Research Article

Drug utilization pattern in chronic kidney disease patients at a tertiary care teaching hospital

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ABSTRACT

Background: Chronic kidney disease (CKD) patients receive many medications with multiple doses per day rendering them at high risk for developing drug-related problems. **Materials and Methods:** A observational prospective study was carried out among the indoor patients of internal medicine wards and hemodialysis unit at Medical College Baroda and SSG Hospital, Vadodara, for 6 months. Patients of both sexes and of any age who were diagnosed to have chronic renal disease and on maintenance hemodialysis were included. Approval of IEC and informed consent was taken before initiation of the study. Data were analyzed using Microsoft Excel. **Results:** A total of 302 patient included in the study were analyzed, of which 185 were male and 117 were female with mean age of patient of 51.78 ± 8.93 years. Of these 302 patients, 17.88% of the patients were on maintenance hemodialysis and anemia was the most commonly occurring comorbid (95%) condition among them. Alimentary tract and metabolism class were the most commonly utilized class of drugs (41.87%) from anatomic therapeutic chemical classification and the average number of drugs prescribed was 9.35 ± 2.5. Drugs prescribed by generic name contributed to 64% of the lot and 76.6% from the national list of essential medicine. Fixed-dose drug combinations (FDCs) prescribed were 17.03%. Of total drugs prescribed, 84.91% of drugs were actually dispensed from the hospital drug store free of cost. **Conclusion:** Variety of drug classes was prescribed in a cohort of CKD patients who contributing to polypharmacy and substantially increasing risk of drug interactions.

Keywords: Chronic kidney disease, drug utilization research, hemodialysis, polypharmacy

Introduction

Drug utilization research is defined by the World Health Organization (WHO) as, "the marketing, distribution, prescription, and use of drugs in a society, with special emphasis on the resulting medical, social, and economic consequences."[1]

Chronic kidney disease (CKD) is now recognized as a major medical problem worldwide.[2] The global burden of disease (GBD) study 2015 ranked CKD 17th among the causes of deaths globally (age-standardized annual death rate of 19.2 deaths per 100,000 population).[3] In many countries, CKD is now among the top five causes of death. In India, GBD 2015 ranks CKD as the eighth leading cause of death.[3]

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CKD represents a progressive irreversible decline in the glomerular filtration rate. A common phenomenon in renal failure is progressive renal function loss irrespective of the underlying cause of the kidney disease. Most chronic nephropathies lack a specific treatment and progress relentlessly to end-stage kidney disease, whose prevalence is increasing worldwide.[4] A reason for increasing prevalence of CKD is the rapidly increasing worldwide incidence of diabetes[5] and hypertension.[6] In India, given its population >1 billion, the rising incidence of CKD is likely to pose major problems for both health care and the economy in future years. Indeed, it has been recently estimated that the age-adjusted incidence rate of end-stage renal disease (ESRD) in India to be 229 per million population[7] and >100,000 new patients enter renal replacement programs annually in India.[8] A vast proportion of kidney failure patients in the developing world, including India, died without receiving renal replacement therapy (RRT).[9] In India, due to scarce resources, only 10% of the ESRD patients receive any RRT.[10]

Polypharmacy is common in CKD patients. ESRD patients who are on hemodialysis have complex drug regimens and receive many medications with multiple doses per day render these patients at high risk for developing drug-related problems and non-adherence to treatment.[11]

Although several drug utilization studies in CKD patients have been done worldwide, there is a lack of data which can shed light on the most common drugs prescribed in practice to these patients. Hence, the present study was carried out with the aim to study the drug utilization pattern in CKD inpatients of Medicine Department and hemodialysis unit at S. S. G. Hospital, Vadodara.

Materials and Methods

An observational prospective study was conducted among the indoor patients of internal medicine wards and hemodialysis unit at Medical College Baroda and SSG Hospital, Vadodara, during January 2017–June 2017.

Data of 302 patients were collected. Patients of either sex and of any age who were diagnosed to have chronic renal disease undergoing treatment in internal medicine wards and hemodialysis unit and patients on maintenance hemodialysis were included in the study. Patients diagnosed with acute renal failure and patients not willing to participate in the study were excluded from the study.

Approval of the Institutional Ethics Committee for Human Research was taken before initiation of the study and patients were given information about the nature of study in their own language and written informed consent was obtained from them before obtaining the required information from their indoor case file.

Patient's demographic data, detailed medical history including drugs prescribed, its dosage forms, route of administration, frequency of administration, indications and duration of therapy, and biochemical parameters were recorded from the patient's file and treatment chart on a predesigned case record form.

Statistical analysis

The data were entered into Microsoft Excel Spreadsheet and analyzed using the WHO core indicators with application of suitable statistical tests (such as mean ± standard deviation, percentage).

Results

Demographic profile of patients according to their age and gender distribution

A total of 302 patients were included, of which 185 (61.26%) were male patients while female patients were 117 (38.74%), with male-to-female ratio of 1.58:1 (185:117). Maximum number of patients (34.44%) belonged to the age group of 41–50 years followed by a very less margin in age the group of 51–60 years of age (33.44%). Mean age calculated was 51.78 ± 8.93 years.

Comorbid conditions associated with CKD patients

Of all the patients, 95.36% were found to be anemic followed by hypertension (80.79%), infective illness (45.03%), dyslipidemia (28.81%), diabetes mellitus (22.19%), ischemic heart disease (7.62%), and hypothyroidism (0.99%). Only 17.88% of the patients were found to be on maintenance hemodialysis.

Drugs prescribed per patient

The total numbers of drug products prescribed to patients were 2823. During the study, the number of drugs per prescription varied from 1 to 18 and majority of the patients 63.57% were prescribed 6–10 drugs per prescription followed by 27.15% were prescribed 11–15 drugs per prescription and 8.27% were prescribed 1–5 drugs per prescription. Sixteen–eighteen drugs per prescription were prescribed to only 0.99% of patient.

Drugs prescribed according to formulations

Drugs were prescribed mainly in five different dosage forms. Tablet was the most commonly prescribed dosage form (69.15%), followed by injectable (23.20%), capsule (6.98%), syrup (0.53%), and granules (0.14%).

Anatomic therapeutic chemical (ATC) classification

According to ATC classification, drugs for alimentary tract and metabolism (41.87%) were the most commonly prescribed class of drugs, followed by drugs for cardiovascular system (25.97%), drugs for blood and blood-forming organs (21.18%), anti-infectives for systemic use (6.09%), drugs classified under various group (2.62%), drugs for nervous system (1.02%), drugs for respiratory system (0.39%), systemic hormonal preparations (0.18%), and drugs for musculoskeletal system (0.11%) [Table 1].

The WHO/international network for rational use of drugs core drug use prescribing indicators

The average number of drugs prescribed per patient was 9.35 ± 2.5. Of the total (2823) prescribed drugs, 64.08% of drugs were prescribed by generic name and 35.92% of drugs were prescribed by brand name. The percentage of patients with antimicrobials prescribed was 44.37%. The percentage of drugs prescribed from national essential drug list was 76.62%. The percentage of patients prescribed with an injection was 77.81%. The percentage of patients prescribed with calcium-based phosphate binders and non-calcium-based phosphate binders was 76.49% and 24.50%, respectively. The percentage of patients prescribed with oral iron and erythropoietin was 57.62% and 17.88%, respectively. A total of 481 drug products (17.03%) were prescribed as fixed-dose combinations (FDCs). Of 2823 drugs, 2397 drugs were supplied from hospital while 426 drugs were purchased by patients from outside pharmacies [Table 2].

Drug group-wise distribution

A total of 2823 drugs were prescribed in 302 patients. Of these, antihypertensive group was the most commonly prescribed drug group and constituted 20.40% of total drugs. In this drug group, diuretics were the major contributors (8.11%), followed by calcium channel blockers (4.99%), centrally acting agents (4.96%), nitrates (2.09%), beta-blockers (1.63%), and angiotensin-converting enzyme inhibitors (0.7%). Hematopoietic agents were the second most common group of drug prescribed (16.61%) followed by vitamins and minerals (16.29%). Other groups of drugs prescribed were phosphate binders (10.8%), antiulcer agents(7.76%), antiemetics (6.77%), antibacterial agents (6.09%), antiplatelet (4.14%), hypolipidemic agent (3.08%), antidiabetics (2.37%), laxatives (0.64%), and miscellaneous group (2.94%) [Table 3].

Table 1: Drug classification according to ATC classification system

Code	Class of medicine	Number of drugs (*n*=2823) *n* (%)
A	Alimentary tract and metabolism	1182 (41.87)
B	Blood and blood-forming organs	598 (21.18)
C	Cardiovascular system	733 (25.97)
D	Dermatology system	0 (0)
G	Genitourinary system and sex hormones	0 (0)
H	Systemic hormonal preparations	5 (0.18)
J	Anti-infectives for systemic use	172 (6.09)
L	Antineoplastic and immunomodulating agents	0 (0)
M	Musculoskeletal system	3 (0.11)
N	Nervous system	29 (1.02)
P	Antiparasitic products, insecticides, and repellents	0 (0)
R	Respiratory system	11 (0.39)
S	Sensory organs	0 (0)
V	Various	74 (2.62)

ATC: Anatomic therapeutic chemical

Table 2: Details of drug utilization based on the WHO/INRUD indicators

S. No.	Indicators assessed	Data value
1.	Total number of patients	302
2.	Total number of drugs prescribed	2823
3.*	Average number of drugs per encounter	9.35±2.5 (2823/302)
4.*	Percentage of drugs prescribed by generic name	64.08% (1809/2823)
5.	Percentage of drugs prescribed by brand name	35.92% (1014/2823)
6.*	Percentage of patients with an antimicrobial prescribed	44.37% (134/302)
7.*	Percentage of patients with an injection prescribed	77.81% (235/302)
8.*	Percentage of drugs prescribed from national list of essential medicines	76.62% (2163/2823)
9.	Percentage of fixed-dose combinations prescribed	17.03% (481/2823)
10.	Percentage of patients prescribed with calcium-based phosphate binders	76.49% (231/302)
11.	Percentage of patients prescribed with non-calcium-based phosphate binders	24.50% (74/302)
12.	Percentage of patients prescribed with oral iron	57.62% (174/302)
13.	Percentage of patients prescribed with erythropoietin	17.88% (54/302)
14.	Percentage of drugs prescribed from in pharmacy	84.91% (2397/2823)

*Indicates WHO/INRUD core drug use prescribing indicators. INRUD: International network for rational use of drugs, WHO: World Health Organization

Prescribing frequency of antibacterial agents

A total of 172 antibacterial agents were prescribed out of total 2823 drugs. Cephalosporins were the most commonly prescribed antibacterial agents. They accounted for 49.41% of the total prescribed antibacterials followed by penicillins (17.44%) and nitroimidazoles (11.63%).

Drugs prescribed as FDCs

A total of 11 commonly prescribed FDCs were given in 302 patients who accounted for 17.03% of the total drugs prescribed. Out of these majorities, 50.10% were multivitamin B complex followed by Vitamin A + Vitamin D (33.06%), soluble insulin 30% + isophane insulin 70% (5.82%), and piperacillin + tazobactam (3.33%). Other FDCs prescribed were amoxicillin + clavulanic acid (2.91%), calcium + Vitamin D (1.87%), trimethoprim + sulfamethoxazole (1.25%), liquid paraffin + milk of magnesia (0.62%), bromhexine + chlorpheniramine + dextromethorphan (0.62%), cefpodoxime + clavulanic acid (0.21%), and ferrous fumarate + folic acid + zinc (0.21%). All the FDCs prescribed were included in the list approved by CDSCO except combination of bromhexine + chlorpheniramine + dextromethorphan and soluble insulin 30% + isophane insulin 70% [Table 4].

Discussion

CKD patients are at high risk of infections and land up in recurrent hospital admissions. Reduced or absence excretion by kidneys in renal failure causes alteration in pharmacokinetics of drug, leading to accumulation of drug metabolites resulting in toxicity. The presence of comorbid conditions may also lead to administer more drugs which further increase chance of drug interactions.

In this study, data from 302 patients were collected over a period of 6 months. The male patients (61.26%) were found to be higher than the female patients (34.74%) in this study with the ratio of male:female coming to 1.58:1. This finding is in concurrence with the results of Ahlawat *et al*.[12] and Bajait *et al*.[13]

The mean age of the patients in the present study was 51.78 ± 8.93 years. It was similar to the results of Bajait *et al*.[13] (51 years) but lower than reported by Ahlawat *et al*.[12] (53.8 years) and Devi and George[14] (55.1 years).

Of the comorbidities that we observed in the present study, anemia was found to be the most commonly occurring comorbidity

Table 3: Different groups of drug prescribed

S. No.	Drug class	ATC class	*n* (%)
1.	Antihypertensive drugs		635 (22.49)
2.	Diuretics	C03CA	229 (8.11)
3.	Calcium channel blockers	C08CA	141 (4.99)
4.	Centrally acting agents	C02AC	140 (4.96)
5.	Nitrates	C01DA	59 (2.09)
6.	Beta-blockers	C07AB	46 (1.63)
7.	ACE inhibitors	C09AA	20 (0.70)
8.	Hypolipidemic drugs		
9.	Statins	C10AA	87 (3.08)
10.	Antidiabetic drugs		
11.	Insulin	A10A	67 (2.37)
12.	Phosphate binders		305 (10.80)
13.	Calcium	A02AA04	231 (8.18)
14.	Sevelamer	V03AE02	74 (2.6)
15.	Vitamins and minerals		460 (16.29)
16.	Hematopoietic agents		469 (16.61)
17.	Iron (oral)	B03A	174 (6.16)
18.	Iron (IV)		17 (0.60)
19.	Folic acid	B03B	224 (7.93)
20.	Erythropoietin	B03XA01	54 (1.91)
21.	Antiplatelets	B01AC	117 (4.14)
22.	Antibacterial drugs	J01	172 (6.09)
23.	Antiulcer drugs	A02B	219 (7.76)
24.	Antiemetics		191 (6.77)
25.	Laxatives		18 (0.64)
26.	Miscellaneous		83 (2.94)

ATC: Anatomic therapeutic chemical

Table 4: Percentage of different FDCs prescribed

S. No.	FDCs prescribed	*n* (%)
1.	Multivitamin B Complex	241 (50.10)
2.	Vitamin A+Vitamin D	159 (33.06)
3.	Soluble insulin 30%+Isophane insulin 70%	28 (5.82)
4.	Piperacillin+Tazobactam	16 (3.33)
5.	Amoxicillin+Clavulanic acid	14 (2.91)
6.	Calcium+Vitamin D	9 (1.87)
7.	Trimethoprim+Sulfamethoxazole	6 (1.25)
8.	Liquid paraffin+Milk of magnesia	3 (0.62)
9.	Bromhexine+Chlorpheniramine+Dextromethorphan	3 (0.62)
10.	Cefpodoxime+Clavulanic acid	1 (0.21)
11.	Ferrous fumerate+Folic acid+Zinc	1 (0.21)

FDCs: Fixed-dose drug combinations

(95%), followed by hypertension (80%), infective illnesses (45%), dyslipidemia (29%), diabetes mellitus (22%), ischemic heart disease (7.6%), and hypothyroidism (0.99%). These findings were similar to the study by Tamilselvan *et al*.[15] where anemia was reported in 89% of patients and hypertension in 83% of patients followed by diabetes and dyslipidemia. In another similar study carried out by Al-Ramahi,[16] 84% of the CKD patients were affected by hypertension followed by anemia in 80% of patients. While in studies carried out by Ahlawat *et al*.[12] and Bajait *et al*.,[13] hypertension was observed in 55% of the patients which was quite lower than the present study. The most likely reason for the hypertension occurring as most common comorbidity after anemia can be well explained by the fact that renin-angiotensin system is affected in the patients of CKD which also is responsible for controlling blood pressure.[12]

Out of the total CKD patients studied, only 17.88% were on maintenance hemodialysis. These numbers were similar as the study by Ahlawatet al. (18%)[12]. In other studies done by Bajaitet al.[13] and Al-Ramahi[16], the number of patients on maintenance hemodialysis was higher which were 25% and 50% respectively.

The average number of drugs prescribed in the present study came to 9.35, which is similar to that reported in studies by Bajait *et al*.[13] (9.4) and Al-Ramahi[16] (9.3). This number is quite higher than reported by Ahlawat *et al*.[12] (6.5) and Devi and George[14] (7.4). Polypharmacy is defined as prescription of five or more medications to one patient at 1 time.[17] However, considering the requirement of drugs in CKD patients, it may not be considered as polypharmacy.[18] However, it is a well-known fact that over-the-counter use of medicines is common in this country. This further increases the chances of drug interactions and ADRs and is accountable for the fact that average number of drugs per patient could be well above 9.35.

In the present study, percentage of drugs prescribed by generic name was 64% which was higher compared to the study carried out by Bajait *et al*.[13] where only 12% of drugs were prescribed by generic name. While the studies carried out by Devi and George[14] and Ahlawat *et al*.[12] had all the drugs prescribed by brand name.

Percentage of drug prescribed from the national list of essential medicine in the present study was 76.6% which is similar to the study carried out by Ahlawat *et al*.[12] (80%), but much higher than that reported in studies carried out by Devi and George[14] (53%) and Bajait *et al*.[13] (42%). This suggests good adherence to the essential drug list in our set up.

According to ATC classification system, drugs from the alimentary tract and metabolism class were the most commonly utilized class of drugs (41.87%) followed by cardiovascular drugs and blood-forming agents contributing to 26% and 21%, respectively. This is similar to the findings in the study by Bajait *et al*.[13] which reported 45%, 23%, and 21%, respectively, for the three classes of drug mentioned above.

In the present study, 44% of patients were prescribed either one or more antibacterial agents which are much higher than reported by Ahlawat *et al*.[12] which was 15%. The antibacterial agents contributed to 6.09% of total drug prescribed which is higher than that reported by Ahlawat *et al*.[12] (2.2%) and Bajait *et al*.[13] (0.9%). The misuse of antibiotics is an impending threat to health of population worldwide. Irrational prescribing of antibiotics can lead to adverse reactions,

leading to hospital admissions, cost, and risk of emerging resistant strains.

The number of drugs prescribed by parenteral route was 23% which was higher compared to 11% recorded in the study conducted by Ahlawat *et al*.[12] and lower than 32% which was reported by Devi and George.[14]

Of total prescribed drugs (2823), most of the drugs were prescribed from antihypertensive group (20.40%) followed by hematopoietic agents (16.61%), and vitamins and minerals (16.29%). Diuretics (8.1%) were the most commonly used antihypertensive agents in the study followed by calcium channel blockers (4.9%) and centrally acting antihypertensive agents (4.9%). Ahlawat *et al*.[12] in their study reported 8.2%, 6.3%, and 2.8% of total drugs prescribed belonging to diuretics, calcium channel blockers, and angiotensin II receptor blockers, respectively.

In CKD patients, erythropoietin is not produced in sufficient amount, which leads to renal anemia.[19] Hence, iron supplements and erythropoietin are routinely prescribed in patients of CKD.

In the present study, hematopoietic agents contributed to 16.6% of total drugs prescribed which is similar to observed in the study by Ahlawat *et al*.[12] Of these agents, folic acid (7.9%) was the most commonly utilized drug followed by iron supplements (6.7%). This is much lower compared to results seen in the study by Tamilselvan *et al*.[15] which is 44.4% and 41.4%, respectively. The use of erythropoietin in the present study was 1.9% which is higher to the study carried out by Ahlawat *et al*.[12] (1.1%) and lower than Bajait *et al*.[13] (2.94%). In the present study, vitamins and minerals contributed to 16.29% of total drugs prescribed which are lower to the study carried out by Bajait *et al*.[13] (24.71%). The use of hypolipidemic agents (3%) in the present study was found parallel to the study carried out by Ahlawat *et al*.[12] (5%). However, these results are stark in contrast of the study by Tamilselvan *et al*.[15] where hypolipidemic agents contributed 41% of total drug prescribed.

Phosphate binders are one of the most commonly prescribed medicines in CKD patients. In the present study, 76.49% of the patients were prescribed with calcium-based phosphate binders followed by non-calcium-based phosphate binders 24.5%. This finding is similar to the study by Navaneethan *et al*.[20] which reported the use of calcium-based phosphate binder and non-calcium-based phosphate binder to 75% and 25%, respectively.

Percentage of FDCs prescribed was 17.03%. Among these combinations, multivitamin B complex was the most commonly prescribed FDCs (50.10%). We were not able to compare the data on this parameter, as we could not find any other study reporting on the same.

The frequent use of FDCs of multivitamin B complex in CKD patients without any specific indication would not serve much purpose, rather will add to the cost of drug therapy. FDCs of antimicrobials used in our set up such as amoxicillin + clavulanic acid and piperacillin + tazobactam are rational and approved for use by CDSCO.

Of total drug prescribed, 84.91% of drugs were actually dispensed from the hospital drug store free of cost as per government policy and this helps to improve compliance, especially in the low socioeconomic population. However, we were not able to compare the data on this parameter as we could not find any other study which had reported on the same.

Although all efforts have been made to make the study explanatory, it still goes with the limitations of having relatively smaller sample size and short duration of the study. There is a need to conduct other such studies in multiple centers, as well as with larger sample size and for a longer duration to get a broader and comprehensive idea of drug use pattern.

Conclusion

This study identified a wide variety of drug classes prescribed in a cohort of CKD patients indicative of prevailing morbidity. It has identified some areas of concerns like polypharmacy which may cause high incidence of drug interactions and adverse reactions. There is a need to conduct other such studies in multiple centers, as well as with larger sample size and for a longer duration to get a broader and comprehensive idea of drug use pattern.

References

1. World Health Organization (WHO) International Working Group for Drug Statistics Methodology, WHO Collaborating Centre for Drug Statistics Methodology, WHO Collaborating Centre for Drug Utilization Research and Clinical Pharmacological Services. Introduction to Drug Utilization Research. Oslo, Norway: WHO; 2003. Available from: http://www.apps.who.int/medicinedocs/en/d/Js4876e/. [Last accessed on 2017 Mar 29].
2. Jha V, Garcia-Garcia G, Iseki K, Li Z, Naicker S, Plattner B, *et al.* Chronic kidney disease: Global dimension and perspectives. Lancet 2013;382:260-72.
3. GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: A systematic analysis for the global burden of disease study 2015. Lancet 2016;388:1459-544.
4. Locatelli F, Pozzoni P, Del Vecchio L. Epidemiology of chronic kidney disease in Italy: Possible therapeutical approaches. J Nephrol 2003;16:1.
5. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27:1047-53.
6. Gupta R. Trends in hypertension epidemiology in India. J Hum Hypertens 2004;18:73-8.
7. Modi GK, Jha V. The incidence of end-stage renal disease in India: A population-based study. Kidney Int 2006;70:2131-3.
8. Kher V. End-stage renal disease in developing countries. Kidney Int 2002;62:350-62.
9. Liyanage T, Ninomiya T, Jha V, Neal B, Patrice HM, Okpechi I, *et al.* Worldwide access to treatment for end-stage kidney disease: A systematic review. Lancet 2015;385:1975-82.
10. Jha V. End-stage renal care in developing countries: The India experience. Ren Fail 2004;26:201-8.

11. Rama M, Viswanathan G, Acharya LD, Attur RP, Reddy PN, Raghavan SV, *et al.* Assessment of drug-drug interactions among renal failure patients of nephrology ward in a South Indian tertiary care hospital. Indian J Pharm Sci 2012;74:63-8.
12. Ahlawat R, D'Cruz S, Tiwari P. Drug utilization pattern in chronic kidney disease patients at a tertiary care public teaching hospital: Evidence from a cross-sectional study. J Pharm Care Health Syst 2015;3:2376.
13. Bajait CS, Pimpalkhute SA, Sontakke SD, Jaiswal KM, Dawri AV. Prescribing pattern of medicines in chronic kidney disease with emphasis on phosphate binders. Indian J Pharmacol 2014;46:35-9.
14. Devi DP, George J. Diabetic nephropathy: Prescription trends in tertiary care. Indian J Pharm Sci 2008;70:374-8.
15. Tamilselvan T, Veerapandiyan AK, Karthik N. Study on drug utilization pattern of chronic renal failure patients in a tertiary care hospital. Hypertension 2014;70:112.
16. Al-Ramahi R. Medication prescribing patterns among chronic kidney disease patients in a hospital in Malaysia. Saudi J Kidney Dis Transpl 2012;23:403-8.
17. Junius-Walker U, Theile G, Hummers-Pradier E. Prevalence and predictors of polypharmacy among older primary care patients in Germany. Fam Pract 2007;24:14-9.
18. Zurakowski T. The practicalities and pitfalls of polypharmacy. Nurse Pract 2009;34:36-41.
19. Pinevich AJ, Petersen J. Erythropoietin therapy in patients with chronic renal failure. West J Med 1992;157:154-7.
20. Navaneethan SD, Sakhuja A, Arrigain S, Sharp J, Schold JD, Nally JV Jr., *et al.* Practice patterns of phosphate binder use and their associations with mortality in chronic kidney disease. Clin Nephrol 2014;82:16-25.