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RESEARCH ARTICLE

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Drug utilisation study in hospitalised chronic kidney disease patients, using World Health Organisation prescribing indicators: an observational study

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ABSTRACT

Background: Chronic kidney disease (CKD) is associated with comorbidities and altered pharmacokinetics, making appropriate prescribing, and monitoring necessary to minimise drug-related problems (DRPs). Therefore, this study aimed to describe the drug-utilisation pattern in hospitalised CKD patients.

Methods: An observational study was conducted in hospitalised adult (≥18 years old) CKD patients in the UK using WHO prescribing indicators, from November 2021 to April 2022 in a large teaching hospital in England from admission until discharge. This study used STATA version 16 for analysis.

Results: The mean number of drugs per prescription was 11.1(±5), the percentage of encounters resulting in the prescription of an antibiotic was 62%, the percentage of drugs prescribed by generic name was 90%, the percentage of encounters resulting in the prescription of an injection was 94%, and the percentage of drugs prescribed from essential drugs list or formulary was 89%. The most frequent drug group prescribed Alimentary Tract and Metabolism was 22%. Longer hospital stays, admission to a renal ward, and the number of comorbidities were independently associated with polypharmacy.

Conclusion: Not all prescribing indicators evaluated in this study were in full compliance with WHO recommendations. Polypharmacy was found in most participants which might require interventions to avoid DRPs. Further

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research is needed to evaluate factors associated with prescribing in the CKD population and prescriber perspectives on decision-making in the context of available guidelines and patient factors.

Abbreviations: ATC: The Anatomical Therapeutic Chemical (ATC) Classification System; CKD: Chronic Kidney Disease; CVD: Cardiovascular Disease; DRP: Drug-Related Problem; INRUD: International Network for Rational Use of Drugs; KDIGO: Kidney Disease Improving Global Outcomes; UK: The United Kingdom; WHO: World Health Organization

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KEYWORDS Chronic kidney disease; drug utilisation prescribing pattern; WHO prescribing indicators

Background

CKD is classified as a non-communicable disease and is the 10th leading cause of death (World Health Organisation [WHO], 2020). CKD affects both the pharmacokinetics and pharmacodynamics of many drugs, necessitating monitoring and dosage adjustment (Berns, 2021; Cao, 2020), with differing risk and benefit balances in CKD patients compared to non-CKD patients (Webster et al., 2017). Additionally, CKD is usually associated with comorbidities that might require using more medications putting patients at higher risk of DRPs than other populations (Alruqayb et al., 2021; BNF, 2022; Lea-Henry et al., 2018). Thus, prescribing and optimising drugs in CKD can be challenging for healthcare professionals. Prescribing, administering, and monitoring drugs requires careful consideration in CKD.

Drug utilisation studies are a method conducted with the purpose of ensuring the rational use of drugs which means using an appropriate drug for patients' clinical needs with an appropriate dose-fulfilling requirements for an appropriate duration, at the lowest possible cost (Elseviers et al., 2016; Holloway & Dijk, 2011). In 1993, the WHO in collaboration with the International Network for Rational Use of Drugs (INRUD) established and developed 5 indicators for prescribing in order to help establish strategies to modify drug use policies at national and local levels (Parthasarathi et al., 2012; WHO, 1993). Irrational drug use is on the rise, and some of the most common examples of concern include polypharmacy, the misuse of antibiotics to treat viral infections, and the preference for injectable medications when oral ones would be more suitable, as well as non-adherence to clinical guidelines when prescribing (Asif, 2009; World Health Organisation [WHO], 2002). To stop or reduce the dangers of irrational drug prescribing, there is a need for understanding the current situation,

increasing prescribers' awareness, evaluating the causes, and designing and implementing interventions.

CKD drug utilisation varies based on time, population, prescribers, and disease condition, so it is essential to conduct drug utilisation studies continually across time. Lifetime treatments in CKD patients make it necessary to conduct drug utilisation studies regularly (Fasipe et al., 2017; Laporte & Orme, 1993; WHO, 2002), and help understand the pattern of drug use in CKD patients (Al-Jabri et al., 2019). Studies have examined the prescribing pattern in CKD patients in Africa, Asia, and the Middle East. An Egyptian study of dialysis patients reported 10.1 as an average of drugs per patient (Al-Ramahi et al., 2016). The others, conducted on CKD patients covering all stages including dialysis, found similarly high numbers of prescribed medicines. For example, Al-Ramahi in 2012 examined 300 CKD patients (89% on dialysis), reporting an average number of drugs per patient (13.4–5.3) more than the WHO recommendations (1.6–1.8) (Al-Jabri et al., 2019; Al-Ramahi, 2012; Fasipe et al., 2018). There is limited information on drug prescribing in hospitalised patients with CKD stages 1–4. Therefore, this study aimed to describe the drug prescribing pattern in hospitalised CKD patients which would help provide information about the current prescribing pattern in this population. Additionally, risk factors for polypharmacy were assessed in this study.

Methods

A prospective observational follow-up study was conducted in order to evaluate the drug utilisation pattern in hospitalised CKD patients in medical and renal wards over 6 months. This study was conducted at a large hospital in the West Midlands region. The hospital has 1,213 beds and serves almost 500,000 adult patients annually with a wide range of medical and surgical specialities. The Department of Nephrology serves and treats all stages of renal disease from early stages through dialysis and transplantation to end-of-life care. This study was conducted according to guidelines established by WHO.

All CKD patients aged ≥18 years were admitted to renal and medical wards with evidence of CKD diagnosis (written in patients' medical notes or laboratory results over the previous three months) with ≥1 drug prescribed during the period of this study. Dialysis patients were excluded.

This study included prospectively all CKD patients during November 2021–April 2022. The total number of CKD patients that were included in this study was 387.

Non-dialysis CKD patients admitted to renal or medical wards aged ≥18 years old. Based on eGFR, patients with ≥90 mL/min with evidence of kidney damage are stage 1, 60–89 mL/min are stage 2, 30–59 mL/min are

stage 3, and 15–29 mL/min are stage 4 according to Kidney Disease Improving Global Outcomes (KDIGO) guideline (Levin et al., 2013)

Data sources used included prescription chart reviews and clinical records of admitted patients in medical and renal wards.

A data collection sheet was prepared to collect required details such as age, ward, sex, CKD stage, length of hospital stay, reason for admission, total number of comorbidities (defining them by name), total number of prescribed drugs with all prescribed drug (defining dosage form, route of administration and duration). This tool did not collect any patient identifiable information such as name, hospital or NHS number and address.

All patients admitted to the selected wards were screened based on the study eligibility criteria. For eligible patients only, all required information was collected using the available data sources. Patients were followed from admission until discharge recording all prescribed drugs, names, doses, frequency and dosage forms.

This study used the World Health Organisation (WHO) Anatomical Therapeutic Chemical (ATC) Classification System (WHO, 2022).

This study used WHO core drug use indicators and recommendations (World Health Organisation [WHO], 1993). For the essential drug lists, this study used the 22nd WHO Model List of Essential Medicines, which is defined as 'Essential medicines are those that satisfy the priority health care needs of the population' and comprised the most effective, safe, and cost-effective medications based on disease prevalence and public health relevance. Additionally, the Expert Committee on Selection and Use of Essential Medicines updates this list biennially (WHO, 2021).

This study used STATA version 16 for analysis (StataCorp, 2021). Descriptive analysis was conducted for patient demographics and prescribed drug data. The pattern of prescriptions of drug classes in all CKD patients and then by stages was described. Categorical variables were described using numbers and percentages within each category. Continuous variables were presented with mean, standard deviation, and interquartile range.

The associated risk factors with the possibility of polypharmacy among study patients were assessed using logistic regression. Seven risk factors were assessed using both univariable and multivariable models. These variables were sex, age (adult <65 years/elderly ≥65 years), length of hospital stay, type of ward, reason for admission, CKD stages and comorbidities (<5/≥5). Odd ratio, 95% confidence interval, and *P* value were stated, where $P < 0.05$ was considered significant. A descriptive analysis of drug utilisation was conducted with the WHO ATC classification system.

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Ethics

Ethical approval required for this research was gained from the research ethics committees. REC, HRA and Care Research Wales (HCRW) (Reference: 20/NS/0116), and Hospital R&D Governance office (Reference: RRK7312).

Results

CKD stage

The total number of CKD patients in this study was 375, with a follow-up period ranging from 1 d to 50 days. There were no participants missing data. The total number of prescribed drugs was 4291. Out of 375 patients, 0.8% (3) patients were CKD stage 1, 3.9% (15) patients were stage 2, 60.4% (234) were CKD stage 3 and 34.9% (135) were CKD stage 4. The distribution of patients, according to their CKD stages, is shown in Figure 1.

Demographic characters

The patients' mean age was 74.74 ± 15.5 (IQR 67–68). 22% (84) of patients were adults (18–64 years) and 78% (303) were elderly (≥65 years). In this study, 54% (208) were female and the majority 62.5% (130) of females were

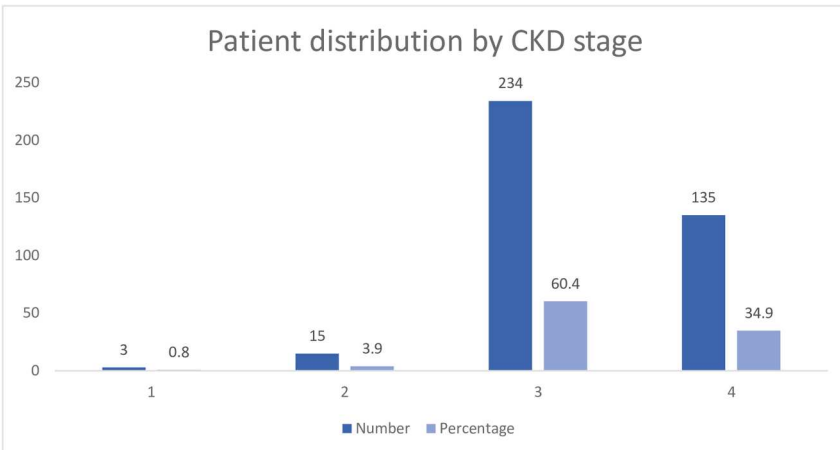


Figure 1. Distribution of patients by chronic kidney disease (CKD) stages.

Table 1. Demographic characters by CKD stages*.

	All *n* (%)	CKD stage 1 *n* (%)	CKD stage 2 *n* (%)	CKD stage 3 *n* (%)	CKD stage 4 *n* (%)
Age					
<65 years old	84 (22%)	2 (66.7%)	6 (40%)	50 (21.4%)	26 (19.3%)
≥65 years old	303 (78%)	1 (33.3%)	9 (60%)	184 (78.6%)	109 (80.7%)
Total number of patients	387	3 (100%)	15 (100%)	234 (100%)	135 (100%)
Sex					
Female	208 (54%)	1 (0.5%)	7 (3.3%)	130 (62.5%)	70 (33.7%)
Male	179 (46%)	2 (4.5%)	8 (4.5%)	104 (58.1%)	65 (36.3%)
Total number of patients	387 (100%)	3 (100%)	15 (100%)	234 (100%)	135 (100%)
Types of Ward					
Medical	290 (75%)	1 (0.4%)	13 (4.5%)	182 (62.8%)	94 (32.4%)
Renal	97 (25%)	2 (2%)	2 (2%)	52 (53.6%)	41 (42.4%)
Total number of patients	387 (100%)	3 (100%)	15 (100%)	234 (100%)	135 (100%)
Length of hospital stay					
<5 (short)	95 (24.5%)	1 (33.3%)	8 (53.3%)	66 (28.2%)	20 (14.8%)
5–10 (Medium)	107 (27.5%)	1 (33.3%)	4 (26.6%)	68 (29.1%)	34 (25.2%)
>10 (Long)	185 (48%)	1 (33.3%)	3 (20%)	100 (42.7%)	81 (60%)
Total number of patients	387 (100%)	3 (100%)	15 (100%)	234 (100%)	135 (100%)
Number of prescribed drugs					
<6 drugs	53 (14%)	1 (33.3%)	3 (20%)	38 (16.2%)	11 (8.1%)
≥6 drugs	334 (86%)	2 (66.7%)	12 (80%)	196 (38.8%)	124 (91.9%)
Total number of patients	387 (100%)	3 (100%)	15 (100%)	234(100%)	135 (100%)
Comorbidities					
<5 comorbidities	210 (54%)	3 (100%)	9 (60%)	125 (53%)	73 (54%)
≥5 comorbidities	177 (46%)	0 (0%)	6 (40%)	109 (47%)	62 (46%)
Total number of patients	387 (100%)	3 (100%)	15 (100%)	234 (100%)	135 (100%)

*This table illustrates the distribution of the study participants according to their demographics and CKD stages.

CKD stage 3. A total of 290 patients were admitted to a medical ward where the CKD stage distribution was 0.4% (1) stage 1, 4.5% (13) stage 2, 62.8% (182) stage 3 and 32.4% (94) stage 4. A total of 48% (185) were admitted for long stays (>10 days) of which 60% were CKD stage 4. Further details on the demographic characteristics of study participants are shown in Table 1.

Almost, all the study participants except one patient had one or more comorbidities. A total of 249 different types of comorbidities were found in the study patients, with a mean of comorbidities of 4.52 ± 1.999 (IQR 3–6). Patients with four or fewer comorbidities represented the highest percentage with 23.5% (91). The most common frequent comorbidities were hypertension with 63% (244) followed by atrial fibrillation with 28.2% (109), and osteoarthritis with 17.1% (66). The top six comorbidities for all patients and each CKD stage were presented in the Supplemental Material.

Drug utilisation

WHO prescribing indicators

The total number of prescribed drugs was 4291 for all the study participants (387 patients) with a mean of 11.1 ± 5 (IQR 8–14), with a minimum of 1 and a maximum of 29.

Table 2. Result of the World Health Organisation (WHO) prescribing indicators in this study*.

Indicator	WHO recommendation	Result Average OR %
(1) Average number of drugs per encounter	1.6—1.8	11.09 ± 4.9
(2) Percentage of encounters resulting in prescription of an antibiotic	20–26.8%	62%
(3) Percentage of drugs prescribed by generic name	100%	90%
(4) Percentage of encounters resulting in prescription of an injection	13.4–24.1%	94%
(5) Percentage of drugs prescribed from essential drugs list or formulary	100%	89%

*These indicators were established by the World Health Organisation (WHO) to evaluate drug prescribing patterns (WHO, 1993).

According to the WHO prescribing indicators, the average number of drugs per patient was 11.09. The percentage of encounters resulting in the prescription of an antibiotic was 62%. The percentage of drugs prescribed by generic name was 90%. The percentage of encounters resulting in the prescription of an injection was 94%. The percentage of drugs prescribed from the essential drug list or formulary was 89%, as shown in Table 2.

Most frequently prescribed drugs

The most frequently prescribed drugs were group 'alimentary tract and metabolism' (Group A) with 22% (3576/4291) where drugs for acid-related disorders represented 26% of the total group. The second frequently prescribed group of drugs was 'cardiovascular system' (Group C) with 19% (803/4291) where lipid-modifying agents represented 22% of the total group. The third group was 'B-Blood and blood forming organs' drugs representing 17% (730/4291) where antithrombotic agents were the highest class with 75% of the total group. For further details on prescribed drugs, see Figure 2 and the Supplemental Material.

A percentage of 0.5% (22) drugs were prescribed for CKD stage 1, with the highest representation in group C at 36% (8 drugs). For CKD stage 2, 3% (147) of the drugs were prescribed and group 'A' represented the highest group at 19.7% (29 drugs). In the CKD stage, 58% (3, 2473) of the drugs were prescribed, with the group 'A' representing 22% (533 drugs). Finally, for stage 4 CKD patients, 1649 drugs were prescribed, with the group 'A' being the highest 23% (377 drugs). The distribution of groups in different CKD patients is presented in Figure 3 and Table 3.

Group 'A' represented the most frequently prescribed drug among almost all different demographic characteristics except short hospital stay and non-polypharmacy patients, whereas groups 'C' and 'B' were more frequently in these groups respectively, as shown in the Supplemental Material.

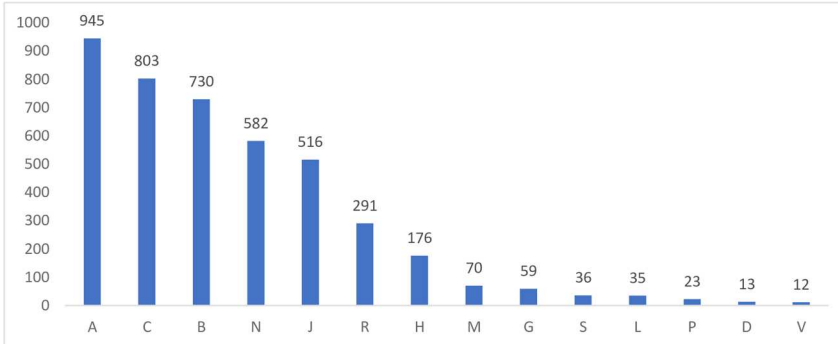


Figure 2. Drug utilisation pattern for all participants.

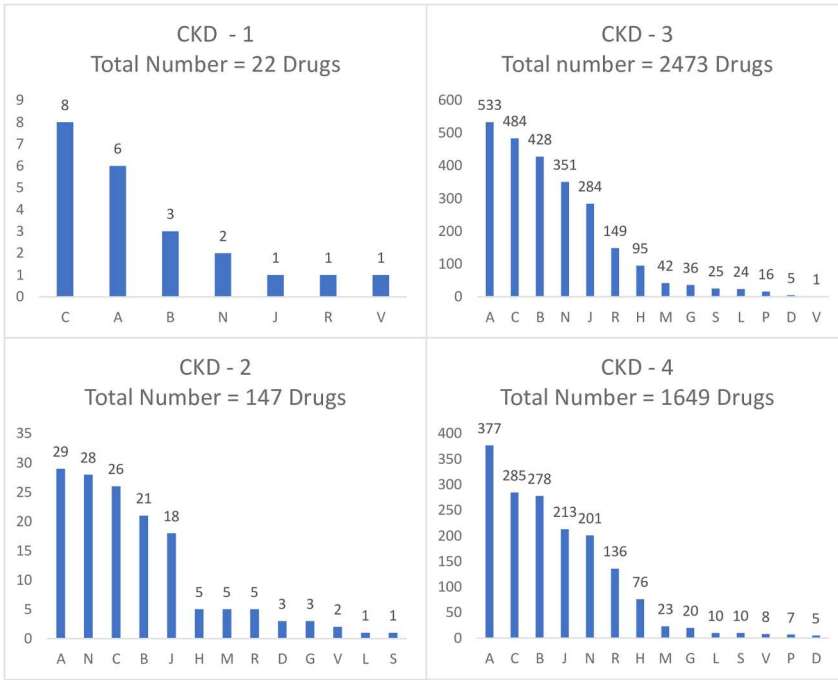
Factors associated with polypharmacy

On univariable logistic regression, there was a significant difference between age groups ($P = 0.020$), length of hospital stay ($P < 0.001$), type of wards ($P < 0.001$) and the number of comorbidities ($P < 0.001$). On multivariable logistic regression, three factors were significant independent predictors which were the length of hospital stay (medium and long stay), type of wards and the number of comorbidities. Patients admitted to medical wards are at risk of having polypharmacy with 71% more than patients admitted to the renal ward (OR 0.29, 95% CI 0.1–0.8; $P = 0.02$). Admission for five to ten days is likely to increase the risk of polypharmacy (OR 48.4, 95% CI 12.9–181.8; $P < 0.001$), and admission for more than ten days is likely putting the patient at higher risk of polypharmacy (OR 57.2, 95% CI 15.9–205.8; $P < 0.001$), compared to patients admitted for less than 5 days. Patients with ≥5 comorbidities are at eight times greater risk of polypharmacy compared with patients with less than 5 comorbidities (OR 8.4, 95% CI 2.8–25.2; $P < 0.001$), as seen in Table 4.

Discussion

Summary

To the best of the researchers' knowledge, this is the first study describing the prescribing pattern among non-dialysis hospitalised CKD patients in one of



A - Alimentary tract and metabolism	**L** - Antineoplastic and immunomodulating agents
B - Blood and blood forming organs	**M** - Musculo-skeletal system
C - Cardiovascular system	**N** - Nervous system
D - Dermatologicals	**P** - Antiparasitic products, insecticides and repellents
G - Genito-urinary system and sex hormones	**R** - Respiratory system
H - Systemic hormonal preparations, excluding sex hormones and insulins	**S** - Sensory organs
J - Antiinfectives for systemic use	**V** - Various

Figure 3. Distribution of drug groups by CKD stages.

the largest teaching hospitals in the UK using WHO core indicators. The average number of drugs per patient (11.09), the percentage of encounters resulting in the prescription of an antibiotic (62%), the percentage of drugs prescribed by generic name (90%), the percentage of encounters resulting in the prescription of an injection (94%), and the percentage of drugs prescribed from essential drugs list or formulary (89%), did not meet the WHO recommendations. Group A drugs were most frequently prescribed, and length of hospital stay, type of ward and number of comorbidities were significantly associated with polypharmacy. No study was conducted on non-dialysis CKD patients, or providing CKD status, to allow direct comparison with this study's findings on prescribing indicators. Thus, this study could form a basis for this population for future studies on prescribing pattern research in patients with CKD.

Table 3. Distribution of drug groups by CKD stages*.

CKD Stages	Total	Group A	Group B	Group C	Group D	Group G	Group H	Group J	Group L	Group M	Group N	Group P	Group R	Group S	Group V
1	22	6	3	8	0	0	0	1	0	0	2	0	1	0	1
2	147	29	21	26	3	3	5	18	1	5	28	0	5	1	2
3	2473	533	428	484	5	36	95	284	24	42	351	16	149	25	1
4	1649	377	278	285	5	20	76	213	10	23	201	7	136	10	8
Total	4291	945	730	803	13	59	176	516	35	70	582	23	291	36	12

A – Alimentary tract and metabolism
B – Blood and blood-forming organs
C – Cardiovascular system
D – Dermatologicals
G – Genito-urinary system and sex hormones
H – Systemic hormonal preparations, excluding sex hormones and insulins
J – Antiinfectives for systemic use
L – Antineoplastic and immunomodulating agents
M – Musculoskeletal system
N – Nervous system
P – Antiparasitic products, insecticides and repellents
R – Respiratory system
S – Sensory organs
V – Various

*This table illustrates the distribution of the prescribed drugs for the study participants according to the Anatomical Therapeutic Chemical (ATC) Classification System for each CKD stage.

Table 4. Risk factors of polypharmacy*.

Characteristics		Univariable	95% CI	*P* Value	Full Model	95% CI	*P* Value
Sex	Male	0.9	0.5–1.6	0.659	1.52	0.65–3.5	0.332
Age	≥65	2.1	1.1–3.9	**0.022**	0.68	0.2–1.89	0.461
Length of hospital stay	<5 (short)	Reference					
	5–10 (Medium)	33.9	10.1–114.5	**<0.001**	48.4	12.9–181.8	**<0.001**
	>10 (Long)	59.4	17.7–199.1	**<0.001**	57.2	15.8–205.8	**<0.001**
Type of ward	Renal	0.33	0.2–0.6	**<0.001**	0.29	0.1–0.8	**0.02**
Reason for admission	Non-Elective	2.8	0.7–11.2	0.129	0.6	0.09–4.2	0.611
CKD stage	1	Reference					
	2	2	0.1–30.2	0.62	35	0.06–200.8	0.54
	3	2.58	0.2–29.2	0.44	1.6	0.03–68.2	0.8
	4	5.6	0.47–67.2	0.17	2.5	0.05–111.6	0.63
Comorbidities	≥5	10.2	3.9–26.2	**<0.001**	8.4	2.8–25.2	**<0.001**
Statistical test used		This data resulted from the univariable and multivariable logistic regression test Significant values are **bolded** (<0.05)					

*This table illustrates the risk factors for polypharmacy occurrence among hospitalised CKD patients. CKD: Chronic Kidney Disease; CI: Confidence Interval; OR: Odd Ratio.

WHO prescribing indicators

This indicator was established to assess the level of polypharmacy (WHO, 1993), which was found in the literature to increase the risk of DRP occurrence (Alruqayb et al., 2021; Subeesh et al., 2020). The mean number of drugs per patient in this study was (11.1 ± 5) which is higher than that of the WHO recommendation (1.6–1.8) which indicated the existence of polypharmacy as per this WHO indicator (WHO, 2002).

In the literature, the average number of prescribed drugs in studies including CKD stage 1–5 and dialysis-only patients, ranged from 5.1 to 13.4 (Al-Ramahi et al., 2016; Fasipe et al., 2017; Prudhivi et al., 2018). However, this study included only CKD patients who were not on dialysis which was not found in the literature. Different reasons for having a high average of prescribed drugs were identified in the literature such as prescribers' behaviour, number of comorbidities or length of hospitalisation. Also, variations could be due to the nature of this study which is a prospective follow-up study from admission to discharge where about 48% of the study participants stayed for >10 days, sample size, number of comorbidities and the prescribing system that deals with patients' hospital stay as one prescription (Desalegn, 2013; Marquito et al., 2014; Sgnaolin et al., 2014).

Although polypharmacy is considered inappropriate, such prescribing might be appropriate for certain serious chronic conditions (Soon et al., 2021). For example, in CKD, using polypharmacy could be appropriate to prevent disease progression and control comorbidities such as anaemia, CVD, and metabolic and bone disorders (Mason, 2011; Schmidt et al., 2019). Appropriate polypharmacy is defined as 'optimisation of medications for patients with complex and/or multiple conditions where medication use agrees with best evidence' (Cadogan et al., 2016). Consequently, differentiation between inappropriate and appropriate polypharmacy is encouraged by several researchers (Bushardt et al., 2008; Gillette et al., 2015). Therefore, it is recommended regarding appropriate polypharmacy that prescribed medicines should rely on the best available evidence, drug–drug interaction, drug-disease interaction and patient's condition, comorbidities, and preference to reach the desired outcomes (Cadogan et al., 2016). Inappropriate polypharmacy can develop if these factors are not considered during prescribing (Rankin et al., 2018), leading to DRPs or medication waste. For example, in 2015, the NHS estimated £300 million wasted prescriptions were wasted annually (Hazell & Robson, 2018), and in Ontario Canada the figure of $1.22 billion in 2020 has been calculated (Black et al., 2020).

Since the WHO prescribing indicators lack a distinction between appropriate and inappropriate polypharmacy, there might be a need for new indicators that consider the nature of CKD, and other conditions, which necessitate the use of multiple medications to prevent progression and control comorbidities. In the case of irrational polypharmacy, deprescribing to identify, reduce, slowly

withdraw, or stop drugs where harms of potential harms exceed the benefits would help rationalise drug use and reduce the risk of further harm to patients (Lai & Fok, 2017; Parker & Wong, 2019; Scott et al., 2015).

In this study, 90% of the medicines were prescribed with the generic name, which was close to the WHO recommendation of 100%. Previous studies investigating generic prescribing in all CKD stages or dialysis-only patients found a wide range of 0%–100% which could reflect a lack of confidence in generic drugs, or differences in the prescribing systems in different hospitals (Ahlawat et al., 2016; Mahmood et al., 2016). Recommendations to use generic names are to avoid confusion that could lead to inappropriate polypharmacy (Laychiluh, 2014). However, in some circumstances, such as bioavailability differences in narrow therapeutic index drugs, using brand names is required (Brennan, 2017), and prescribers should be aware of this.

A total of 89% of prescribed drugs were from the EML which is less than the WHO recommendation. Several studies including dialysis patients showed similar non-compliance with a range of 44%–81% (Ahlawat et al., 2016; Atray et al., 2021). The use of a national drug list is recommended by the WHO, but carrying implementation of a national drug list could be the reason for these differences among studies.

Injected drugs carry an inherent additional risk to patients, and, therefore, may increase the risk of DRPs, infections, or even death. In the present study, the percentage was 93.5% which is much higher than the WHO recommendations (13.4–24.1%) and this could be due to the comorbidities the patients have such as diabetes mellitus, anaemia, and infections which may require this formulation of drugs. A range of 9.7%–77.8% was found in studies including dialysis patients (Al-Jabri et al., 2019; Atray et al., 2021; Kamath et al., 2019; Kanani et al., 2019). High percentages reveal concerns with prescriber expertise or emergencies as well as awareness of the strength of various pharmaceutical formulations (i.e. injection and oral) (Ofori-Asenso, 2016).

Antibiotic resistance is a growing worldwide issue which could lead to infection treatment issues or even death (WHO, 2021). The percentage of prescriptions with antibiotics in the present study was 62% which is noticeably higher than that of WHO recommendation (20–26.8%). A wide range of 3.9–77% exists in CKD studies including dialysis patients (Al-Jabri et al., 2019; Mathew et al., 2021). High percentages of antibiotic prescribing might indicate indiscriminate antibiotic use (Ofori-Asenso, 2016), which is a growing global health risk that could lead to DRPs, hospitalisation, further kidney damage or higher cost (Aloy et al., 2020; Eyler & Shvets, 2019).

Overall, according to the WHO guidance document, the 'gold standard' for correct behaviour is unknown; so, these indicators should be viewed as preliminary measures intended to encourage further enquiry and future action (WHO, 1993). However, this study provided data on prescribing patterns in hospitalised non-dialysis CKD patients according to the best available tool

(WHO prescribing indicators) that could help in understanding the current prescribing in this population and designing future studies on prescribing pattern research in this population.

Prescribed drugs

The drug groups most commonly prescribed in this study were Alimentary tract and metabolism (group A) at 22%, followed by the Cardiovascular system (group C) at 18.7%, and Blood and blood-forming organs (group B) at 17%. These findings are consistent with two previous studies conducted in India in 2019 and 2014 that focused on CKD patients, including those undergoing dialysis (Bajait et al., 2014; Kanani et al., 2019). However, contrasting results were observed in several other studies (Ahlawat et al., 2016; Kamath et al., 2019; Roux-Marson et al., 2020).

Antihypertensive and antithrombotic agents represented the highest prescribed drug classes in this study which was in line with the literature (Al-Jabri et al., 2019; Kamath et al., 2019). Treating hypertension was found to be effective in slowing the progression of CKD (Pugh et al., 2019). Also, prescribing anti-thrombotics needs to be undertaken with caution, especially in CKD patients. Research has indicated a high risk of bleeding associated with the use of antithrombotic drugs, leading to visits to the hospital emergency department (Laville et al., 2021). Overall, prescribers' knowledge and awareness of pharmacokinetics, pharmacodynamics, and pharmacology will help in improving safe drug prescribing in hospitalised CKD patients.

Risk factors for polypharmacy

In this study, length of hospital stay, type of ward and number of comorbidities were found to be independent predictors of polypharmacy which was also found in the literature for all CKD stages including dialysis (Abolhassani et al., 2017; Fulton & Riley Allen, 2005; Jokanovic et al., 2015; Schmidt et al., 2019). These predictors should be considered since polypharmacy was found to be associated with DRP occurrence and avoid limiting patients' life expectancy (Alruqayb et al., 2021; Jokanovic et al., 2015; Roux-Marson et al., 2020). Even though prescribers frequently evaluate the appropriateness of the prescribed drugs for the patient, it is not easy to reduce the burden of drugs. Therefore, prescribers should review medication regularly assessing efficacy and problems as well as consider deprescribing when the drug is ineffective or unsafe.

Strengths and limitations

This study used primary data from patients' medical notes and prescription details were available prospectively. Another strength of this study is the

design, which allowed patients to be followed throughout the hospital journey from admission until discharge – observing any changes in drug utilisation. This study was only conducted for five months and included only one hospital and two wards. Additionally, comparing the results with a similar population in other studies was not possible as all available studies either included dialysis patients or were conducted only on dialysis patients.

Conclusion

In this study of CKD patients, none of the prescribing indicators were following the recommended WHO guidelines. Polypharmacy was prevalent among the majority of CKD patients, highlighting the need for interventions to assess the appropriateness of medication use and the potential for the withdrawal of deprescribing inappropriate prescriptions. Additionally, the complex nature of CKD, characterised by multiple medications due to comorbidities and progression prevention, suggests the potential requirement for new prescribing indicators specifically tailored for serious chronic conditions like CKD. This study contributes valuable data on the prescribing patterns for non-dialysis CKD patients across different stages (1–4). Further research is warranted to explore healthcare professionals' perspectives on prescribing for CKD patients during hospitalisation and identify potential strategies to mitigate polypharmacy.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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