Medication Knowledge of Hemodialysis Patients and Influence of Clinical Pharmacist Provided Education on their Knowledge

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The primary aim of the study was to assess the medication knowledge of hemodialysis patients and to evaluate the impact of education on their medication knowledge. This was a prospective randomised study, conducted in two phases. Study population consisted of 90 hemodialysis patients, randomised into two groups. Baseline medication knowledge of these patients was assessed using medication knowledge assessment questionnaire developed for the study. During the first phase of the study, group I patients received the education provided by a trained clinical pharmacist regarding their medications for eight-weeks and group II patients were deprived of clinical pharmacist provided education but received services only by usual healthcare group. At the end of week eight, medication knowledge assessment questionnaire was applied to both the groups of patients. In the second phase, group I patients were deprived of clinical pharmacist education and group II patients were rendered with clinical pharmacist provided education for eight-weeks and medication knowledge assessment questionnaire was once again administered to both the groups at the end of week 16. At the end of week eight, there was a statistically significant ($P<0.05$) improvement in the medication knowledge assessment questionnaire scores observed in group I, compared to baseline medication knowledge assessment questionnaire scores and week eight scores of group II patients. There was no significant ($P>0.05$) improvement observed in scores of group II compared to baseline. At the end of week 16 of the study period, there was a statistically significant ($P<0.05$) improvement in the medication knowledge assessment questionnaire scores of the group II patients compared to their baseline and week eight scores. At the end of week 16 there was a significant ($P<0.05$) drop in the medication knowledge assessment questionnaire scores of group I patients compared to their week nine scores. The study confirms that medication knowledge of the hemodialysis patients was extremely poor regarding the name, indication and dosage regimen of their medications. Study emphasizes the need for the continued education to the hemodialysis patients for better understanding of the medications they use. A trained clinical pharmacist could play a vital role in educating hemodialysis patients, which has obvious benefits on therapeutic outcome.

Several factors are said to influence medication adherence in chronic disease patients. Patients' lack of knowledge amongst other factors, contributes to medication nonadherence[1]. Knowledge about the name, indication (purpose of the medication), dosage, frequency and side effects of the medications are considered basic essential information that patients must know about their medications[1,2]. The medication knowledge of the patient is approximated based on the extent of patient's ability to recall these basic essential information[3].

Research has demonstrated that approximately two-thirds of the information provided by the health care providers are forgotten immediately and 50% of the information appears to retained is recalled wrongly, in addition it is likely that extent of recall of information by the patients would diminish over a period of time[4,5]. Various factors were thought to influence recalling of information by patients such as age of the patients, anxiety, stress, perceived importance of the information, type (verbal or written information) and amount of the information provided by the health care team and frequency of patient and physician interaction[5,6].

The incidence and prevalence rate of end stage renal disease (ESRD) is increasing over the last decade in India. Although the exact incidence and prevalence rate

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is not available, it is estimated that one out of 10,000 people suffer from chronic renal failure in India and around one-lakh new patients develop ESRD in India annually and increasing number of patients are requiring renal replacement therapies such as dialysis or renal transplantation[7-9].

Previous studies conducted in developed countries have documented the extent of medication knowledge of the patients with various disease conditions including ESRD patients[1,10-12]. ESRD patients who are on hemodialysis have complex drug regimen and often they receive on an average of 10-12 medications daily, many of which requires multiple doses/day[13]. Due to polypharmacy, frequent medication adjustments on dialysis versus non-dialysis days, medically unstable nature of the disease and restricted life styles, these patients are at high risk for developing drug related problems and nonadhearence[14].

Results of previous studies indicated that hemodialysis patients have inadequate knowledge and understanding about their medications[3,15]. In addition ESRD it self is a life threatening condition, which causes physical and psychological disturbances (such as anxiety, stress) contributing for reduced functional capacity and quality of life[16,17]. Hence assessing the medication knowledge of these patients and providing them with required medication related information would be more meaningful and beneficial.

Patient focused interventional strategies such as patient education/counseling can help in increasing the patient knowledge and thereby improve medication adherence[18]. Educational interventions by clinical pharmacists have shown to improve the patients' medication knowledge and adherence[19,20]. Clinical pharmacists' involvement in the medication management of ESRD patients has shown to improve the therapeutic outcome in these patients[21-23].

To the best of our knowledge, no published Indian data are available on studies assessing medication knowledge or adherence of hemodialysis patients to medications. In this study we have made an attempt to evaluate the medication knowledge of hemodialysis patients and to provide education to bring medication awareness in them. Commonly, in medication knowledge assessment studies researchers assess medication knowledge of patients before and after education or counseling sessions and compare the changes knowledge of the patients before and after education sessions. But in this study we examine the medication knowledge of the patients few weeks (eight weeks) after discontinuing the education sessions.

The rationale of this study was to test the hypothesis that the medication related knowledge retention of hemodialysis patients diminishes over a period of time or in the absence of continued patient education. This information would be beneficial in planning appropriate tailor made interventional strategies to enhance medication knowledge or adherence of the hemodialysis patients.

The objectives of the study were to determine the hemodialysis patients' knowledge regarding their medications and to assess the epidemiological and treatment characteristics associated with medication knowledge. The study also aims at evaluating the impact of education on medication knowledge of the haemodialysis patients

MATERIALS AND METHODS

The Institutional Research and Ethics Committee of JSS Medical College and Hospital, Mysore approved the study. Prior to the enrollment, each patient was explained about the purpose of the study. Participation in the study was voluntary. Patients were enrolled to the study, after obtaining the informed consent. This was a randomised prospective open label study. From April 2003 until June 2004, 102 patients satisfying study inclusion criteria were recruited for the study from dialysis centres of JSS Medical College Hospital and Basappa Memorial Hospital, Mysore.

Study criteria:

Male and female hemodialysis patients aged from 18 to 80 years, undergoing regular hemodialysis on outpatient basis and receiving their scheduled medications at least for the past one month were approached for consent to participate in the study. Patients were excluded; if they had multiple organ system failure, malignancies, memory impairment, unconscious, severely disabled, if they were on short-term/irregular dialysis, were unable to speak/ understand the local language, Kannada or English or if they were unwilling to participate in the study.

Data collection:

A review of medical records, interview with hemodialysis patients and their family members and review of patient dialysis dairies (maintained by renal health care team) was conducted to document baseline data. Baseline data collected for each patient included: gender, age,

education, number of medications, duration of dialysis, family income, and residing area of the patient.

Assessment:

The medication knowledge of the patients was assessed using interviewer-administered, five items Medication Knowledge Assessment Questionnaire (MKAQ) developed by the investigators (appendix 1) for the study.

Validity and reliability of the MKAQ:

A five-item MKAQ instrument was developed to assess medication knowledge of the hemodialysis patients. The questionnaire was finalized after having discussions with content experts (nephrologists, senior clinical pharmacists), reviewing the literatures and focus group discussions (hemodialysis patients). Prior to field-testing, questionnaire was evaluated for its content validity[24]. After content validity evaluation, the questionnaire was pilot tested on a convenient sample of subjects, to assess its reliability.

A convenient sample was a group of few subjects (hemodialysis patients) randomly selected by the study pharmacist, from the existing target group hemodialysis patients. The reliability of the MKAQ instrument was estimated by interrater reliability (n=10)), test-retest analysis (n=10) (Cronbach's alpha), and repeatability (n=25) (Pearson's coefficient). The questionnaire was found to have good content validity, reliability and was easily understood by the hemodialysis patients.

Questionnaire administration:

The MKAQ is an interviewer-administered questionnaire. A structured face-to-face interview of the study subjects, conducted in a single session of 25-30 min was used to elicit the medication knowledge of the enrolled patients. During the interview, five parameters like ability of each patient to recall the names of his/her medications, the purpose of use (indication), dose/strength, the number of doses to be taken each time and side effects of the medications was assessed. Number of medications assessed and counselled was restricted to five most common classes of medications received by hemodialysis patients: 1) antihypertensives 2) calcium and phosphate binders 3) vitamin D_3 analogues 4) folic acid 5) iron preparations.

Randomization:

The eligible patients were randomised using a block design and were assigned to group I and II after the assessment of baseline medication knowledge using MKAQ. The study was conducted in two phases, Phase I and Phase II.

Phase I:

Group I patients received the education provided by a trained clinical pharmacist regarding their medications for eight-weeks. Patients were counselled verbally and written educational materials like patient information leaflets and take home medication chart in the local language (listing all the current medications, indication,

APPENDIX-1: MEDICATION KNOWLEDGE ASSESSMENT QUESTIONNAIRE (MKAQ)

S.No	1. Please, Name the medications you take?		2. What is it for?		3. What are the strength/dose of the each medication you take?		4. How many times/day you take this medication & what time of the day?		5. Are you aware of the side effects of these medications? If yes, Please, name the side effects of each medicine you take?
	Actual	Patient	Actual	Patient	Actual	Patient	Actual	Patient	Patient

Actual: Current actual list of the medications taken by the patient: This Column has to be filled by the interviewer before interviewing the patient by referring to patients' case records and dairies. Question 1- 4 has to be administered by the interviewer to assess the medication knowledge of the patient and has to be entered in patient column. Each question is assessed and scored separately.

Scoring:

1. Percentage Recall score of Name of the medication to be taken = Total number of medication name appropriately recalled by the patient x100 / Actual number of medications prescribed
2. Percentage Recall score of Indications of the medication to be taken = Total number of medication indications appropriately recalled by the patient x100 / Actual number of medications prescribed
3. Percentage Recall score of Strength of medication to be taken = Total number of medication strength appropriately recalled by the patient x100 / Actual number of medications prescribed
4. Percentage Recall of Number of doses of the medication to be taken = Total number of medication schedule appropriately recalled by the patient x100 / Actual number of medications prescribed

Note: If the patient recalls only one of the parameter without recalling the other three parameters (for e.g., if patient recall the indication of the medication without recalling the name, strength and number of doses /day) it has to be considered as true knowledge). Question number five does not have a scoring system hence it is not scored.

dosage and time of administration) were also provided. The duration of the patient education was restricted to 15-20 min, twice a week, conducted during the regular hemodialysis procedure.

Group II patients were deprived of clinical pharmacist provided education during the phase I of the study and received services by usual health care group (renal physicians and nurses). At the end of eight-weeks MKAQ was administered to both the groups of patients.

Phase II:

During the second phase of the study, educational intervention for group I patients were withdrawn but the same was initiated for group II patients through week eight to week sixteen. The educational programme was very similar in all aspects as provided to group I patients. At the end of week sixteen, MKAQ was once again administered to patients of both the groups. The MKAQ was scored later to assess the medication knowledge of the patients.

Statistics:

Data collected were analyzed using statistical package for the social sciences (SPSS, version 10) after coding and entering into a database, and presented as percentage and mean±SD scores where appropriate. For categorical variable characteristics (for demographic and number of medications) Pearson Chi-square test for independent proportions was used. Student paired't' test was used for continuous normally distributed variables. The medication knowledge scores of two groups was compared using independent paired't' test. The association between the variables and medication knowledge scores were examined using independent paired't' test for two group comparisons and one-way ANOVA for three or more different groups. Tests were two tailed and a *P*-value less than 0.05 ($P<0.05$) was considered statistically significant.

RESULTS AND DISCUSSION

Chronic kidney disease patients on hemodialysis receive multiple medications on long-term basis. Medication adherence is an issue in chronic kidney disease patients. Adherence to medication is reported to correlate with the medication knowledge of these patients[25]. In the present study we assessed the baseline medication knowledge of hemodialysis patients using MKAQ questionnaire developed for the purpose of the study. Subsequently they were provided with structured education regarding these medications and the impact of educational intervention was assessed.

After seeking the opinion of content experts (renal physicians, senior clinical pharmacists), reviewing of literature, focus group (hemodialysis patients) discussion, we decided to incorporate five items in the final version of MKAQ: the name of the medication, its dosage, indication, administration time and adverse effects of the medications. These are the most fundamental information any patient is expected to remember for better medication adherence. Although, issues like drug-drug interaction and missing a dosage are important, that was not considered as primary for medication adherence.

Although, the questionnaire had five parameters in it, the results and discussions of only four parameters excluding side effects of the medications have been presented in this research paper. It was difficult to quantify the side effects of the medications, mentioned by the patients using MKAQ scoring system, because each drug has multiple side effects and patients could not specifically relate a side effect to a particular medication.

After the development, the final version of MKAQ was assessed for its content validity and reliability. The purpose was to ascertain that the instrument developed measures what it is supposed to measure and provides consistent results from repeated measurement of subjects over a different time period or if assessed by the different researchers[26]. To test the content validity seven content experts were selected. The panel of experts included one renal physician, one senior clinical pharmacist one renal clinical pharmacist, one senior hemodialysis nurse, two patients (who on dialysis in a different dialysis center) and a linguistic expert.

All the five items of MKAQ scored a content validity index score over 0.75. The test-retest reliability alpha coefficient for one item of the instrument was found to be 0.70 item and (r= 0.90-1.0) for the remaining three items. For a standard questionnaire the alpha coefficient value of 0.75-1.0 is desired to flawlessly establish the validity. However, for a newly developed questionnaire an alpha coefficient of 0.70 is acceptable[27]. Our validity and reliability result indicated that MKAQ instrument had good reliability and content validity in ESRD patients.

Out of 102 hemodialysis patients enrolled, 90 patients completed the study, 12 patients were considered as dropouts (six patients expired, four patients moved out of

the city and two patients shifted to another hospital for the treatment). Majority of the patients were in the age group of 50.69±13.69 and 47.29±17.78 years in group I and II, respectively. The demographics of the patients are presented in Table 1. The baseline difference in the gender, age, education, number of medications, duration of dialysis, residing area of the patient (Table 1) and medication knowledge scores (Table 2) between the groups were not statistically significant (P>0.05).

At baseline hemodialysis patients had extremely poor knowledge of name, indication and dosage regimen of their medications. Lack of knowledge of patients about their medications could be a contributing factor for medication nonadherence. In a study conducted by Vasquez *et al*. the lack of knowledge of renal transplant patients regarding their immunosuppressive medications was associated with nonadherence to immunosuppressive medications[28].

At week nine, percentage medication knowledge scores of group I patients was found to be 92.11±17.07%, 83.28±20.88%, 73.69±24.39% and 95.44±14.99% with respect to ability to recall the name, indication, strength and number of doses of medications to be taken respectively. These values were significantly higher

TABLE 1: DEMOGRAPHIC CHARACTERISTICS OF THE STUDY PATIENTS

Factors	Number of patients in group I (n=45)	Number of patients in study group II (n=45)
Gender[b]		
Male	31(68.9%)	37 (82.2%)
Female	14 (31.1%)	8 (17.8%)
Age[a] (In years)	50.69 ± 13.69	47.29 ± 17.78
Education[a]		
Illiterate	3 (6.7%)	4 (8.9%)
Up to 10	26 (57.8%)	24(53.3%)
More than 10	3 (6.7%)	6 (13.3%)
Diploma	4(8.9%)	2 (4.4%)
Degree	9 (20%)	9 (20%)
Number of medications[a]		
≤5	20 (44.4%)	13 (8.9%)
>5	25 (55.6%)	32 (71.1%)
Duration of dialysis [a] (Months)		
<6	28 (62.2%)	32 (71.1%)
6-12	1 (2.2%)	5 (11.1%)
12+	16 (35.6%)	8 (17.8%)
Income (In Rupees)[a]		
<50,000	18 (40%)	11(24.4%)
50-1 Lakh	16 (35.6%)	18 (40%)
>1 lakh	11 (24.4%)	16 (35.6%)
Residing Area[a]		
Urban and Semi-urban	35 (77.8%)	33 (73.3%)
Rural	10 (22.2%)	12 (26.7%)
Dialysis Centre[a]		
JSSH	31 (68.9%)	34 (75.6%)
BMH	14 (31.1%)	11 (24.4%)

[a]No significant differences; t test for independent samples, [b]No significant differences; Pearson Chi-square test

TABLE 2: MEDICATION RECALL KNOWLEDGE SCORES (MEAN±SD) OF GROUP I AND GROUP II PATIENTS AT BASELINE, WEEK EIGHT AND WEEK SIXTEEN

Items of MKAQ	Group	Baseline Mean±SD MKAQ Scores	Week Eight Mean±SD MKAQ Scores	Week sixteen Mean±SD MKAQ Scores
Name of the Medications	Group I	39.02±38.15	92.11±17.07 (P<0.01)[†]	67.31±25.53 (P<0.01)[*] (P<0.01)[a]
	Group II	38.96±33.49	40.57±35.22 (P=0.46)[†]	83.06±21.29 (P<0.01)[*]
Indication of the Medications	Group I	20.49±20.83	83.28±20.88 (P<0.01)[†]	53.15±23.61(P<0.01)[*] (P=0.0001)[a]
	Group II	27.0±23.06	27.78±21.43 (P=0.43)[†]	79.38±22.48 (P<0.01)[*]
Strength of the Medications	Group I	9.80±15.91	73.69±24.39 (P<0.01)[†]	47.67±21.08 (P<0.01)[*] (P<0.01)[a]
	Group II	11.33±16.85	14.80±17.13 (P=0.16)[†]	64.61±21.54 (P<0.01)[*]
Number of doses of medications to be taken	Group I	55.28±38.51	95.44±14.99 (P<0.01)[†]	82.77±23.08 (P=0.01)[*] (P=0.0001)[a]
	Group II	53.93±38.58	55.46±36.61(P=0.42)[†]	90.84±17.20 (P<0.01)[*]

P-value less than 0.05 (P<0.05) was considered statistically significant. [†]Indicates the value for comparison of baseline and week eight medication knowledge scores of group I and II patients. *Indicates the value for comparison of week eight and week sixteen medication knowledge scores of group I and II patients. [a]Indicates the value for comparison of baseline and week sixteen scores of group I patients

($P<0.05$) than its baseline scores and week eight scores of group II patients. In group II patients the improvement observed in their medication knowledge scores was statistically nonsignificant ($P>0.05$) for all the four parameters assessed (Table 2).

There was a statistically significant ($P<0.05$) drop in the knowledge scores observed in the group I patients at the end of week sixteen, compared to their week eight medication knowledge scores. But these scores were significantly ($P<0.05$) higher than their baseline medication knowledge scores. In group II patients, a significant ($P<0.05$) improvement in the medication knowledge scores was observed at week sixteen with respect to all the four parameters assessed while compared to their baseline scores as well as the week eight scores (Table 2).

A repeated evaluation of medication knowledge of group I and II patients at the end of the eight weeks and at week sixteen showed that considerable improvement in the medication knowledge of these patients was observed, only after the pharmacist provided medication education.

The important finding of our study was that, there was a drop in the medication knowledge scores of the study subjects (group I), after they were deprived of clinical pharmacist provided education. However, these scores were significantly ($P<0.05$) higher than their baseline medication knowledge scores. This emphasizes the difficulty of patients in retaining the medication knowledge gained in the absence of well-focused continuous education.

The drop in the medication knowledge scores of patients' possibly due to 1) Chronic unstable nature of the disease, which may affect the thoughtful process[29,30]. Recall of information by patients is more precise when the patient is in the same emotional and physical state as when the information was learnt/memorized and recalled[4]. Any altered physical and emotional state is expected to be a barrier for recall of information. Altered physical and emotional status of our study patients might have resulted in reduced recalling of medication information, which resulted in drop in the medication knowledge at week sixteen, 2) Lack of continuous education by other members of healthcare team and frequent modifications of dosage and timing of medications especially antihypertensives and phosphate binders based on the blood pressure and serum phosphate level of the patients, respectively, and 3) Lack of interest or lack of active participation in the education program by some patients. However, this observation may only be confirmed with further focused studies on these issues.

The result of the study is consistent with a previous study conducted by Skoutakis *et al.* where the authors reported that clinical pharmacist activities improved the patients overall drug/disease knowledge, adherence to drug dosage regimen, and biochemical and therapeutic responses in hemodialysis patients. The improvements reversed in the absence of the clinical pharmacists' activities[25]. This fact further strengthens the need for continuous patient education to haemodialysis patients.

The knowledge about the strength (dose) of their medications was lowest in the study subjects, compared to their ability to recall the name (generic /brand name), indication and dosage schedule of their medications. This may be because of the complicated dosage regimens of some of the medications received by the patients, like the dosage of vitamin D and clonidine (antihypertensive commonly prescribed in the study population), which is in micrograms and the dose of phosphate binder, is 667 mg.

During the study period, we observed that some of the study patients had a negative belief towards their medication usage. Few patients mentione 'it is not so important to remember the dosage of the medications as I am able to recognise my medications by its blister colour or by its size'. This negative belief and practice by patients could be harmful. Since, both adverse effects and therapeutic outcome of the medications are based on the dosage and dosing regimen, the awareness of correct dosage and timing of the medications are considered vital for improved therapeutic outcome[29].

Majority of our study subjects were aware of the indication for the antihypertensive medications, than for other class of medications like vitamins, calcium supplements, iron preparations and phosphate binders. These observations are in line with that reported by Cleary *et al.* who found that majority of the dialysis patients, knew the indication for their antihypertensive medications than for their phosphate binders[3]. These findings were also consistent with the findings of Lim, where the authors reported that medication knowledge of the dialysis patients was deficient particularly about their phosphate binders and Vitamin D[32].

The association between the variables and baseline medication knowledge scores of hemodialysis patients

were assessed using independent paired't' test for two group comparisons and ANOVA for three or more group comparisons.

Sixty-eight men and 22 women subjects participated in the study. At baseline, there was no significant ($P>0.05$) difference between the mean medication knowledge scores of male and female patients with respect to the ability to recall the name, indication, strength and number of doses of their medications to be taken.

In the study population, seven patients were illiterate, fifty patients had studied upto 10th standard, nine patients had studied upto 12th standard, six patients had completed diploma education and eighteen patients had completed university education. At baseline, mean medication knowledge scores of illiterate patients (9.86±13.32%) was significantly lower ($P<0.05$) than the scores of patients of higher educational groups, with respect to ability to recall the name of their medications. While, scores of patients of higher educational groups, upto 10th standard (38.08±34.06%), 12th standard (35.56±38.53%), diploma (29.33±39.73%), and university education was (57.81±35.03%). However, there was no significant ($P>0.05$) different in the mean medication knowledge scores of patients of different education groups with respect to the other three parameters assessed.

In the study population, 18 subjects were in the age group of less than 30 years, 51 subjects were in the age group of 31-60 years and 21 patients were aged more than 60 years. At baseline there was no significant ($P>0.05$) difference between the mean medication knowledge scores of patients of different age groups with respect to all the four parameters assessed. In contrast to our finding Veivia *et al.* observed a significant correlation between age and medication knowledge of hemodialysis patients. In their study, hemodialysis patients older than 60 years of age had deficient knowledge about erythropoietin and iron therapy.

The baseline medication knowledge of group of subjects taking five and less than five medications (n=33) was compared with those subjects taking more than five medications (n=57). MKAQ scores of patients taking more than five medications were significantly ($P=0.05$) less (33.40±33.51%) with respect to their ability to recall the names of their medications compared to subjects taking less than five medications (48.65±37.77%).

The study patients were categorized into three groups based on the time on of maintained hemodialysis therapy. The first group of patients was maintained on hemodialysis therapy for less than 6 mo; group two, patients maintained on hemodialysis therapy for 6-12 mo; and group three, patients maintained on hemodialysis therapy for more than 12 mo. There were statistically significant ($P<0.05$) differences in medication knowledge (with respect to patient ability to recall the name of their medications) according to the duration of time maintained on hemodialysis therapy. Patients who was on maintenance hemodialysis therapy since less than 6 mo period scored lower (25.66±29.83%) compared to patients of 6 to 12 mo (51.17±43.66%) and more than 12 mo (69.2927.82%). However, there was no significant ($P>0.05$) difference in the knowledge scores was observed among these three groups with respect to recalling the indication, strength and number of doses of medications to be taken.

In our study, 68 patients were urban and semi urbanites and remaining patients were from rural areas. There were no significant differences ($P>0.05$) in the baseline medication knowledge scores of different groups with respect to all the four parameters assessed.

Economic status of patient population is presented in Table 1. At baseline, there was no significant ($P>0.05$) difference in the mean medication knowledge scores of patients with different income levels with respect to all the parameters assessed.

In this study, we could not observe any association between patient demographic parameters like gender, age, urban versus rural population and socioeconomic status with the medication knowledge of the patients. However, variables such as education, number of medications and duration of dialysis have shown a positive association with one or two aspects of the parameters of medication knowledge assessed.

One of the finding of our study was contrary to the findings of Blanchard et al, where they found no relation between the variables such as duration of dialysis treatment and the knowledge of the dose[12]. But, in our study the knowledge of patients undergoing dialysis for less than six-month duration was significantly ($P<0.05$) deficient with respect to the ability to recall the name of their medications. However, there was no significant ($P>0.05$) association between level of medication knowledge and other variables assessed.

There were some limitations to our study. The

improvement in the patients' medication knowledge was not correlated with its influence on biochemical and therapeutic responses. It is possible that improvement in the medication knowledge has been overestimated in our study as the same pharmacist who educated the patients assessed the medication knowledge of the study and control group, contributing some possible bias towards intervention group.

The study confirms that medication knowledge of the hemodialysis patients were extremely poor at baseline in both the study groups. Medication education provided by the clinical pharmacist resulted in a considerable increase in the medication knowledge of both group I and II patients at week eight and sixteen of the study period respectively. Although there was a drop in the scores of group I patients at week sixteen, these scores were significantly ($P<0.05$) higher than their baseline scores. The results of this study revealed that medication knowledge of hemodialysis patients might be improved through medication education sessions. Thus a trained clinical pharmacist could play a vital role in educating hemodialysis patients, which is expected to result in improved outcome.

As there is a likelihood of reduction in the hemodialysis patients' retention of medication knowledge over a period of time, study emphasizes the need for the provision of constant education to the hemodialysis patients for better retention of medication knowledge. The study warrants investigating the influence of cognitive, physical or psychological variables that contribute for poor recall or retention of medication related knowledge in ESRD patients.

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