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Assessing Individual Medication Adherence among Chronic Kidney Disease Patients: A Multi-centered Study

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Authors' contributions

This work was carried out in collaboration among all authors. Author FI designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors TNITAK and MZA managed the literature search, collected the data, analysed the study and wrote the first draft of the study. Authors NI and PKB reviewed the protocol and analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study aims to identify differences in outcomes of assessing overall versus individual adherence and factors associated with adherence to medication therapy in chronic kidney disease patients.
Study Design: This is a cross-sectional study.

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Place and Duration of Study: Nephrology Clinic, Universiti Kebangsaan Malaysia Medical Centre and Ministry of Health Hospitals between June 2018 and June 2019.
Methodology: We included 491 patients (243 men, 248 women); average age of 54.5 (±14.6) years with chronic kidney disease and prescribed at least one medication, using a validated questionnaire.
Results: Patients were prescribed an average of 7.0±2.4 medications. Majority were categorized as adherent (n=404, 82.3%) based on an overall assessment. In contrast, only 27.5% (n=135) were adherent when medications were assessed individually. Based on individual medication assessment, a multivariate logistic regression demonstrated patients aged >55 years were 2.3 times more likely to be adherent toward medicines (*P=.001*). Those with <3 comorbidities and <7 medications increased the odds of adherence by 2.1 (*P=.002*) and 2.2 (*P=.001*) times respectively. Having a drug knowledge score >80% increase the odds of adherence by 8.7 times compared to their counterparts (*P<.01*).
Conclusion: Potential strategies for targeted management should be developed in order to remove barriers towards medication adherence in chronic kidney disease patients.

Keywords: Adherence; chronic kidney disease; medication; factors.

1. INTRODUCTION

Chronic kidney disease (CKD) is increasingly recognized as a major non-communicable disease and global public health problem associated with morbidity and mortality. It has been reported that CKD is the 12th most common cause of death, accounting for 1.1 million deaths worldwide [1]. Over the last decade, CKD mortality has increased by 31.7%, making it one of the fastest rising major causes of death [2]. In Malaysia, overall prevalence of CKD was found to be 9.07% [3]. Unfortunately, the number of dialysis patients for end stage renal disease (ESRD) has increased from 629 per million populations (pmp) in 2007 to at least 1286 pmp in 2016 [4]. One of the main challenges of CKD patients is the risk of comorbidities and the wide range of debilitating symptoms that affect the patient's quality of life [5]. In the long-run, managing these patients includes prescribing various medications with the aim to slow disease progression. In view of the complexity of the disease, these patients have the highest burden of daily pill intake per day [6].

Effective pharmacological treatment is vital, yet CKD patients face various challenges when managing their medications. This is evident with the varying rates of medication adherence from 3% to 80% [7]. Evidently, medication non-adherence is common, and multifactorial, especially among CKD patients [7]. The wide range in adherence rates is also dependent on which aspect of drug therapy is investigated. In most cases, adherence among CKD patients is determined as an overall assessment [7,8]. Regardless of pill burden, patients are usually assessed based on a set of questions that addresses medication adherence as a whole [7,8]. Very rarely is adherence towards medications assessed separately due to the high pill burden [6]. Therefore, the level of adherence to medications is usually assumed to be the same for each individual medicine taken. Determining adherence for each and every medication in CKD is thus, clearly a major challenge due to its multiple medication regimens and complexity [6,9].

The burden of multiple medications is evident, especially among CKD patients as typically patients are prescribed on average 6 to 12 different medications [9]. Among them, the more common ones are phosphate binders, vitamin D preparations, calcimimetics, antihypertensive, anti-diabetics, erythropoiesis-stimulating agents, iron supplements and many others [6,9]. In addition, patients may also be prescribed insulin injections, iron injections and chewable tablets, among the normal oral tablets to be taken [6,8,9]. A full understanding towards each medication therapy is thus, required, to ensure minimal error in taking medicines [10]. This is especially vital as better understanding of medicines is associated with better medication adherence, fewer drug-related problems and less emergency visits [11].

The factors that affect medication non-adherence can be different from one population to another. The major predictors of the poor adherence can also be varied including patient or therapy-related factors [12,13]. Patient-related factors may include demographic characteristics, level of education, knowledge, attitude, health belief and

interpersonal communication [12]. Among the elderly, physical impairments and cognitive limitations may increase the risk for non-adherence [13]. Forgetfulness and not being aware of the importance of each medicine were also common factors for non-adherence [12,13]. Lack of knowledge about the disease, medication and motivation, as well as low health literacy are also associated with poor medication adherence [7]. On the other hand, therapy-related factors such as number of prescribed medications, duration of therapy, taste of medication, route of medication and medication side effects may also affect adherence [9]. When managing such complex medication regimes among CKD patients it is useful to identify potential contributing factors that may aid in development of interventions to improve adherence.

In short, medication use among CKD patients are complex and numerous. There is a lack of work looking at each drug individually. The aim of this work is to identify predictors of non-adherence based on assessment of each drug taken. This could potentially aid in a more focused intervention in improving medication adherence among CKD patients.

2. METHODOLOGY

2.1 Study Design

This was a multi-centred, cross-sectional study, conducted in ten tertiary hospitals in Malaysia. Patients diagnosed with CKD with or without dialysis, with a current serum creatinine value (on the day of data collection) and on at least one medication were included. Patients that did not complete the questionnaire were excluded. Consent from patients were obtained prior to inclusion into the study.

2.2 Sample Size

A total of 384 respondents [14] was required based on an approximate population of 39,711 CKD patients in Malaysia [4]. However, a total 500 respondents were targeted to increase the power of the study and to allow for possible exclusion of patients. Patients were screened for eligibility during their physician visit at the outpatient nephrology clinic and interviewed during medication dispensing at the pharmacy. A simple random sampling method was used to select patients. Those that were eligible were assigned a number and random numbers were selected using a random number generator [15].

2.3 Data Collection

The respondents answered a researcher-assisted questionnaire conducted by appointed pharmacists at each study site. The questionnaire assessed demographic variables, overall and individual medication adherence, and reasons for non-adherence [16,17,18,19]. Demographic characteristics collected were age, gender, ethnicity, years diagnosed with CKD, CKD stage, current creatinine clearance (CrCl), number of comorbidities and complementary and alternative medication (CAM) use.

Assessment on general medication adherence was performed using a previously reported questionnaire [16]. The questionnaire consisted two domains which were drug taking behaviour (Items 1-7) and drug-stopping behaviour (Items 8-10) based on the previous one month. Possible scores on the Likert-like scale ranged from 1 ("Never") to 5 ("Very Frequent"). Patients scoring ≥75% were considered adherent to medications [16].

Individual adherence was assessed by calculating number of missed doses of each individual drug reported by the patient for the past one month using the following calculation: [(prescribed doses - missed doses)/total prescribed dose] x 100% [17,18]. Patients were considered adherent if the percentage of consumption of prescribed drugs was higher or equal to 80% [18]. For individuals who used more than one drug, the overall individual medication adherence was determined by considering patients that were adherent to all drugs (achieved > 80% adherence for each individual medication taken) as adherent. Those that had one or more individual medication that was <80% adherent was considered non-adherent [17].

Medication knowledge was assessed for each medication taken using an assessment of drug dose (D), frequency (F), indication (I), and administration (T) (DFIT) [19,20]. Medications knowledge was measured based on the number of correct responses as a correct answer was scored as '1', whilst an incorrect answer was scored '0' [19,20]. The total score for each medication was calculated based on the number of correct answers; [number of correct answers/4] x100% [19,20]. An overall knowledge score was determined by determining the average score of all medications. A higher score demonstrated better knowledge of medication.

The data was the categorized into good and poor knowledge based on a median split [21].

Reasons for non-adherence to each medication were also noted. Reasons were categorized based on several studies, such as forgetfulness, complex dosing schedule, fear of adverse effects, unpleasant taste, do not believe it works, feels better [9,13].

2.4 Data Analyses

All data were analysed using IBM® Statistical Package for Social Sciences version 22.0 (IBM corp. 2013). Descriptive statistic was used to analyse demographic data, clinical characteristics, class of medication used and reasons for non-adherence towards individual medication. Students' t-test and Chi-squared test were used to compare differences in means and categorical data, respectively. Mann-Whitney U test was used for data that were not normally distributed. A univariate and multivariate logistic regression were used to determine predictors of adherence towards overall individual medication. Factors with a p-value of equal or less than 0.25 from the univariate analysis were included into the multivariate analysis [22]. All statistical tests with p-values of <0.05 denote statistical significance.

3. RESULTS

3.1 Demographics and Clinical Characteristics

A total of 491 respondents were included in the study. The average age was 54.5 (±14.6) years. Gender was found to be approximately equal and subjects were predominantly Malay (n=395, 80.4%). Most patients (n=361, 73.5%) included in the study were found to be in end-stage renal disease (stage 5). The most common comorbidities among subjects were hypertension (n=422, 85.9%) and anaemia (n=318, 64.8%). Details of patient characteristics are shown in Table 1.

Table 1. Demographic data and clinical characteristics of the study population (N=491)

Characteristics	Value
Age, mean (SD), year	54.5 (±14.6)
Gender, n (%)	
Male	243 (49.5)
Female	248 (50.5)
Ethnicity, n (%)	
Malay	395 (80.4)
Chinese	71 (14.5)
Indian	19 (3.9)
Others	6 (1.2)
No. of years diagnosed with CKD, mean (SD), year	5.2 (±4.5)
Current CrCl, mean (SD), ml/min/1.73m^2	12.6 (±10.0)
No. of comorbidities present, mean (SD)	3 (±1.2)
Comorbidities, n (%)	
Hypertension	422 (85.9)
Diabetes	291 (59.3)
Cardiovascular Disease	247 (50.3)
Anaemia	318 (64.8)
Others	178 (36.2)
Number of medications, mean (SD)	7.0 (±2.4)
Use of complementary alternative medicine, n (%)	
Yes	82 (16.7)
No	409 (83.3)
Type of complementary alternative medicine, n (%)	
Herbal	63 (76.8)
Non-herbal	19 (23.2)
Drug knowledge score, mean (SD), %	77.1 (±22.8)

The average number of medications prescribed was found to be 7.0 (±2.4), ranging from 1 to 14 medicines. Of these the most popular class of drug used was phosphate binders (n= 394, 80.2%) followed by haematinics (n=325, 66.2%) and statin (n=321, 65.4%). Calcium channel blockers (n=281, 57.2%) was the most common prescribed antihypertensive in CKD patients. Interestingly, a total of 82 (16.7%) patients admitted to taking complementary and alternative medicine (CAM). The most popular use of CAM was herbal medicines, which made up 76.8% (n=63) of CAM users.

3.2 General Adherence Assessment

A total of 404 (82.3%) were found to be adherent to their medications, compared to 87 (17.7%) that were non-adherent (Table 2). When comparing general adherence and patient characteristics, significant associations were found with current CrCl, CKD stage, number of comorbidities and drug knowledge score. There was a higher CrCl in those that were adherent (13.2±4.8 ml/min) to medicines compared to those that were not (10.1±6.9) (U=15185, p=0.047). Less co-morbidities (2.9±1.2) was an indicator of better adherence than their counterparts (3.3±1.0) (U=14502, *P<.01*). A higher drug knowledge score (82.1±16.7) was also associated with better adherence (48.9±30.9) (U=3061.5, *P<.01*). No other significant findings were observed.

3.3 Individual Adherence Assessment

A total of 135 (27.5%) were found to be adherent to their medications when assessed using overall individual adherence (Table 2). There were statistical significant associations demonstrated in number of comorbidities, number of medications and drug knowledge score with overall individual adherence. There was a higher number of medications in those that were non-adherent (7.2 ± 2.3) to medicines than those that were adherent (6.0 ± 2.4) (U=17376, *P <.01*). Similar to overall adherence, patients with fewer comorbidities (2.6±1.3) were found to have better adherence compared to their counterparts (3.2 ± 1.1) (U=17378.5, *P<.01*). A higher drug knowledge score (90.0±9.8) was also associated demonstrated in those that were adherent compared to those that were non-adherent (71.1 ± 24.6) (U=7026.5, *P<.01*). No other significant findings were observed.

Table 2. Adherence of patients based on general and individual assessment (N=491)

Characteristics	General adherence assessment		Individual adherence assessment	
	Adherent	Non-adherent	Adherent	Non-adherent
Overall	404 (82.3)	87 (17.7)	135 (27.5)	356 (72.5)
Age, mean (±SD), year	54.4 (±14.7)	54.9 (±14.3)	54.5 (±14.5)	54.5 (±14.7)
Gender, n (%)				
Male	202 (83.1)	41 (16.9)	69 (28.4)	174 (71.6)
Female	202 (81.5)	46 (18.5)	66 (26.6)	182 (73.4)
Ethnicity, n (%)				
Malay	328 (83.0)	67 (17.0)	104 (26.4)	291 (73.7)
Chinese	53 (74.6)	18 (25.4)	22 (31.0)	49 (69.0)
Indian	18 (94.7)	1 (5.3)	5 (26.3)	14 (73.7)
Others	5 (83.3)	1 (16.7)	4 (66.7)	2 (33.3)
No. of years diagnosed with CKD, mean (SD), year	5.3 (±4.8)	4.9 (±3.0)	5.3 (±5.5)	5.2 (±4.1)
Current CrCl, mean (SD), ml/min/1.73m^2	13.2 (±4.8)	10.1 (±6.9)	12.9 (±10.4)	12.5 (±9.9)
No of co-morbidities present, mean (SD)	2.9 (±1.2)	3.3 (±1.0)	2.6 (±1.3)	3.2 (±1.1)
No of medications, mean (SD)	6.8 (±2.4)	7.4 (±2.3)	6.0 (±2.4)	7.2 (±2.3)
Use of CAM, n (%)				
Yes	64 (78.0)	18 (22.0)	19 (23.2)	63 (76.8)
No	340 (83.1)	69 (16.9)	116 (28.4)	293 (71.6)
Type of CAM used, n (%)				
Herbal	49 (77.7)	14 (22.3)	15 (22.2)	48 (77.8)
Non-herbal	15 (78.9)	4 (21.1)	4 (5.3)	15 (94.7)
Drug knowledge score, mean (SD), %	82.1 (16.7)	48.9 (30.9)	90.0 (9.8)	71.1 (24.6)

Patients were mostly adherent to antiplatelets (n=128, 87.1%) and antihypertensives (n=649, 81.9%). However, the most common medicines patients were non-adherent to were insulin (n=93, 50%) and phosphate binders (n=189, 48%) (Table 3).

When comparing level of adherence between the two methods of assessment, it was clear that the number of adherence was lower when using individual medication assessments (adherent: n=135, 27.5%; non-adherent: n=356, 72.5%) compared to assessing patients based on a general adherence assessment (adherent: n=404, 82.3%; non-adherent: n=87, 17.7%) (χ^2=40.1, df(1), *P<.01*).

3.4 Reasons for Non-Adherence

Whilst assessing individual medications, reasons for non-adherence were also reported (Table 4). Overall, the most common reason for non-adherence was found to be forgetting to take medications (51.1±24.8%) and complex medication schedule (20.8±25.8%). Patients were mostly non-adherent to insulin and phosphate binders, which were mainly due to fear of adverse effects (n=47, 50.5%) and unpleasant taste (n= 68, 35.9%), respectively (Table 3).

3.5 Factors Affecting Medication Adherence

A univariate and multivariate logistic regression analysis was performed to identify demographic characteristics that predicted adherence of individual medication (Table 5). Predictors from the univariate analysis with a p-value <0.25 [22] was then included in the multivariate analysis. The multivariate logistic regression model was statistically significant (χ^2=125.67, df(4), *P<.001*), and demonstrated that age, number of comorbidities, number of medication and drug knowledge score were significant predictors of individual adherence when holding all other variables constant. Patients aged ≥55 years were 2.3 times more likely to be adherent toward all medicines (p=0.001) compared to younger patients. Those with <3 comorbidities and <7 medications increased the odds of adherence by 2.1 (*P=.002*) and 2.2 (*P=.001*) times respectively. Having a drug knowledge score ≥80% increased the odds of adherence by 8.8 times compared to their counterparts (*P<.001*). The model was able to explain 32.7% of the variance in the individual adherence and correctly identified 76.6% of the cases.

4. DISCUSSION

CKD is expected to significantly increase in the future, mainly due to the increasing prevalence of diabetes, hypertension and the aging population [4]. In view of the complex interplay between the cause and effect of renal disease, managing it becomes very much a challenge, and is characterised by a remarkably high rate of hospitalization. As such, close monitoring and strict management of this group of patients is vital, to ensure the burden of disease is reduced. In general, patients took an average of seven medicines in the current work, albeit slightly lower compared to other studies that demonstrated a higher pill burden of up to twelve medications per day [9]. Nonetheless, a total of ten different drug groups were identified, with antihypertensives, phosphate binders and haematinics being the most common, similar to previous work [6,8,9]. It is clearly not surprising that medication management becomes a burden in CKD patients.

Table 3. Individual adherence towards medications (n=491)

Type of medication (total number)	Adherent	Non adherent
Antihypertensives (n=792)	649 (81.9)	143 (18.1)
Antiplatelets (n=147)	128 (87.1)	19 (12.9)
Statins (n=321)	201 (62.6)	120 (37.4)
Oral hypoglycaemic agents (n=75)	56 (74.7)	19 (25.3)
Insulin (n=186)	93 (50.0)	93 (50.0)
Antigout (n=37)	28 (75.7)	9 (24.3)
Proton pump inhibitor (n=120)	78 (65.0)	42 (35.0)
Phosphate binder (n=394)	205 (52.0)	189 (48.0)
Anaemia agents (n=325)	207 (63.7)	118 (36.3)
Vitamins & minerals (n=207)	158 (76.3)	49 (23.7)
Other medications (n=124)	94 (75.8)	30 (24.2)

Table 4. Reasons for non-adherence towards individual medications (n=491)

Type of medication (n=non-adherent)	Forget, n (%)	Complex schedule, n (%)	Fear of adverse reaction, n (%)	Unpleasant taste, n (%)	Do not believe it works, n (%)	Feels better, n (%)	Others, n (%)
Antihypertensives (n=143)	68 (47.6)	37 (25.9)	16 (11.2)	0 (0.0)	25 (17.5)	22 (15.4)	0 (0.0)
Antiplatelets (n=19)	14(73.7)	4(21.1)	1(5.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Statins (n=120)	100(83.3)	9(7.5)	1(0.8)	0(0.0)	6(5.0)	5(4.2)	0(0.0)
Oral hypoglycaemic agents (n=19)	3(15.8)	2(10.5)	1(5.3)	0(0.0)	1(5.3)	2(10.5)	10(52.6)
Insulin (n=93)	37(39.8)	1(1.1)	4750.5)	0(0.0)	3(3.2)	2(2.2)	3(3.2)
Antigout (n=9)	8(88.9)	8(88.9)	2(22.2)	0(0.0)	3(33.3)	3(33.3)	0(0.0)
Proton pump inhibitor (n=42)	25(59.5)	4(9.5)	0(0.0)	0(0.0)	8(19.1)	5(11.9)	0(0)
Phosphate binder (n=189)	60(31.8)	53(28.0)	0(0.0)	68(35.9)	3(1.59)	5(2.65)	0(0.0)
Anaemia agents (n=118)	55(46.6)	18(15.3)	7(5.9)	6(5.1)	28(23.7)	7(5.9)	0(0.0)
Vitamins & minerals (n=49)	12(24.5)	0(0.0)	4(8.2)	0(0.0)	0(0.0)	3(6.1)	30(61.2)

Table 5. Factors affecting the individual medication adherence

	Beta	OR	Lower 95% CI	Upper 95% CI	p-value
Clinical characteristics (reference)	**Univariate Logistic Regression**				
Age (<55 years)	0.25	1.29	0.86	1.92	.21
Gender (Male)	-0.09	0.91	0.62	1.36	.66
Ethnicity (non-Malay)	-0.29	0.75	0.46	1.21	.24
Years diagnosed CKD (<4)	-0.40	0.67	0.45	0.99	.04
Current creatinine clearance (<9ml/min)	-0.12	0.89	0.59	1.32	.57
No. of comorbidities (<3)	-0.97	0.38	0.25	0.57	<.001
No. of medication (<7)	-0.82	0.44	0.29	0.66	<.001
CAM users	-0.27	0.76	0.44	1.33	.34
Drug knowledge score (<80%)	2.13	8.39	5.25	13.41	<.001
Clinical characteristics	**Multivariate Logistic Regression**				
Age (<55 years)	0.84	2.33	1.43	3.79	.001
Ethnicity (non-Malay)	-0.51	0.60	0.34	1.07	.08
Years diagnosed CKD (<4)	-0.43	0.65	0.41	1.04	.07
No. of comorbidities (<3)	-0.75	0.47	0.29	0.76	.002
No. of medication (<7)	-0.79	0.46	0.29	0.73	.001
Drug knowledge score (<80%)	2.17	8.76	5.32	14.43	<.001

Adherence to individual medication is very seldomly assessed as part of CKD medication management. Here, we were able to assess individual medications taken by each patient. Patients were considered adherent if they were adherent to each drug individually. These strict criteria ensure that patients are taking all drugs appropriately, as compared to the traditional assumption that patients are adherent based on a set of questions on general medication taking. When assessing overall adherence to individual medication, it was noted that only a quarter of CKD patients were found to be fully adherent to all medication given to them. This was a significantly lower number when compared to overall adherence, which demonstrates the strict assessment of individual medication. The need to address each medication stems from the possibility that patients could adhere to their multiple medications differently and exhibit various medication-taking behaviours [23]. Furthermore, it is vital to understand how patients routinely manage their medications as different levels of adherence could be associated with potentially different clinical outcomes [23,24].

Among the various different medications taken, antihypertensive agents were reported to be the most adherent, with phosphate binders and insulin being the least. With antihypertensives, it is quite likely that the rise and fall of blood pressure can usually be felt directly by the patient based on symptoms such as headache, dizziness and visual problems [25], which makes them much more adherent towards their medications. It is also quite likely due to the ease in monitoring blood pressure, and the fact that most patients are educated on frequent self-monitoring [26]. Unfortunately, phosphate binders and insulins were among the least adherent medication, partly in due to problems with administration. This low level of adherence in both medications is supported in previous work [27]. The main reason for non-adherence to phosphate binders in the current work, were mainly due to the unpleasant taste and forgetting to take the tablets, which was similarly reported [27]. The unpleasant taste and having to chew the medicines have also been reasons for a reduced appetite that leads to most patients skipping their phosphate binders [27]. Unfortunately, among barriers to insulin therapy were being afraid of hypoglycaemia and feeling worse after insulin injection, similar to previous findings [28]. Other significant barriers to insulin omission reported were injection site reactions, injections being time-consuming, intrusion with physical activity and lack of adequate injection instructions [28]. A few approaches to overcome these barriers include involving patients in the decision-making process that may aid in providing the best individualized treatment plan [29,30]. Intervention and education by a pharmacist was also likely to improve adherence to medication whilst improving clinical outcome [31].

Identifying contributing factors towards adherence aids in the development of individualized interventions. Interestingly, this work demonstrates that age, number of

comorbidities, number of medication and drug knowledge score were found to be significant predictors of medication adherence. In the current work, older participants were more likely to be adherent to medication compared to younger patients. There have been findings that contradict the current results [13], with lower adherence reported among older patients partly in due to the complex therapeutic regimen, forgetfulness, and lack of insight into disease [13]. However, younger patients have been found to be less adherent presumably due to a busier lifestyle, as well as putting more focus on their professional and social life rather than on their illness [30], which further supports current findings. In the current setting, it is quite possible that older patients are much more adherent due to their less busy schedule, and are much more well-versed with the need to take medicines due to their frequent hospital visits.

An increase in co-morbidities directly increases pill burden, mortality and hospitalization [4], as well as having a negative influence on medication adherence. Patients with fewer comorbidities increased the odds of adherence, a finding similar to other work [10]. Multiple co-morbidities may increase the treatment burden on patients that leads to polypharmacy, a complex regimen and complicated administration of medications [13,32]. Such is observed in the current work, in which patients may need more than one drug for one indication, i.e., hypertension. This, added with differences in frequency and dosing, further adds to confusion. In this instance, the addition of insulin, a drug that is required to be taking subcutaneously, or phosphate binders, that should be chewed for optimum results, further increases non-adherence due to the difficulty and discomfort in administration. Thus, the complexity in multiple medicines due to multiple co-morbidities has been shown to result in negative outcomes such as non-adherence and reduced quality of life [23,24].

Improving the knowledge on medication use is a vital component that may affect patient adherence and effective management in CKD patients. In the current study, patients with a drug knowledge score >80% increase the odds of adherence by 8.7 times compared to their counterparts. Based on previous studies, lack of understanding about the indications and effects of each medicine was a reason for non-adherence [7]. Interestingly, in the current work, a simple assessment of dose, frequency, indication and assessment was also able to distinguish ability to adhere to medicines. Indeed, knowledge and adherence to therapy are major interventions that aids in slowing disease progression as well as preventing complications of CKD [26]. This is especially important in patients that received multiple medications for various indications. Therefore, pharmacists should be able to identify the need for educating patients with multiple medications.

The aim of the study was successfully achieved, and highlights the need to consider assessing medication adherence of each and every drug. However, as with all survey-based studies, there were limitations that should be considered. The results of the study are based on the honesty of the patients when answering questions. It should also be noted that there may be errors in determining how often they took their medicines, as this was based solely on the patients' memory of taking medicines within the last one month. Furthermore, factors that affect adherence are multifactorial and not limited to the study alone. Other factors such as belief, occupation, religion and adverse effects [9,13] were not assessed and could contribute towards adherence or the lack thereof.

5. CONCLUSION

The current practice of general assessments of medication overestimates adherence levels among CKD patients. As such, individual medications should be assessed to clearly determine adherence among this group of patients. Although time-consuming, a pharmacist-led intervention should be recommended from time-to-time, with appropriate medication education, in order to identify specific problems faced by the patient. This is especially a concern in patients with multiple comorbidities such as CKD patients, and in which the success of slowing disease-progression and reducing complications is dependent on pharmacological management.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this study. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal

ETHICAL APPROVAL

The study has been approved by the appropriate institutional and/or national research ethics

committee and has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Ethical approval was obtained from the Universiti Kebangsaan Malaysia Research Ethic Committee (JEP-2019-070) and Medical Research and Ethics Committee, Ministry of Health (KKM.NIHSEC.P19-172(6)). All patients were included with oral informed consent.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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