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ORIGINAL ARTICLE

Knowledge of chronic kidney disease management among primary healthcare doctors: A cross-sectional study

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ABSTRACT

Introduction: The prevalence of chronic kidney disease (CKD) is increasing worldwide including in Malaysia. Primary healthcare professionals are required to have sufficient knowledge in all aspects of CKD management. The study aims to determine the level of knowledge on chronic kidney disease and management, its associated factors, and to describe the practice of chronic kidney disease management among public primary healthcare providers in Kelantan. **Methods:** This was a cross-sectional study using an online self-administered questionnaire involving purposively sampled medical officers working at the health clinics in the Ministry of Health. The questionnaire assessed knowledge of CKD definition, risk factors, complications, investigations, and management. Descriptive statistics and multivariate analysis were used to determine factors associated with knowledge level. **Results:** One hundred seventy-nine primary healthcare providers in Kelantan participated in this study. The mean score for knowledge among primary healthcare providers was 71.6% (SD= 13.5). Most participants were able to identify the risk factors of CKD correctly. Previous exposure to CKD management training (p= 0.004; 95% CI: -9.49, -1.79%) and use of clinical practice guidelines (p< 0.001; 95% CI: -13.91, -4.17%) were significantly associated with knowledge. Some practices among the participants were discordant with the guidelines. More than three-quarters (n=137) of participants used serum creatinine as the initial screening test for CKD, whereas only 47.5% (n=85) screened for anaemia among CKD patients. **Conclusion:** Previous exposure to training and usage of guidelines were significant associated factors for the level of knowledge. Educational activities and the availability of guidelines in clinical practice are important to improve the quality of care among healthcare professionals.

1. INTRODUCTION

Chronic kidney disease (CKD) is a significant global health burden, affecting an estimated 850 million people worldwide. The increasing prevalence of CKD has been attributed to the growing incidence of diabetes mellitus and hypertension, the two leading causes of CKD globally and in Malaysia [1,2]. This is

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worrying as CKD is a disease that not only affects one's health but also financially burdens the patient, the close family members, and the country [3,4]. With the rise in these conditions, the need for effective CKD management, especially at the primary care level, has become more critical. A comprehensive understanding of CKD among healthcare providers is essential for early detection and intervention, which can significantly reduce the progression of the disease and improve patient outcomes.

Despite the importance of CKD management, studies have shown that knowledge levels among healthcare providers vary widely. A study conducted among internal medicine residents at United States found that there were gaps in knowledge on CKD among the internal medicine residents [5]. In addition, this also applied to general practitioners, non-nephrology specialists and family medicine residents [6,7].

In Malaysia, a study conducted by Loo et al. (2022) revealed that both undergraduate and postgraduate students had gaps in their knowledge of CKD, particularly in areas related to disease staging and risk factors [8]. This lack of knowledge is concerning, as it can lead to suboptimal patient care and delayed referrals to specialists, ultimately worsening patient outcomes. Similarly, a study by Ng et al. (2016) among medical outpatient clinic patients highlighted the need for better education and training for healthcare providers to improve CKD management in primary care settings [9]. Despite these findings, there are still gaps in research regarding recent knowledge and practice of CKD management among primary health care professionals working in health clinics under the Ministry of Health which are the backbone of primary health care in Malaysia.

Primary healthcare providers (PHCPs) in Malaysia especially those working under the Ministry of Health play a crucial role in managing CKD due to the limited number of nephrologists available in the country. With a ratio of 1 nephrologist to 197,450 patients, the burden of CKD management falls heavily on PHCPs [10]. As such, these providers must be equipped with the necessary knowledge and skills to diagnose and manage CKD effectively. This study aims to assess the knowledge and practices related to CKD management among PHCPs working in the health clinics in Kelantan, Malaysia, and to identify factors that may influence their knowledge levels.

The findings of this study are expected to provide valuable insights into the current state of CKD management in primary care settings in Malaysia. By identifying knowledge gaps and associated factors, the study can inform future educational interventions and policy changes to improve CKD care. Moreover, understanding the practices of PHCPs in managing CKD will help in developing targeted strategies to enhance adherence to clinical practice guidelines and improve patient outcomes.

2. MATERIALS AND METHODS

This cross-sectional study assessed the knowledge and practices related to chronic kidney disease (CKD) management among primary healthcare providers (PHCPs) in Kelantan, Malaysia. The study utilized a self-administered online English questionnaire for data collection, targeting PHCPs working in government health clinics within the state.

The study population consisted of medical officers fully registered with the Malaysian Medical Council (MMC) and working in health clinics under the Ministry of Health in Kelantan regardless of duration of service. This includes those under training for the family medicine specialty. The exclusion criteria included medical officers working in clinics without outpatient departments, family medicine specialists, and those performing purely administrative duties. Family medicine specialists (FMSs) might distort the results due to their advanced knowledge, while medical officers (MOs) in charge of administrative duty are excluded because their limited clinical work may result in lower knowledge levels. The study was conducted between February 17, 2021, and March 25, 2021.

Sampling was carried out in two stages. Simple random sampling was first used to select districts within Kelantan. The selected districts were Kota Bharu, Pasir Mas, Pasir Puteh, Kuala Krai, and Machang. Convenience sampling was then applied within these districts to select participants. Due to the constraints posed by the COVID-19 pandemic and the implementation of movement control orders, the originally planned paper-based survey was shifted to an online format.

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The sample size for this study was calculated based on the study objectives, with the largest sample size required derived from the second objective, which aimed to identify socio-demographic and health service-related factors associated with CKD knowledge among PHCPs. The calculations were performed using the Power and Sample Size Calculation software (Dupont and Plummer, 2009)[11], with alpha value of 0.05, power set at 0.8 and detectable difference of 6.5. The standard deviation (SD) of 12.9 was taken from the SD gender differences obtained from our pilot study and the ratio of female to male participants (m) set 3:1. The calculated sample size for this objective was 168. After considering a 20% non-response rate, the final sample size required was 202 participants.

Data were collected through a self-administered online English questionnaire designed specifically for this study. The questionnaire consisted of three main sections: socio-demographic information, details of health service, and assessments of CKD knowledge and practices. The first component was knowledge on CKD, which consists of 18 items to assess the knowledge on definition (2 items), staging of CKD (2 items), risk factors (8 items), complications (2 items), investigations (2 items) and management of patient with CKD (2 items). Participants were instructed to answer the statements with True/False or Unsure. 1 point was given for each correct answer and no marks were given if they answered wrongly or as 'unsure'. The maximum knowledge score was 18 marks. The knowledge score was calculated in the percentage format, with the numerator being the sum of correct responses and the denominator being the total number of items (i.e. 18). The practice assessment section included 12 items focusing on CKD management, including the frequency of relevant investigations, management practices, and timing of referrals. Responses in this section were rated on a scale of Never, Sometimes, or Always.

The development of the questionnaire involved several stages to ensure validity and reliability. Initially, the questionnaire was designed based on the Malaysian Clinical Practice Guidelines (CPG) on CKD (2018) to ensure content validity. The content of the CPG is considered valid for up to 5 years. Expert opinions were sought from three family medicine specialists to validate the content further. Face validity was conducted with six master's students in family medicine, leading to minor adjustments in wording for clarity. A pilot study involving 57 healthcare providers from the outpatient department of Hospital Universiti Sains Malaysia was conducted to assess the construct validity and reliability of the questionnaire. The participants were not included in the actual study. The Cronbach's Alpha value for the knowledge section was 0.618, indicating acceptable internal consistency. Due to pandemic-related restrictions, the final version of the questionnaire was administered online using Google Forms.

Data collection occurred over two months. An email containing a link to the online questionnaire and an ethics approval letter was sent to the administrative offices of the selected district health offices (Pejabat Kesihatan Daerah, PKD). Study information and inclusion criteria were communicated to family health coordinators, who then disseminated the questionnaire link to the eligible medical officers in their respective districts through the clinic's group email and WhatsApp. Consent for the study was also included on the first page of the Google form. Participation was voluntary, and confidentiality was maintained by not recording any personal identifiers.

The data retrieved from the online responses were entered into SPSS version 23 for analysis. Descriptive statistics were used to summarize the data. Categorical variables were presented as frequencies and percentages, while continuous variables were described using means and standard deviations for normally distributed data or medians and interquartile ranges for skewed data. To identify socio-demographic and health service-related factors associated with CKD knowledge, simple linear regression was first employed to screen variables, followed by multiple linear regression to adjust for potential confounders. All variables with p-value less than 0.1 and clinically important variables were included in Multiple Linear Regression. The p value was set as such for screening variables in simple linear regression before being selected into the subsequent analysis of multiple linear regression. The level of significance was set at 0.05 for all analyses.

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3. RESULTS

One hundred and seventy-nine participants consented to participate in this study. The study involved mostly Malay healthcare providers (95.5%). The participants' mean (SD) age was 33.9 (4.6) years, with the age range being 27.7 years to 52.5 years old. Mean (SD) duration of working experiences was 8.60 (5.00) years. The mean (SD) number of clinic consultations seen per day by the participants was 28.0 (9.4) cases. Most of the participants used clinical practice guidelines (CPG) regarding CKD in their practice (81.0%). Almost half of the responders did not attend any related training activities or courses to the CPG CKD (44.7%) (Table 1).

Table 1. Characteristics of study participants (n=179)

Variables	Mean (SD)	n (%)
Socio-demographic data		
Age (year)*	33.9 (4.6)	
Sex		
Male		34 (19.0)
Female		145 (81.0)
Race		
Malay		171 (95.5)
Non-Malay		8 (4.5)
Marital Status		
Married		152 (84.9)
Single/Divorced/Widowed		27 (15.1)
Health Service Factors		
Type of Health Clinics		
Clinic without FMS		74 (41.3)
Clinic with FMS		105 (58.7)
Working Experiences (years)	8.6 (5.0)	
Number of cases seen per day	28.0 (9.4)	
Previous exposure to training		
No		80 (44.7)
Yes		99 (55.3)
Awareness of CPG CKD 2018		
No		15 (8.4)
Yes		164 (91.6)
Use of CPG CKD 2018		
No		34 (19.0)
Yes		145 (81.0)
Attended Training of the Trainers (TOT) course		
No		153 (85.5)
Yes		26 (14.5)

*one missing data

Source: Lee et al (2026)

The mean score on the CKD knowledge questionnaire was 71.6 % (SD = 13.5). The minimum score was 33.3 % and the maximum score was 100%. Less than half of the participants were able to define CKD correctly; 49.2% of them correctly answered that a patient is diagnosed to have CKD when he/she has persistent proteinuria for more than 3 months despite normal estimated glomerular flow rate (eGFR), while only 40.2% of the participants knew that the item K1b: "A patient is diagnosed to have CKD when his/her eGFR is less than 60ml/min/1.73m^2 regardless of duration" is a wrong statement (Table 2).

Table 2. Knowledge of chronic kidney disease management (n = 179)

Knowledge score		Mean (SD) 71.6 (13.5)		
Knowledge	Items		Correct answers n	(%)
	K1	**A patient is diagnosed to have CKD when:**		
Definition of CKD	K1a	he/she has persistent proteinuria > 3 months despite normal eGFR (estimated glomerular flow rate).	88	49.2
	K1b	his/her eGFR is less than 60ml/min/1.73m2 regardless of duration.	72	40.2
	K2	**Regarding staging of CKD:**		
Staging of CKD	K2a	It categorized into 4 stages based on eGFR.	161	89.9
	K2b	Persistent eGFR 30-59ml/min/1.73m^2 is categorized as Stage 3 CKD.	164	91.6
	K3	**The following is/are risk factor(s) of CKD:**		
	K3a	Hypertension	179	100.0
	K3b	Diabetes mellitus	179	100.0
	K3c	Pregnancy	140	78.2
Risk factor of CKD	K3d	Obesity	117	65.4
	K3e	Age > 65 years old	151	84.4
	K3f	Long term use of proton-pump inhibitors	94	52.5
	K3g	Autoimmune disease	162	90.5
	K3h	Gout	160	89.4
	K4	**The following is/are potential complication(s) of CKD:**		
Complication of CKD	K4a	Anaemia	175	97.8
	K4b	Hypercalcemia and hypophosphatemia	85	47.5
	K5	**Regarding investigations of CKD:**		
Investigations of CKD	K5a	Patients with type 2 diabetes without evidence of microalbuminuria should be tested for microalbuminuria every 6 months.	33	18.4
	K5b	Testing on serum creatinine alone is adequate to assess renal function.	156	87.2
	K6	**Regarding management of CKD:**		
Management of CKD	K6a	The targeted BP for patient with proteinuria (≥1g/day) is ≤140/90mmHg.	105	58.7
	K6b	Asymptomatic patient at CKD stage 4 requires renal replacement therapy referral.	86	48.0

Source: Lee et al (2026)

Most of the participants were able to classify CKD correctly. The majority were able to recognize that persistent eGFR 30-59ml/min/1.73m^2 is categorized as Stage 3 CKD. All participants answered correctly that hypertension and diabetes mellitus were risk factors for CKD, but only 52.5% of participants knew long-term use of proton-pump inhibitors is one of the risk factors of CKD.

The items that the participants scored poorly include questions regarding the frequency of rechecking for microalbuminuria in patients with diabetes mellitus without evidence of microalbuminuria (18.4%). Only about half of the participants were able to answer questions regarding CKD management correctly; 58.7% of them knew that the targeted blood pressure (BP) for patients with heavy proteinuria is not lesser or equal to 140/90 mmHg, and 48% of them answered correctly that asymptomatic patient at CKD stage 4 requires renal replacement therapy referral (Table 2).

A multiple regression analysis was performed following simple regression analysis to analyze the associated factor for knowledge score (Table 3). There is a significant linear relationship between previous exposure to CKD management training and knowledge level of chronic kidney disease (p=0.004). Those without previous exposure have a knowledge level reduced by 5.64% (95% CI: -9.49, -1.79 %). There is a significant linear relationship between the usage of the clinical practice guideline on CKD and the knowledge level of chronic kidney disease (p<0.001). Those who do not practice the CPG CKD 2018 have

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a knowledge level reduced by 9.05% (95% CI: -13.91, -4.17 %). With these 2 significant variables, the model explains 13% of the variation of the knowledge score on CKD in the study sample (R^2=0.13).

Table 3. Factors associated with knowledge on CKD

Independent Variable	SLR[a]				MLR[b]				
	b[c]	95%	CI	p-value	*Adj. B*[d]	95%	CI	t-stat	p-value
Age(years)	0.46	0.03	0.899	0.035	-	-	-	-	-
Gender: Male	-2.66	-7.77	2.44	0.305	-	-	-	-	-
Race: Malay	-9.37	-19.00	0.25	0.056	-	-	-	-	-
Marital Status: Married	3.87	-1.71	9.46	0.173	-	-	-	-	-
Type Of Health Clinic: Clinic Without Family Medicine Specialist	-1.12	-5.19	2.96	0.589	-	-	-	-	-
Working Experience (Including housemanship) (months)	0.04	0.01	0.07	0.009	-	-	-	-	-
Number Of Cases Seen Per Day	-.0002	-0.216	0.212	0.987	-	-	-	-	-
Previous Exposure to CKD Management Training: No	-7.17	-11.06	-3.27	<0.001	-5.64	-9.49	-1.79	-2.89	0.004
Aware Of CPG CKD 2018: No	-9.02	-16.15	-1.90	0.013	-	-	-	-	-
Use Of CPG CKD 2018: No	-10.53	-15.40	-5.65	<0.001	-9.05	-13.91	-4.17	-3.67	<0.001
Attended Training of Core Trainer (TOT) CPG CKD 2nd Edition: No	-7.23	-12.83	-1.63	0.012	-	-	-	-	-

[a] Simple linear regression. [b] Multiple linear regression (R^2=0.13; The model reasonably fits well; Model assumptions are met; There is no interaction between independent variables, and no multicollinearity problem. Variables in final model were selected via backward selection). [c] Crude regression coefficient. [d] Adjusted regression coefficient. constant: 75.77

Source: Lee et al (2026)

The result of the practice section is as illustrated in Table 4. In terms of practice, the majority (76.5%) reported ordering serum creatinine for initial screening of CKD, with only 7.3% of participants not utilizing this as an initial test. For diabetic patients, only 46.4% of participants indicated that they would request an albumin: creatinine ratio test for microalbuminuria when the initial urine dipstick was negative for protein.

Table 4. CKD practice test items

Practice domain		Items	Always		Sometimes		Never	
			n	(%)	n	(%)	n	(%)
Investigation used to screen for CKD	**1**	**Regarding investigations on CKD:**						
	a)	I order serum creatinine as initial screening test.	137	(76.5)	29	(16.2)	13	(7.3) [a]
	b)	I order urine albumin: creatinine ratio (early morning spot urine sample) to screen for microalbuminuria in diabetic patient if urine dipstick for protein is negative.	83	(46.4) [a]	56	(31.3)	40	(22.3)
	c)	I screen for anaemia when patient diagnosed CKD.	85	(47.5) [a]	75	(41.9)	19	(10.6)
General management of CKD	**2**	**Regarding managing a patient with CKD:**						
	a)	I prescribe (or refer to prescribe) Angiotensin-converting enzyme inhibitor (ACEi)/ Angiotensin-receptor blocker (ARB) for diabetic patients who develop persistent microalbuminuria regardless of his/her blood pressure level.	131	(73.2) [a]	37	(20.7)	11	(6.1)
	b)	I target HbA1c 6.5 % to 7 % in a young diabetic nephropathy patient without other comorbid.	128	(71.5) [a]	32	(17.9)	19	(10.6)

	c)	I provide (or refer dietician) for low protein diet counselling to CKD patient.	84	(46.9) [a]	70	(39.1)	25	(14.0)
	d)	I prescribe (or refer to prescribe) aspirin as primary prevention of cardiovascular disease in CKD patient	37	(20.7)	58	(32.4)	84	(46.9) [a]
	e)	I aim blood pressure <130/80 mmHg in young diabetic nephropathy patient.	123	(68.7) [a]	45	(25.1)	11	(6.1)
	3	**Regarding referral to physician or nephrologist:**						
	a)	I refer when patient has persistent heavy proteinuria.	122	(68.2) [a]	43	(24.0)	14	(7.8)
Regarding referral to	b)	I refer when eGFR reduce >5ml/min/1.73m2 within one year	96	(53.6) [a]	57	(31.8)	26	(14.5)
physician or nephrologist	c)	I refer to nephrologist when patient has CKD secondary to renal outflow obstruction.	91	(50.8)	30	(16.8)	58	(32.4) [a]
	d)	I refer all asymptomatic elderly patients with CKD to the nephrologist.	17	(9.5)	89	(49.7)	73	(40.8) [a]

[a:] correct practice

Source: Lee et al (2026)

Approximately 47.5% of participants screened for anemia in CKD patients. In managing CKD, 73.2% of participants prescribed Angiotensin-converting enzyme inhibitors (ACEi) or Angiotensin-receptor blockers (ARB) for diabetic patients who developed persistent microalbuminuria, while 71.5% adhered to a target HbA1c of 6.5% to 7.0% in young diabetic nephropathy patients without comorbidities. A significant proportion (68.7%) of participants aimed for a blood pressure target of less than 130/80 mmHg in the same patient group.

Referral practices showed that 68.2% referred patients with persistent heavy proteinuria to a nephrologist, and 53.6% referred patients when the estimated glomerular filtration rate (eGFR) decreased by more than 5 ml/min/1.73m² within a year. However, 14.5% did not refer in these cases. When CKD was secondary to renal outflow obstruction, 50.8% of participants referred patients to a nephrologist, while 41% did not refer asymptomatic elderly patients with CKD as this was not typically indicated. These findings reflect varying adherence to CKD management guidelines.

4. DISCUSSION

Our result showed that the mean score on the CKD knowledge questionnaire of primary healthcare providers in our study was 71.6 %. This is in comparison to a study by Loo et al. that involved undergraduate and postgraduate medical students and found that the students' baseline knowledge of chronic kidney disease was lower [8]. This contrasts with our study, which involved professionals who are expected to have a better foundational knowledge of CKD. However, despite this, we identified some knowledge gaps that led to suboptimal knowledge level and these knowledge gaps needed to be filled in to provide better quality of care for patients with CKD as well as patients at risk of CKD.

Knowledge on the correct definition of CKD is important for better coordination of care between nephrologist and primary healthcare providers. In our study, more than half of the medical officers were not aware that a more-than-three-month duration is required for the diagnosis of CKD. Furthermore, only nearly half (49.2%) of the participants could correctly identify that persistent proteinuria defines CKD. These findings were similar to a study conducted in the United States, which showed that 46.1% (n=221) of internal residents did not know that kidney injury for 3 months or longer defines CKD [5,12]. In comparison, according to a study from Cameroon, 58.8% (n=67) of general practitioners and non-nephrologists were able to define CKD correctly [7].

Al-Ali from Saudi Arabia also reported a higher percentage (68.9%; n=217) of family medicine residents that provided a correct definition of CKD [6]. From the results of our study and the studies carried out across the globe, the percentage of doctors in our study who can define CKD correctly remains low.

The reason behind this could be due to the inadequate training on the management of CKD during internship as well as when working as a medical officer as highlighted by the percentage of respondents who had prior training in this study. Additionally, this could be due to inadequate exposure to continuous medical education on the subject. The implication of not knowing the correct definition of CKD may lead to unnecessary referral to tertiary centre.

In contrast to the ability to define CKD, the majority of the participants were able to stage CKD correctly and were able to pick out most of the risk factors for CKD precisely. All participants (100%) in our study were able to identify that hypertension and diabetes mellitus were risk factors for CKD. These results were similar to previous studies [7,13]. In our opinion, this finding is important as most patients with diabetes mellitus and hypertension are under regular follow-up for their chronic diseases at primary health clinics in Malaysia.

Concerning complications of CKD, almost all the participants (97.8%) were able to identify anaemia as one of the potential complications correctly. However, only 47.5% of the participants were able to recognize that hypercalcemia and hypophosphatemia are not complications of CKD accurately. The pathophysiology of mineral bone disease of CKD is complex, and it usually results in hypocalcaemia and hyperphosphatemia instead of hypercalcemia and hypophosphatemia. The reason why the majority of the participants were unable to identify this correctly is unclear.

Around 78% of the participants had the false impression that "patients with type 2 diabetes without evidence of microalbuminuria should be tested for microalbuminuria for every 6 months", and only 18.4% of them were able to identify that this was a wrong statement. It is encouraging to know that most participants were aware that there is a need to test for microalbuminuria among patients with diabetes; however, the duration to repeat the test should be reasonably justified and should follow the local guidelines, especially among diabetic patients with stable eGFR, good diabetic and blood pressure control. The natural history of diabetic nephropathy shows that it usually requires several years to develop this complication in a patient with diabetes mellitus and it takes a few years to progress from albuminuria to overt nephropathy [14,15]. As suggested by the Malaysian CPG CKD 2018 and the American Diabetes Association, testing for urine albumin should be repeated annually if the initial test was negative [16]. It is noteworthy to observe that, even though information on the frequency of screening for diabetes complications, such as nephropathy, is easily visible in the medical records and patient portable records, knowledge of this was nevertheless poor.

To slow down the progression of CKD, the CPG CKD guidelines also recommend good blood pressure and glycaemic control, with the target blood pressure of a patient with proteinuria at less than 130/80 mmHg. More than half of the doctors (58.7%, n= 105) in our study were aware of this treatment goal and this result was consistent with the study conducted by Agrawal *et al* [12]. The target blood pressure of less than 130/80 mmHg is also stated in the Malaysian CPG Hypertension 2018 guidelines, in which most primary care doctors are more familiar with.

Several factors were identified in our study that were believed to be in association with the level of knowledge on CKD among primary healthcare providers. Our study indicated a significant association between use of CPG CKD and level of knowledge, whereby PHCPs who did not use the guideline was associated with lower level of knowledge on CKD than those who used it. This finding was consistent with the study performed by Cabana *et al.* where barriers affecting adherence to guidelines would affect knowledge of physicians [17]. CPGs are drafted based on latest evidence-based studies that have been shown to improve patients' outcome and have been related to better patient prognosis [18]. CPGs usually contain the latest information regarding treatment options, up-to-date and evidence-based recommendations, with reliable information regarding the disease, thus, it is reasonable that CPG users would be better equipped with latest knowledge. However, lack of awareness and familiarity towards guidelines were the barriers identified in previous research studies which could affect a physician's knowledge [17]. In our study, the level of awareness towards the existence of the CPG was high, however the percentage of respondents who used the CPG in their daily practice was slightly lower. This might suggest that there are barriers to using the CPG despite knowing its existence. The most reported barriers

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were suboptimal healthcare networks, time constraints, poor applicability of CPGs in real-world practice, poor motivations and adherence, and inadequate reinforcement [19]

We also found a statistically significant association between previous training experience on CKD management and level of knowledge on CKD. Primary healthcare providers who did not attend CKD management training were associated with lower level of knowledge than those who did. Examples of training activities related to CKD management include, but not confined to, attending continuous medical education (CME) sessions about CKD, doing attachment or rotation in a nephrology unit in a tertiary hospital, and attending courses related to CKD. The respondents who had not attended these training sessions scored 5.64% lower in the knowledge section of our study. This finding was similar to a cross-sectional study done among physicians in Iran on knowledge of hypertension [20]. The researchers concluded that the study participants' (i.e. doctors') level of knowledge improved after they had had previous training related to management of the respective diseases.

Chronic kidney disease (CKD) is often asymptomatic in its early stages, necessitating the use of laboratory investigations for detection. According to the CKD-EPI formula, serum creatinine is frequently used to estimate glomerular filtration rate (GFR), but this marker shows changes much later than albuminuria, an earlier indicator of CKD [14]. Despite this, the majority of healthcare providers in the study still rely on serum creatinine for initial CKD screening, which is not recommended as the most appropriate method.

Anemia is a well-known complication of CKD, yet only 47.5% of the respondents reported screening for it, despite nearly all participants (97.8%) acknowledging its importance. This finding mirrors a U.S. study where 40% of physicians screened for anemia, although 90% recognized it as a major CKD complication [21]. Screening for anemia in CKD patients is crucial, as untreated anemia can lead to worse outcomes, including a higher risk of death, heart failure, and a diminished quality of life. In Malaysia, the prevalence of anemia among pre-dialysis CKD patients is notably high, yet treatment rates remain low [22]

Encouragingly, a majority of primary care providers in the study demonstrated good practices in other areas of CKD management, namely on the use of angiotensin-converting enzyme inhibitors (ACEi) or angiotensin II receptor blockers (ARB) for patients with diabetic nephropathy and persistent albuminuria. These results highlight better adherence to guidelines compared to a study in Pakistan, where only 66.7% of doctors chose ACEi/ARB for CKD patients [23]. Furthermore, over half of the respondents referred CKD patients to nephrologists based on appropriate indications, which is crucial in improving patient outcomes by facilitating early intervention.

We identified a few limitations in our study. This study used a convenience sampling method which might lead to sampling bias. Secondly, the study only assessed knowledge on CKD which might not translate into their practice. Although there is a link between theoretical understanding and practical application, our study could not identify whether the respondents behave in a manner consistent with the reported answers. Thus, further research is required to evaluate these areas further.

5. CONCLUSIONS

There are still knowledge gaps in some areas regarding chronic kidney disease among primary care professionals that would require improvement. Previous exposure to training and usage of guidelines showed a significant association with the level of knowledge. As knowledge can affect one's practice, more educational activities can be organized to provide up-to-date knowledge. Furthermore, healthcare professionals should be encouraged to use the latest evidence-based guidelines to provide better quality of care in primary healthcare settings.

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6. FUNDING

This study did not receive any sponsorship or external funding.

7. CONFLICT OF INTEREST

Authors declare none.

8. AUTHORS' CONTRIBUTION

LKY, LHY and SBI were involved in the conceptual design, statistical analysis, manuscript preparation, editing and review.

9. ETHICS STATEMENT

Ethical approval for the study was obtained from the Human Research Ethics Committee (HREC) of USM (JEPeM Code: USM/JEPeM/19080461) and the Medical Research & Ethics Committee (MREC) of the Ministry of Health Malaysia (Research ID: NMRR-19-3654-50055). Participants provided informed consent before participating in the study, and all data were handled with strict confidentiality.

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