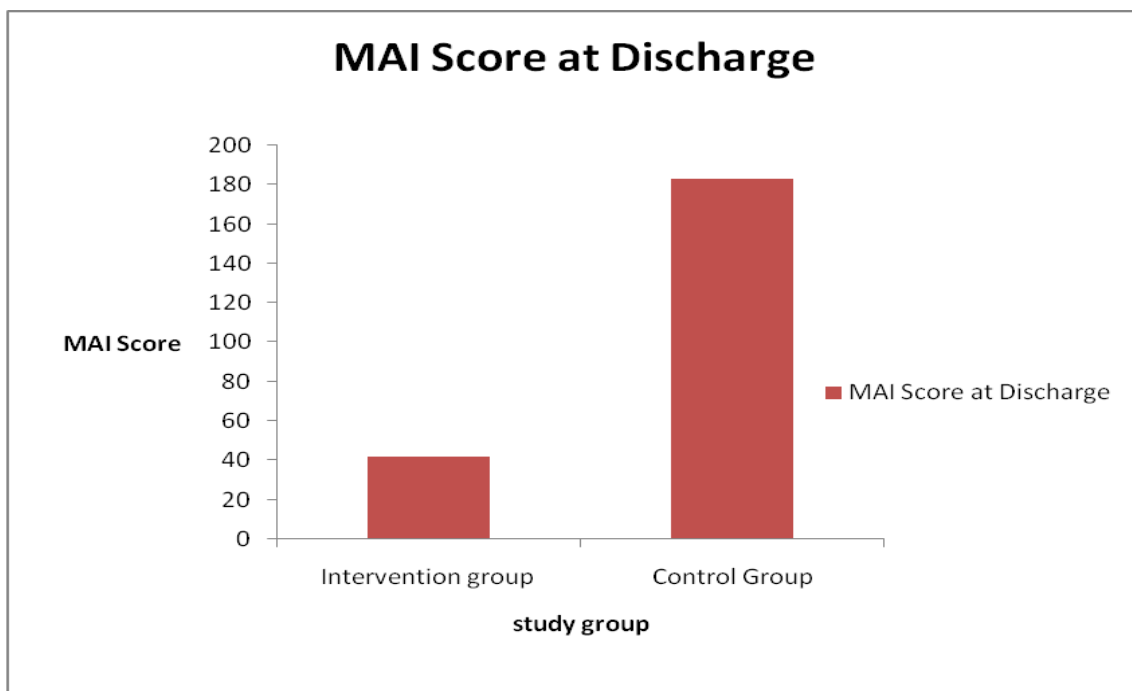**Figure 4:** Comparison of MAI scores during admission.

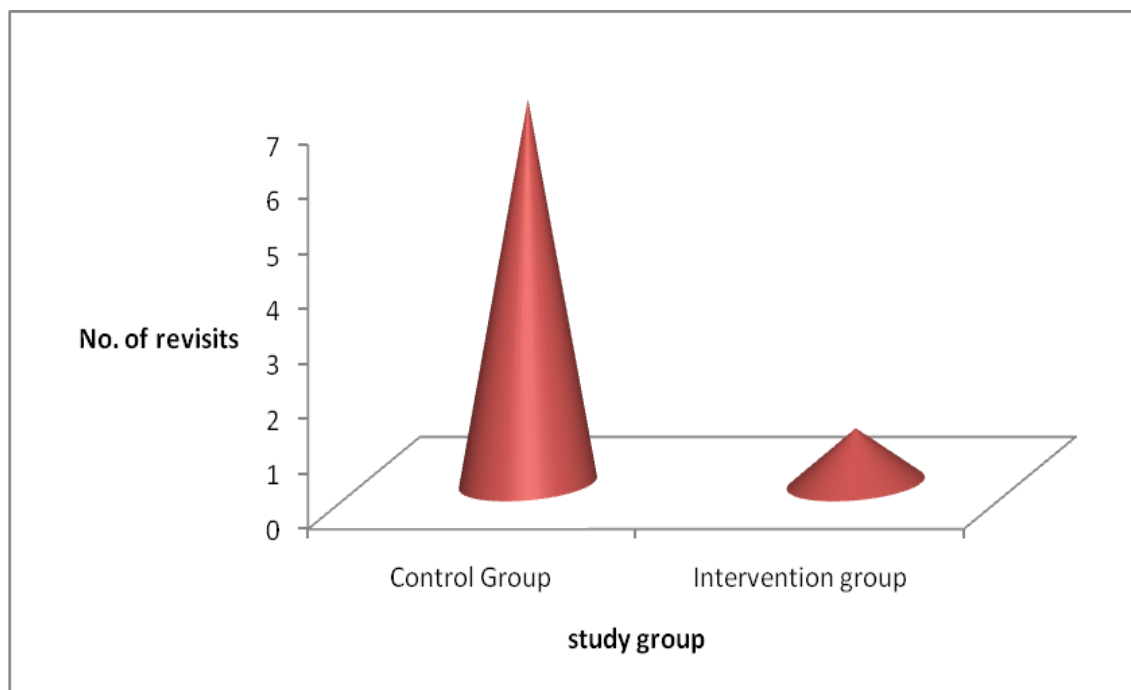**Figure 5:** Comparison of MAI scores during discharge

Figure 6: Comparison of drug related revisits in intervention and control group

VI. Conclusion

The results of this study indicate that medication reconcillation and reviews according to LIMM reduced the number of inappropriate drug and number of revisits.

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