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Original article

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

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Abstract: Chronic kidney disease is a public health problem affecting people worldwide. This study was aimed to examine the characteristics of patients with chronic kidney disease and to identify prevalence of drug-related problems among Libyan patients. This is a descriptive retrospective study carried out in Southern-west part of Libya, Sebha City. Information abstraction forms were used for 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 files were selected for this study. The majority of the participants were male (73, 61.0%) and the mean age was 56.1 years. 576 comorbidities among the selected patients were identified (73.61%) and the average number per patients 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 staying 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 a crucial to involve clinical pharmacist in hospital to improve the care of patient 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 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 regimen to treat CKD and to slow progression as well as associated comorbidity. The progression of CKD may lead to increased number of medications taken by patients to manage the complication and the comorbidities, thus, subsequently increase the prevalence of drug-related problems (DRPs) [5]. Medication-related problems are implicated in 16.1% of all the hospital admissions to an internal medicine ward [6]. Of these, 58.9% of the admissions could possibly 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, 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 get mistakes in taking of these medications, intentionally or unintentionally. Understanding what characteristics of CKD patients, their comorbidities and polypharmacy would potentially effect on their health outcome and improve the overall prescribing and quality of care in CKD. DRPs can lead to increase in hospitalization rate; therefore, strategies aimed at identifying and resolving DRPs can help reduce the number of hospitalization [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 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 is 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 record 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 pattern 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 guideline as a pathophysiologic approach and the clinical use of drugs. Medscape website was used which provides an 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.

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 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 number and percentage and data presented as frequency, average and percentage for descriptive presentation. For the comparative analysis, Chi-square test was used for qualitative data and 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 the middle age (30 - 60 years) which was accounted for 56.0% compared with the elderly group (> 60 years) which was accounted for 37.0%. The average of 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 the half of them were from 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	00	00	00	00	00	00	00
II	00	00	00	02	00	01.6	00	00	00	02 (01.6%)
III	00	00	00	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	05.0	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%)

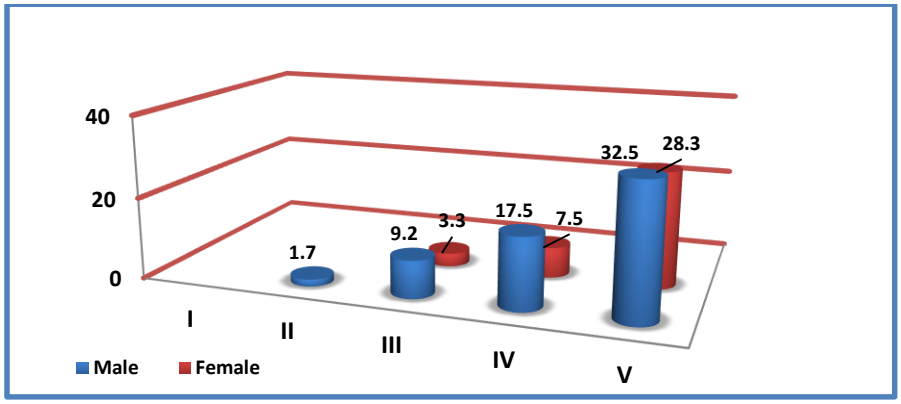

Figure 1: Distribution of chronic kidney disease stage

Comorbidities: As showed in **Table 2**, all of the patients were found to have at least one comorbidity. Nearly, two-third 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-third of the patients have hypertension and diabetes mellitus which accounted with 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 disorder for 40.8% and cardiovascular diseases for 35.8% as ischemic heart disease. The minority of the patients have dyslipidemia (06.7%) (**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 (08.3%) and hypercalcemia (00.8%), 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 were accounted for 33.9% and 18.6%, respectively. To a less 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 were accounted for 03.7%, 03.6%, 03.0%, 02.9% and 02.1%, respectively. However, corticosteroids were the lowest prescribed drugs which accounted for 00.3%. Other medications were represented by 05.9%. The pattern of prescribed drugs based on patients is showed in **Table 5**. Supplements were the highest category prescribed drugs to the patients which reported by 93.3% of the patients and followed by antibiotics which accounted with 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 diuretic made up 58.3% of the patient population. The majority of the patients have received GIT medications (76.7%) and to a less 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**, poly-pharmacy (the concurrent use of more than five different medications by patient) was observed among all the participants in this study. The majority of the patients (53.3%) were used more than 10 medications in this study compared with those who had 5 to 10 medications (46.7%) as showed in **Figure 2**. The average of drugs per each 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
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	
Mean comorbidity per patient is 4.8		

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%

Drug-related problems: As showed 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 by 39.6% followed by improper drug selection (16.3%). To a less extent, drug use without indication, over-therapeutic dose which were reported by 13.5% and 12.5%, respectively. A minority of DRPs were reported in ADRs and sub-therapeutic dose which accounted for 08.2% and 06.8%, respectively. The lowest rate was reported in drug-drug interaction (03.1%). 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 01.6%. Patient with progression of renal failure stage is more likely related with 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 with 26.0% and 12.0%, respectively. There is a significant relationship between number of comorbidities and prevalence of DRPs in this study with a p of < 0.001. Patients with higher rate of comorbidities have more risk to incidence of DRPs. For example, patient with 3 - 5 comorbidities have 65.0% of the total of patients 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

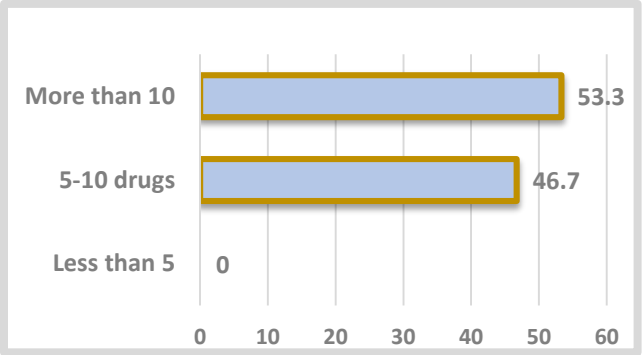

Figure 2: Prevalence of polypharmacy among Libyan CKD patients

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**	

Discussion

This study reveals older patients are more likely increasing in renal failure stage. The progression of CKD rises dramatically with age as supported by the significant finding of ordinal-ordinal correlation by suing 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 females. This is consistence with a previous study that revealed the incidence rate to end stage kidney disease (ESKD) in Libya was higher in males than females [11] predicting that renal impairment in female start in older age compared with male. 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 hospital after developing ESRD. This is slightly lower than the finding obtained in Ethiopia [12]. The high prevalence rate of ESKD might associated with a limited access to renal transplantation in the Libya [11]. All the patients with CKD have at least one comorbidity. Evidence showed that people with CKD have high mean number of comorbidities than people without CKD [13]. Majority of the patients of this study have anemia similar to Ethiopia patients [12]. However, in Nigeria's study, only 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 is existing in high number of patients [15, 16]. Appropriate and timely intervention using erthyropoiesis-stimulating agent is needed to improve clinical indices and to 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 shortage of medication in hospital.

The majority of CKD patients have electrolytes imbalance. This trend is higher than the published study conducted in Ethiopia which represented the electrolyte abnormality prevalence was 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 represented highest rate of electrolyte imbalances. Hypernatremia is much less common than Hyponatremia among patients admitted to the hospital and 10.0% in critical care unit [19]. This trend is in consistence with present findings, since most of the patients in advanced stages of CKD. It has been documented that the 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 prevalence of hyperkalemia increases from 02.0% in patients with eGFR > 60 ml/min/1.73 m^2 to 42% 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 current study than hyperkalemia.

Hypertension and diabetes mellitus are the most common comorbid conditions present in CKD while those have these two comorbidities are almost half of the patients. Published data indicated that patients with diabetes mellitus and hypertension have 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 current study, half of the patients have bacterial infection while about double of patients have prescribed antibiotics during staying in hospital. Basically, medical professionals believe patient has an infection based on their symptoms, physical examination, laboratory results and risk factors. However, at SMC, the poor and

incomplete documenting practice among physicians was noticed in 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 association between disorders of mineral metabolism or deranged markers of CKD-MBD and poor clinical outcomes 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 total, about third of the patients have been given statins, only eight patients have dyslipidemia. This shows that the majority of patients who treated by statins have successful management of their dyslipidemia. Patients with CKD suffer from high comorbidities. In German CKD cohort, the prevalence of polypharmacy was 81.8%, which was increased with the increase of CKD stages [35]. Polypharmacy was observed among all the patients and the majority of patients using more than 10 medications. Additionally, it is noticed a substantial correlation between rising drug usage per patient and deteriorating renal function. The interpretation of the rising drug use may point to increase comorbidities among renal patients, which contributes to 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 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 hospital. Dietary prescription may limit foods which 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 disorder who need supplements to correct these deficiencies. The second major drugs prescribed 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 some benefits among patients with advanced CKD and cardiovascular protection [41]. However, currently, the percentage of patients prescribed ACEIs and ARBs was 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 infection while double of patients have prescribed antibiotics without documented their indications in medical records. Appropriateness of antibiotic use determined by presence documented indications in medical records. However, this documentation may miss indication data which lead 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 rate of comorbidities and DRPs. So, DRPs were reported among patients with stage V and just over the quarter accounted with those having stage IV. But, polypharmacy has insignificant relationship with prevalence DRPs. This finding has a lower rate compared with Indonesian study that the average of DRPs about ten

DRPs for each patient [44]. In contrast, higher than 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 the characteristics the population and duration of study. Nearly, two thirds of patients with CKD stage V patients are likely to have multiple comorbidities and complications and their treatment need a variety of drugs which are potential risk 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 need additional drug therapy or untreated conditions. This explained by the high burden of comorbidities among the study population and higher rate of untreated condition could be illustrated that physicians are more likely focusing on major conditions and paying less attention on minor disease conditions 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) is prescribed to nine patients which is the most common contraindicated used medicines 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 have 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 were reported by 13.5% of patients and 84.1% of patients have received antibiotics, 50.0% of have recoded for infection indication. In line with treatment guidelines and recommendations, only patients who have confirmed infectious diagnosis 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% prescribed drugs have over-therapeutic dose of all DRPs identified. As, metoclopramide need 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 were 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 was reported for few patients of all the prescribed drugs. A similar trend was reported in Ethiopia for of DRPs [12]. Early diagnosis, optimal use of medications, treatment of comorbid conditions which they have all been associated with better outcomes in patients with CKD [29]. Given the nature of clinical pharmacist 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, introduce their recommendations regarding prevention and treatment of these problems and collaboration between all healthcare providers [57]. Clinical pharmacist-led programs showed higher proportions of CKD patients achieving hemoglobin target [58] increased medication knowledge [59] decreased hospitalization rate [28] and an overall improvement in the quality of life of CKD patient [60]. Based on the above, enhancing the involvement of clinical pharmacist may be one potential strategy to improvement patient healthcare outcome.

Conclusion: The majority of the CKD patients in Libya are middle-aged with advanced stages. High rate of Libyan patients have comorbidities and

polypharmacy with DRPs. To lower the incidence rate of DRPs among CKD patients, therapeutic intervention is necessary. Since their intervention involve patient follow-up, medication review and dose adjustments according to the functions of the kidneys, the clinical pharmacist's presence at hospital is a crucial for enhancing the care of CKD patients. To achieve this goal, physician and clinical pharmacist in the renal field must improve their communication, collaboration and teamwork.

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Author declarations: The authors confirm that all relevant ethical guidelines have been followed and any necessary IRB and/or ethics committee approvals have been obtained.

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