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ORIGINAL RESEARCH article

Prevalence of comorbidities, polypharmacy and drug-related problems among hospitalized patients with chronic kidney disease

Mustafa A. Alssageer [*], **Manal M. Saad** and **Omkalthum M. Mosbah**

Department of Pharmaceutical Care, Faculty of Pharmacy, Sebha University, Sebha, Libya
[*]Author to whom correspondence should be addressed

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Keywords: Chronic kidney disease, comorbidities, drug-related problems, hospitalized patient, Libya

Abstract: Chronic kidney disease is a public health problem affecting people worldwide. This study aimed to examine the characteristics of patients with chronic kidney disease and to identify the prevalence of drug-related problems among Libyan patients. This is a descriptive retrospective study in southern west part of Libya, Sebha City. Information abstraction forms were used for the collection of data. The investigators reviewed the medications, medical records and laboratory data to identify drug-related problems.1,000 patients' files during 2019-2020 were examined and only 120 were selected for this study. Most participants were male (73, 61.0%) and the mean age was 56.1 years. 576 comorbidities among the selected patients were identified (73, 61.0%) and the average number per patient was 4.8 concurrent diseases. There were 1 350 medications prescribed and the average of prescribed drugs per patient was 11.25. The majority of patients use more than 10 drugs (64, 53.3%) and the average length of stay in the hospital was 5.58 days. 502 drug-related problems were identified with an average of 4.18 per patient. Untreated conditions such as Hyponatremia and anemia were the highest rate of drug-related problems identified (199, 39.6%) followed by improper drug selection (82, 16.3%) such as cefotaxime, vancomycin and aminoglycoside for chronic kidney disease and drug use without indications such as antibiotics (68, 13.5%) and over-therapeutic dose such as metoclopramide (63, 12.5%). In conclusion, all the patients have polypharmacy and the majority have comorbid conditions and chronic kidney disease with frequent drug-related problems, thus, to lower the incidence rate of drug-related problems, therapeutic interventions are needed. Subsequently, it is crucial to involve clinical pharmacists in hospitals to improve the care of patients with chronic kidney disease.

Introduction

Chronic kidney disease (CKD) is a worldwide public health problem and affects more than 50 million people worldwide [1]. CKD is associated with end-stage renal disease (ESRD) and increases morbidity and mortality as well as the cost of the health care system [2]. CKD has resulted in almost one million deaths worldwide [3]. The significance of CKD not only lies in the burden associated with the disease but also in the burden associated with

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the use of medication in this chronic disease. Patients with CKD present a variety of metabolic and nutritional abnormalities [4]. Thus, patients require numerous medications and complex regimens to treat CKD and to slow progression as well as associated comorbidity. The progression of CKD may lead to an increased number of medications taken by patients to manage the complication and the comorbidities, thus, subsequently increasing the prevalence of drug-related problems (DRPs) [5]. Medication-related problems are implicated in 16.1% of all hospital admissions to an internal medicine ward [6]. Of these, 58.9% of the admissions could be avoided. Once admitted to the hospital, greater than 18.0% of patient deaths in the internal medicine ward can be attributed to one or more drugs [7]. DRPs may increase hospital admissions, morbidity, and mortality and pose a financial burden to the healthcare system [8]. Therefore, the patient who is burdened by administering many medications, it's not surprising may make mistakes in taking these medications, intentionally or unintentionally. Understanding what characteristics of CKD patients, their comorbidities and polypharmacy would potentially affect on their health outcomes and improve the overall prescribing and quality of care in CKD. DRPs can lead to an increase in hospitalization rate; therefore, strategies aimed at identifying and resolving DRPs can help reduce the number of hospitalizations [9]. Therefore, this study was conducted to identify characteristics of hospitalized CKD Libyan patients and to evaluate the prevalence rate of comorbidities and polypharmacy among the patients in southern west region of Libya.

Materials and methods

This is a descriptive retrospective study carried out in southern west part of Libya, Sebha city, Libya and conducted in adult patients (18 years or older) who were diagnosed with CKD at all stages and hospitalized in the general medical ward at Sebha Medical Centre (SMC). The study was conducted from January to September 2021, among CKD patients admitted to SMC in 2019 and 2020. Patients were eligible for inclusion if their age was more than 18 years and pre-dialysis patients. Hemodialysis patients who were reported in records he\she admitted to the medicine region were excluded.

Convenience sampling was carried out to select patients' records to include in the study. Two investigators obtained and examined patient files from SMC's statistics division which serves as a repository for hospitalized patients' medical records. A standardized data extraction sheet was used to collect the relevant data from patient medical records and data were collected by trained pharmacy students by a pre-tested data collection checklist. Investigates reviewed the medications, comorbidities, medical records and laboratory data to identify patterns of prescribed drugs, examine the prevalence of comorbidities and identify and address DRPs.

For each patient, the following data were collected: age, gender, body weight, family and social histories, history of drug allergies, relevant medical and medication history, vital signs, drugs used at admission, drugs started during the hospital stay and at discharge, results of routine laboratory tests and the diagnosed diseases which are important for identification of drug therapy problems. All personal data including name, contact details and diagnosis remained confidential. Each documented drug therapy was evaluated for the presence of DRPs based on using standard guidelines as a pathophysiologic approach and the clinical use of drugs. Medscape website was used which provides access to medical information for clinicians. The reliability and accuracy of each drug therapy problem were assessed by clinical pharmacist. Data about weight was not always available for all the patients' records. Based on the literature, the modification of diet in renal disease (MDRD) equation was applied to calculate the GFR since the MDRD formula is simpler and does not require body weight information.

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Ethical consideration: A letter of ethical clearance was obtained from the ethical review committee of Sebha University, Sebha, Libya (02/2021). The investigators obtained official permission from the Faculty of Pharmacy and SMC administration. Investigators evaluated all the prescribed drugs included in individuals' medical records to find any potential DRPs and recorded their findings on a report form. The investigators were trained by a professional clinical pharmacist (principal investigator).

Statistical analysis: Data were analyzed by Microsoft Excel and IBM Statistical Package for the Social Sciences (SPSS-20) software. The categorical and nominal variables were expressed as frequencies and percentages and data was presented as frequency, average and percentage for descriptive presentation. For the comparative analysis, the Chi-square test was used for qualitative data and the Kendall rank correlation coefficient for ordinal-ordinal correlation. A p-value of <0.05 was considered as a significant.

Results

Demographic data: The demographic characteristics of the patients with CKD are summarized in **Table 1** and **Figure 1**. The majority of respondents were in middle age (30-60 years) which accounted for 56.0% compared with the elderly group (>60 years) which was accounted for 37.0%. The average age is 56.10 years old. The majority of the patients were male (61.0%) compared to females. The CKD patients were from stage V which accounted for 61.0% and from this stage, 61.0% belong to the age group of 31-60 years. The next highest stage was IV which accounted for 25.0%, whereas, over half of them were from the elderly (over 65 years, 53.0%). However, a minority of the patients are from stage III (12.5%) and stage II (01.6%).

Table 1: Frequency and gender of Libyan patients according to the stage of renal failure

	18 - 30		%	31 - 60		%	< 60		%	Total
Stage	Male	Female		Male	Female		Male	Female		
I	00	00	00.0	00	00	00.0	00	00	00	00
II	00	00	00.0	02	00	01.6	00	00	00	02 (01.6%)
III	00	00	00.0	05	03	06.6	06	01	05.8	15 (12.5%)
IV	02	01	02.5	07	04	09.1	12	04	13.3	30 (25.0%)
V	04	02	0.05	23	22	37.5	12	10	18.3	73 (61.0%)
Total	06	03	07.5	37	29	55.0	30	15	37.5	120 (100%)

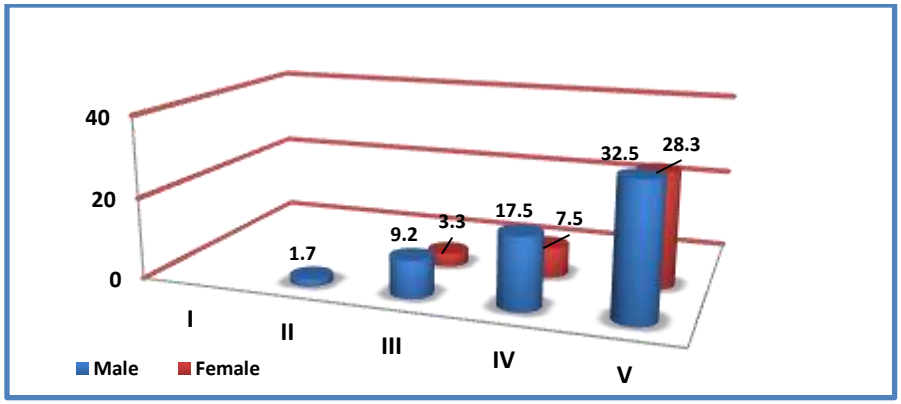

Figure 1: Distribution of chronic kidney disease stage

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Comorbidities: As shown in **Table 2**, all of the patients were found to have at least one comorbidity. Nearly, two-thirds of the patients had three to five comorbidities which accounted for 65.0% whereas 34.2% had one or two comorbidities. The average of comorbidities for each patient was 4.8. In **Table 3**, the majority of patients have anemia and electrolyte imbalance which was reported by 90.8% and 86.7%, respectively, followed by over two-thirds of the patients have hypertension and diabetes mellitus which accounted for 70.8% and 60.8%, respectively, and those patients who have hypertension accompanied with diabetes mellitus were 46.6%. In this study, the infection was recorded in 42.5% and mineral and bone disorders for 40.8% and cardiovascular diseases for 35.8% as ischemic heart disease. The minority of the patients have dyslipidemia (6.7%) (**Table 3**). Regarding to electrolyte imbalance, the present results showed that hyponatremia is the highest prevalence rate (58.3%) followed hypocalcemia (39.1%) and to a less extent, hypokalemia (21.6%) and hyperkalemia (16.6%) while minority of patients have hypernatremia (8.3%) and hypercalcemia (0.8%), as shown in **Table 4**.

Pattern of drug use: In this study, 1350 medications were prescribed for patients with CKD during their stay in SMC. As outlined in **Table 5**, the most frequently prescribed medications were supplements followed by anti-hypertension drugs which accounted for 33.9% and 18.6%, respectively. To a lesser extent, antibiotic and GIT drugs were represented by 18.6% and 14.0%, correspondingly. Among all the prescribed drugs, anti-thrombotic, anti-diabetic, analgesic, anti-lipidemic and CNS agents accounted for 3.7%, 3.6%, 3.0%, 2.9% and 2.1%, respectively. However, corticosteroids were the lowest prescribed drugs which accounted for 00.3%. Other medications were represented by 5.9%. The pattern of prescribed drugs based on patients is shown in **Table 5**. Supplements were the highest category prescribed drugs to the patients reported by 93.3% of the patients and followed by antibiotics which accounted for 84.1% of the patients. Patients who received antihypertensive medications and diuretics concurrently made up 80.0% of the patient population while those who solely received diuretics made up 58.3% of the patient population. The majority of the patients have received GIT medications (76.7%) and to a lesser extent, the antibiotic and anti-thrombotic, analgesic agents and anti-hyperlipidemic drugs were taken (32.5%, 30.0%, 29.2% and 28.3%, respectively). A minority of the patients have been given corticosteroids (03.3%).

Polypharmacy: In **Figure 2**, polypharmacy (the concurrent use of more than five different medications by a patient) was observed among all the participants in this study. The majority of the patients (53.3%) used more than 10 medications in this study compared with those who had 5 to 10 medications (46.7%) as shown in **Figure 2**. The average of drugs per CKD patient was found to be 11.25.

Table 2: Prevalence rate of comorbidities

Rate	Frequency	Percentage
1 - 2	41	34.2
3 - 5	78	65.0
> 5	1	00.8
Total	120	100.0
Average rate is 4.8 per patient		

Table 3: Type of comorbidities

Comorbidity	Frequency	Percentage
Anemia	109	90.8
Electrolyte imbalance	104	86.7
Hypertension	85	70.8
Diabetes mellitus	71	59.1
Hypertension & Diabetes	56	46.6
Infection	51	42.5
Mineral and bone disorder	49	40.8
Cardiovascular disease	43	35.8
Dyslipidemia	08	06.7
Total	576	

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Table 4: Electrolyte imbalance		
Hyponatremia	70	58.33%
Hypernatremia	10	08.33%
Hypokalemia	26	21.66%
Hyperkalemia	20	16.66%
Hypocalcaemia	47	39.16%
Hypercalcemia	01	00.83%
The mean comorbidity per patient is 4.8		

Drug-related problems: As shown in **Tables 6** and **7**, the total number of identified DRPs was 502 events with an average of 4.18 per patient. The rate of overall DRPs was 37.18 per 100 medication orders. The identified DRPs were in decreasing order, the highest rate of DRPs reported were untreated conditions which accounted for 39.6% followed by improper drug selection (16.3%). To a lesser extent, drug use without indication, and over-therapeutic dose were reported by 13.5% and 12.5%, respectively. A minority of DRPs were reported in ADRs and sub-therapeutic doses which accounted for 08.2% and 06.8%, respectively. The lowest rate was reported in drug-drug interaction (3.1%). 98.4% of the patients have at least one DRP. The common rate of prevalence (3-4) of DRPs among the patients was represented by 41.7%, then followed by (5-6) for over one-quarter of the patients (27.5%) whereas the (1-2) and (>6) were represented by 16.7% and 12.5%, respectively. Lastly, only two patients had no DRPs which accounted for only 1.6%. Patients with progression of renal failure stage are more likely related to an increased number of DRPs with highly significant ($p<0.001$). Patients with stage V have 60.0% of DRP events compared with stages IV and III which accounted for 26.0% and 12.0%, respectively. There is a significant relationship between the number of comorbidities and the prevalence of DRPs in this study with a p of <0.001. Patients with higher rates of comorbidities have a higher risk of incidence of DRPs. For example, patients with 3-5 comorbidities are 65.0% of the total of patients who have DRPs compared with just 34.2% accounted with those having 1-2 comorbidities.

Table 5: Pattern of the drug prescribed in CKD patients					
Number and percentage of drugs prescribed based on total of drugs			**Number and percentage of patients used different categories of drugs**		
Drugs	Frequency	Percentage	Drug category	Frequency	Percentage
Supplements	458	33.9	Antibiotic	101	84.17
Anti-hypertensive	251	18.6	GIT drugs	92	76.67
Antibiotics	189	14.0	Anti-lipidemic	34	28.33
GIT Drugs	163	12.0	Anti-diabetic	39	32.50
Other drugs	79	05.9	Anti-hypertensive	96	80.00
Anti-thrombotic	50	03.7	Diuretic	70	58.33
Anti-diabetic	48	03.6	Anti-hypertensive without diuretics	81	67.50
Analgesics	40	03.0	Analgesic	35	29.17
Anti-lipidemic	39	02.9	Corticosteroid	04	03.33
CNS drugs	28	02.1	Anti-thrombotic	36	30.00
Corticosteroids	05	00.3	CNS drugs	21	17.50
Total	**1350**		Supplements	112	93.33
			Others	58	48.33

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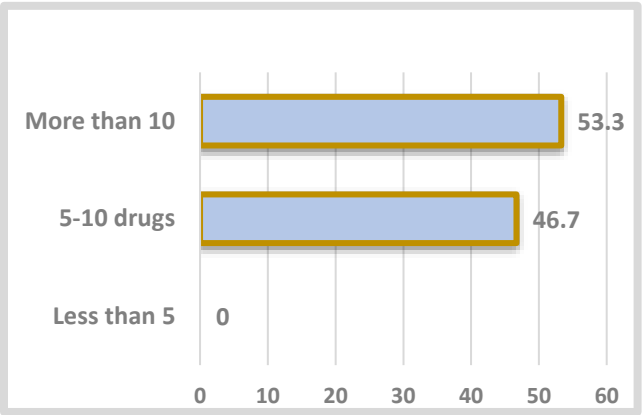

Figure 2: Prevalence of polypharmacy among Libyan CKD patients

Table 6: Type of drug related problems

DRP	Frequency	Percentage
Untreated condition	199	39.6
Drug without indications	68	13.5
Over-therapeutic dose	63	12.5
Sub-therapeutic dose	34	06.8
Improper drug selection	82	16.3
Adverse drug reaction	41	08.2
Drug-drug interaction	15	03.1
Total	**502**	**100**

Table 7: Categorized drug related problems with their examples

Drug related problems	Examples	Frequency	Details
Untreated diseases	Hyponatremia	52	
	Anemia	48	
	Hypokalemia	18	
	Thrombocytopenia	12	
	Hypocalcemia	10	
	Diabetes mullitus	09	
	Hyperkalemia	07	
	Diarrhea	05	
	Infection	05	
	Dyslipidemia	05	
	Others	28	IHD, pleural effusion, constipation
	Total	199	
Drug without indication	Antibiotics	50	
	Diuretics	06	
	Others	12	diazepam, haloperidol and propranolol
	Total	68	
Inappropriate drug Selection	ACE and ARBs	22	
	Metformin	07	
	Antibiotics	14	cefotaxime, vancomycin, aminoglycosides for CKD
	Hematinic agents	14	Not based on type of anemia
	Others	25	H-2 blocker instead PPIs
	Total	82	
Over therapeutic dose	Metoclopramide	33	need dose adjustment based GFR
	Antibiotic	22	need dose adjustment based GFR
	Others	08	allopurinol, aspirin, lisinopril
		63	
Sub-therapeutic dose	Furosemide	27	advanced stage need higher dose
	Others	07	antibiotics and insulin
	total	34	
Possible adverse effects	ACEI	23	cause hyponatremia or dry cough
	diuretics	09	cause hyperkalemia or hypokalemia
	Others	09	diarrhea from metformin and hypotensive effects from ACEIs, ARBs
		41	
Potential drug-drug interaction	Risk of bleeding	10	due to more than antiplatelet
	Others: nephrotoxicity, hypotension	05	due to combination of antihypertensive agents and antibiotics
	Total	**15**	

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Discussion

This study reveals older patients are more likely to be in the renal failure stage. The progression of CKD rises dramatically with age as supported by the significant finding of ordinal-ordinal correlation by using the Kendall rank correlation coefficient test. The kidneys are affected by the aging process which results in numerous effects on the renal system [10]. The majority of the current participants were male compared to females. This is consistence with a previous study that revealed the incidence rate of end-stage kidney disease (ESKD) in Libya was higher in males than females [11] predicting that renal impairment in females starts in older age compared with males. The majority of patients were from stage V. The reasons for this finding could be related to that most of the participants live in the South Libya areas and may have a history of many medical conditions and came to the hospital after developing ESRD. This is slightly lower than the finding obtained in Ethiopia [12]. The high prevalence rate of ESKD might associated with limited access to renal transplantation in Libya [11]. All the patients with CKD have at least one comorbidity. Evidence showed that people with CKD have a higher mean number of comorbidities than people without CKD [13]. The majority of the patients in this study have anemia similar to Ethiopia patients [12]. However, in Nigeria's study, only a few patients had anemia [14]. Reasons for this difference could be explained that patients were in stage IV and V renal failure. In advanced stages of CKD, anemia exists in a high number of patients [15, 16]. Appropriate and timely intervention using an erthyropoiesis-stimulating agent is needed to improve clinical indices and retard the progression of renal failure [17]. Interestingly, there was no prescribing of erythropoietin for our patients. The absence of erythropoietin-stimulating agents from the treatment regimen might be due to a shortage of medication in the hospital.

The majority of CKD patients have an electrolyte imbalance. This trend is higher than the published study conducted in Ethiopia which represented the electrolyte abnormality prevalence among CKD inpatients, the most serious electrolyte disturbances involve abnormalities in the levels of sodium, potassium or calcium. Hyponatremia is highly prevalent in patients with CKD [18]. The majority of the patients have hyponatremia representing the highest rate of electrolyte imbalances. Hypernatremia is much less common than Hyponatremia among patients admitted to the hospital and 10.0% in the critical care unit [19]. This trend is inconsistence with present findings since most of the patients are in the advanced stages of CKD. It has been documented that intestinal calcium absorption was decreased [20]. Reduced production of active vitamin D will result in reduced absorption of calcium from the gut [21]. Hypocalcemia was observed in patients of this study as the eGFR falls, the renal excretion of potassium is reduced and the prevalence of hyperkalemia increases from 2.0% in patients with eGFR >60 ml/min/1.73 m^2 to 42.0% in patients with eGFR <20 ml/min/1.73 m^2 [22, 23]. Patients with CKD may be predisposed to hyperkalemia for a variety of reasons. Interestingly, hypokalemia was higher in the current study than hyperkalemia.

Hypertension and diabetes mellitus are the most common comorbid conditions present in CKD while those who have these two comorbidities are almost half of the patients. Published data indicated that patients with diabetes mellitus and hypertension have a seven-fold greater risk for progression to end-stage renal failure [24]. When CKD and hypertension exist together, the risk of CVD morbidity and mortality are substantially increased [25, 26]. Patients presenting with CKD are particularly vulnerable to infections as the quality of their humoral and cellular immune response is impaired [27] and overwhelming uremia, which is associated with alterations in primary host defense mechanisms [28]. In the current study, half of the patients have bacterial infection while about double of patients have been prescribed antibiotics while staying in the hospital. Medical professionals believe a patient has an infection based on their symptoms, physical examination, laboratory results and risk factors. However, at SMC, the poor and incomplete documentation practice among physicians was noticed in

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patients' records about infection, the measurement used for diagnosing bacterial infections and frequent missing antibiotic prescribing for it. Bone abnormalities are found in the majority of patients with CKD stages III - V [29]. About half of patients have chronic renal disease - mineral and bone disorder. Numerous cohort studies have shown an association between disorders of mineral metabolism or deranged markers of CKD-MBD and poor clinical outcomes such as fracture, cardiovascular disease and mortality in patients with CKD [30-32]. Dyslipidemia is often present in patients with renal failure, long before they reach ESRD [33, 34]. Out of the total, about a third of the patients have been given statins, and only eight patients have dyslipidemia. This shows that the majority of patients who are treated with statins have successful management of their dyslipidemia. Patients with CKD suffer from high comorbidities. In the German CKD cohort, the prevalence of polypharmacy was 81.8%, which increased with the increase in CKD stages [35]. Polypharmacy was observed among all the patients and the majority of patients used more than 10 medications. Additionally, there is a substantial correlation between rising drug usage per patient and deteriorating renal function. The interpretation of the rising drug use may point to increased comorbidities among renal patients, which contributes to the advancement of renal impediments in stages [36]. Polypharmacy has the potential to DRPs. Australian general practices found that the mean number of medications prescribed to people with CKD was 8.2 with a third of the patients prescribed at least one potentially inappropriate medication [37]. Currently, almost all the patients have at least one DRPs. Inappropriate polypharmacy can lead to significant morbidities and mortality [38]. Of total medication orders for CKD patients, supplements were the highest category of drugs which was prescribed during patients staying in the hospital. Dietary prescription may limit foods that are high in vitamins, particularly water-soluble vitamins, because of their high potassium or phosphorus content [39]. The majority of patients have anemia and nearly half of the cases have mineral and bone disorders that need supplements to correct these deficiencies. The second major drugsprescribed for CKD patients was anti-hypertension. Blood pressure becomes more difficult to control with advancing CKD stages [40]. ACEIs were more prescribed orders compared with calcium channel blockers [28]. The effects of antihypertensive therapy on kidney function need to be carefully considered. According to the current KDIGO guideline [1] that recommends RAAS blockade as the first-line therapy in non-diabetic and proteinuric patients with CKD. RAAS inhibitor therapy compared with CCBs may provide kidney benefits among patients with advanced CKD and cardiovascular protection [41]. However, currently, the percentage of patients prescribed ACEIs and ARBs is less than prescribing CCBs. Infectious diseases are the second leading cause of death in end-stage CKD patients [42]. Thus, antibiotic treatment is common in these patients and requires special attention. All antibiotic use, whether appropriate or not, carries a risk of contributing to the development of antibiotic resistance. High antibiotic use is unnecessary or inappropriate. Patients have infections while double of patients were prescribed antibiotics without documenting their indications in medical records. Appropriateness of antibiotic use is determined by the presence documented indications in medical records. However, this documentation may miss indication data which leads to underestimation the risk of inappropriate antibiotic use.

Evidence indicates that as CKD progresses and medication usage increases, the prevalence of DRPs increases [43]. A significant relationship between stages of CKD and the prevalence of DRPs was found. In the same way, the result shows a significant relationship between rates of comorbidities and DRPs. So, DRPs were reported among patients with stage V and just over the quarter accounted for those having stage IV. However, polypharmacy has an insignificant relationship with the prevalence DRPs. This finding has a lower rate compared with the Indonesian study that the average of DRPs is about ten DRPs for each patient [44]. In contrast, then similar study was conducted in Ethiopia which reported the average of DRPs was 1.9 per patient [12]. This variation could relate to differences in characteristics the population and duration of study. Nearly, two-thirds of

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patients with CKD stage V patients are likely to have multiple comorbidities and complications and their treatment needs a variety of drugs which are potential risks of DRPs [45]. The poor collaboration between physicians and pharmacists was recognized as a significant factor responsible for an inappropriate prescription [46]. DRPs data analysis showed the most common type of DRPs was needing additional drug therapy or untreated conditions. This is explained by the high burden of comorbidities among the study population and higher rate of untreated condition could illustrate that physicians are more likely focus on major conditions and pay less attention to minor disease conditions such as anemia. Physician prescribing errors can arise from the choice of the wrong drug or improper drug selection. Thus, about 15.0% of the prescribed drugs were under improper drug selection. It is worth noting that anti-diabetic drugs (metformin) are prescribed to nine patients which is the most common contraindicated medicine in CKD patients because it may cause life-threatening lactic acidosis [47]. However, the use of metformin in patients with mild renal impairment was subject to debate. The poor quality of data about prescribing decisions in medical notes has been identified as contributing to prescribing errors [48]. Medication indications are not routinely documented by prescribers, in inpatient and outpatient settings [49]. Currently, drug use without indication was reported by 13.5% of patients and 84.1% of patients have received antibiotics, 50.0% have recoded infection indication. In line with treatment guidelines and recommendations, only patients who have confirmed infectious diagnoses are expected to be given an antibiotic prescription [50, 51].

One of the most important DRPs in patients with renal impairment is medication dosing errors. Hence, many medications require dosage adjustments in CKD in order to ensure efficacy and prevent toxicity. Currently, 12.5% of prescribed drugs have over-therapeutic doses of all DRPs identified. As, metoclopramide needs adjusting dose according to patient GFR as a similar trend in Ethiopia and Canada [12, 52]. Unnecessary decreases in dosage may result in under-treatment, or changing to an alternate drug with a narrower therapeutic index, lower efficacy or both. A major reason for inappropriate dosage adjustment is the underestimation of potential adverse consequences [53]. One of the strategies suggested to assist practitioners in monitoring and adjusting drug therapy in patients is clinical pharmacist dosing services [54]. CKD is a major health burden that amplifies the risk for adverse events [55], the mild interaction experienced by renal competent patients may be life-threatening in patients with impaired renal disease since their pharmacokinetic responses to the drugs are altered [56]. The potential drug-drug interactions were reported for a few patients of all the prescribed drugs. A similar trend was reported in Ethiopia for DRPs [12]. Early diagnosis, optimal use of medications, and treatment of comorbid conditions have all been associated with better outcomes in patients with CKD [29]. Given the nature of clinical pharmacist's major responsibilities and tasks, they can directly be engaged in the care of CKD and ESRD patients in different settings by identifying and addressing the DRPs in hospitals, introducing their recommendations regarding the prevention and treatment of these problems and collaborating between all healthcare providers [57]. Clinical pharmacist-led programs showed higher proportions of CKD patients achieving hemoglobin targets [58] increased medication knowledge [59] decreased hospitalization rate [28] and an overall improvement in the quality of life of CKD patients [60]. Based on the above, enhancing the involvement of clinical pharmacists may be one potential strategy to improve patient healthcare outcomes.

Conclusion: The majority of the CKD patients in Libya are middle-aged with advanced stages. A high rate of Libyan patients has comorbidities and polypharmacy with DRPs. To lower the incidence rate of DRPs among CKD patients, therapeutic intervention is necessary. Since their intervention involves patient follow-up, medication review and dose adjustments according to the functions of the kidneys, the clinical pharmacist's presence at the hospital is crucial for enhancing the care of CKD patients. To achieve this goal, physicians and clinical pharmacists in the renal field must improve their communication, collaboration and teamwork.

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