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A retrospective analysis of pharmacotherapy in Kazakhstan: Assessment of the rational prescription and use of antibiotics in the nephrology department of a multidisciplinary hospital

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ABSTRACT

Introduction: The rapid development of the pharmaceutical industry has increased the need to assess and monitor the use of medicines. Thus, necessitates the importance of monitoring the appropriate use of medicines including antimicrobials.

Objective: Pharmacoeconomic analysis of pharmacotherapy in the nephrology department at a multidisciplinary hospital.

Methods: The study is a retrospective analysis of medicine use and expenditure. The study utilized the ABC-VEN analysis of medical use and the WHO-AWaRe-2021 analysis of antibiotic use, to determine the prescription and financial trends of the nephrology department (30 beds) of a multidisciplinary regional hospital (total 844 beds) in Turkestan, Kazakhstan 2018-2021.

Results: The analyzed costs of drugs included 116 international nonproprietary names prescribed to patients from the nephrology department during the study period. In total, pharmacotherapy costs increased by 52.6% in 2021 compared to 2018. Five INN drugs were purchased without their inclusion in the Kazakhstan National Medicinal Formulary, such as atropine sulfate, sodium bicarbonate, sodium chloride (crystalline salt), nitroxoline, and nitrofural. The pharmacoeconomics analysis of antibiotics usage for 2018-2021 showed a sharp increase in the%age of costs.

Conclusion: The study showed an increase in funding for pharmacotherapy in the department of nephrology, which increases the availability of medicines. However, the trend in prescribing drugs with poor evidence base level, and the increase in the proportion of antibiotic prescription, require immediate intervention including the utilization of clinical pharmacy services for regular assessment of the pharmacoeconomic feasibility of antibiotic therapy. This will improve the quality of medical care and reduce the financial costs.

Keywords: nephrology, ABC/VEN, AWaRe, drug efficacy, safety

INTRODUCTION

Approximately, more than 50% of all antimicrobial drugs are either prescribed or dispensed inappropriately and that almost every second patient takes them incorrectly [1]. However, this practice appears to worsen during the COVID-19 pandemic with the irrational use of medicines, including antibiotics became more frequent [2]. Thus, a systematic monitoring of drug supply and evaluation of the appropriate use of medicine is vital to stabilize and improve drug-dispensing practice. The evaluation of drug dispensing and use in a healthcare setting are based on the implementation of a number of procedures including the estimation of the rationality of drug procurement structure and assessing the organization of drug distribution within a particular setting. Therefore, it is necessary to consider the validity of drug prescription considering the principles of evidence-based medicine, which must comply with formularies, diagnostic protocols, and treatment. In addition, prescriptions must also be assessed for eligibility in the Kazakhstan state guarantee program, which includes a list of medicines for additional preferential coverage that needs to be prescribed through a specific procedure of medical commissions that are regulated by specific governmental protocols. Consequently, the use of drugs that have high costs in a healthcare structure necessitates the use of strict justification for prescribing parameters and rational consumption guidelines.

Table 1. List of drugs not included in the KNF for the period from 2018-2021

No	n (non-vital)	Clinical treatment guidelines of genitourinary system diseases according to ICD-10 (N00-N99)	Amount of expenses in Kazakh Tenge
1	Atropine sulfate	No data	667.00 (group C)
2	Sodium bicarbonate	No data	13,588.01 (group C)
3	Sodium chloride	No data	176.15 (group C)
4	Nitroxoline	No data	174,370.00 (group A)
5	Nitrofural	No data	8,494.1 (group C)

Furthermore, the irrational use of antibiotics, as well as the growth of antibiotic resistance increases financial pressure and constrains on healthcare funds for the purchase of critical drugs.

Nonetheless, the combined assessment of the activity-based-costing analysis and the vital, essential, and non-essential assessment (ABC/VEN) is one of the available and relevant methods for assessing drug supply and rational pharmacotherapy. ABC-VEN analysis is a clinical and economic method for evaluating a medical organization's pharmacotherapy and drug supply.

ABC examines the feasibility of using financial costs for medicines by categorizing them into three groups based on the volume of their consumption over a given time period: A (80%); B (15%); or C (5%) consumption per year. Whilst VEN analysis assesses the effectiveness of medicine and categorizes them as: vital includes medicines necessary or important to save and maintain life; essential such as drugs effective in the treatment of less dangerous but serious diseases; Non-essential–this covers expensive medicines that are used for symptomatic indications.

Other methods of assessing drug supply include the use of WHO access, watch, and reserve classification (AWaRe 2021) of antibiotics that assesses the main indicators of rational medicine use and monitoring of antibiotic consumption [3, 4]. However, there are no data available in Kazakhstan to show the current rate or prevalence of irrational use/prescription of antibiotics in healthcare settings. Therefore, the current study aims to use the ABC/VEN analysis and the WHO-AWaRe 21 methods to determine the prevalence and irrational use/prescription of antibiotics in Kazakhstan, respectively.

METHODS

This is a retrospective study performed using the ABC/VEN pharmacoeconomic analysis to comparatively analyze and assess the rational use of medicines and their costs over a four year period from the department of nephrology in the Turkestan Regional Hospital that is located in the southern region of the Republic of Kazakhstan. The nephrology department has 30 beds, accounting for 3.5% of the hospital's total bed count of 844 beds. Taking the four-year study period into consideration, the department's average bed capacity is 9029 bed-days per year. The analysis was based on the number of prescribed medicines and the number of treated patients from 2018 to 2021. The ABC/VEN-analysis was carried out considering the data on expenditures for antibiotics in the department of nephrology (30 beds) of a multidisciplinary regional hospital (total 844 beds) with one full-time clinical pharmacologist.

The formal method of VEN analysis used in the study is a comparative analysis based on the Kazakhstan National Medicines Formulary (KNF). KNF is the main component of the formulary system in the Republic of Kazakhstan's healthcare, developed in accordance with the principles of evidence-based medicine, which is a list of medicines that has passed a review of data on safety and efficacy, and it is updated on an annual basis [5-7]. In addition, the main indicator of rational medicine use - monitoring antibiotic consumption - was investigated using the WHO-AWaRe 2021 (access, watch, and reserve) antibiotic classification.

RESULTS

The costs of drugs were analyzed during the study period of 2018-2021, with a list of 116 international non-proprietary names (INN) prescribed to patients from the Nephrology Department. **Table 1** shows a four-year period, the cost of medicines in the department totaled 25,035,782.6 Kazakh Tenge (USD=58,516.7), with an average of 6,258,945.65 Kazakh Tenge (USD=14,629.2).

According to the results of VEN analysis (**Table 1**) from 2018 to 2021, five drug positions were identified with a total cost for four years of 197,295.26 Kazakh Tenge (0.78% of total costs) that were not included in the KNF and clinical treatment guidelines of Kazakhstan: atropine sulfate, sodium bicarbonate, sodium chloride (crystalline salt), nitroxoline, and nitrofural [8, 9].

The ABC analysis (**Table 1**) revealed a steady increase in the volume of the most expensive drugs (group A) from 3,763,114.9 Kazakh Tenge in 2018 to 6,144,539.9 Kazakh Tenge in 2021, for a total of 6,144,539.9 Kazakh Tenge. Simultaneously, the group A medicine structure included 18 INNs in 2018, 16 INNs in 2019, 18 INNs in 2020, and 19 INNs in 2021.

Table 2 shows an examination of commonly used drugs in the department of nephrology in the context of ABC groups revealed the purchase of 26 INNs from 2018 to 2021 (four years in a row). All 26 INN positions were studied using criteria "renal failure" from KNF and "nephrotoxicity" from internationally recognized clinical guidelines-"The renal drug handbook" [10].

Table 2. List of frequently purchased INNs for the period from 2018-2021

No	INNs purchased every year from 2018-2021	ABC group	VEN by KNF	KNF diagnosis in nephrology	Renal failure according to KNF	Nephrotoxicity*
1	Albumin	A	V	Kidney disease (nephritis, nephrotic syndrome)	Use with caution	No data
2	Amlodipine	A	V	Arterial hypertension	Use with caution, dose adjustment is not required	No

Table 2 (Continued). List of frequently purchased INNs for the period from 2018-2021

No	INNs purchased every year from 2018-2021	ABC group	VEN by KNF	KNF diagnosis in nephrology	Renal failure according to KNF	Nephrotoxicity*
3	Albumin	A	V	Kidney disease (nephritis, nephrotic syndrome)	Use with caution.	No data
4	Amlodipine	A	V	Arterial hypertension	Use with caution, dose adjustment is not required.	No
5	Amoxicillin & beta-lactamase inhibitor	A	V	Urinary tract infections	Use with caution. With a creatinine clearance (CC) of 10-30 ml/min), 625 mg is prescribed every 12 hours: with CC less than 10 ml/min-625 mg every 24 hours. With anuria, the interval between doses should be increased to 48 hours or more.	No
6	Heparin sodium	A	V	Control of blood clotting during surgery	Contraindicated.	No
7	Ceftriaxone	A	V	Urinary tract infection	Reduce dose if there is impaired renal function. With creatinine clearance less than 10 ml/min, daily dose should not exceed 2 g.	No
8	Epoetin alfa, beta, & zeta	A	V	Treatment of symptomatic anemia in patients with chronic renal failure. Treatment of symptomatic anemia in adult patients with solid non-myeloid tumors receiving chemotherapy	Use with caution.	No
9	Lactulose	B	V	Constipation (regulation of physiological rhythm of colon)	There are no specific dosing recommendations as intravenous exposure to lactulose is negligible.	No
10	Omeprazole	B	V	Peptic ulcer of stomach & duodenum; gastroesophageal reflux disease	Dose adjustment is not required.	No
11	Ciprofloxacin	B	V	Urinary tract infections (including urethritis & cervicitis, orchiepididymitis, & pelvic disease caused by neisseria gonorrhoeae)	Dose adjustment depending on values of creatinine clearance. Crystalluria associated with appearance of an alkaline urine reaction is possible, to ensure sufficient fluid intake. Use in children with impaired renal function has not been studied.	Yes
12	Ampicillin	C	V	Urinary tract infections	Use with caution. Reduce dose of drug with a creatinine clearance (CC) of 20-30 ml/min-by 2/3 of the usual dose; with CC less than 20 ml/min-1/3 of the usual dose; with a pronounced violation-the dose of ampicillin should not exceed 1 g in 8 hours.	No
13	Bisoprolol	C	V	Arterial hypertension, coronary heart disease (angina pectoris)	Dose adjustment is not required, with creatinine clearance less than 20 ml/min, the maximum daily dose is 10 mg.	No
14	Diclofenac	C	V	Urolithiasis disease	Contraindicated in creatinine clearance less than 30 ml/min.	No
15	Diphenhydramine	C	V	Allergic reactions such as: urticaria, angioedema, rhinitis, conjunctivitis, pruritic dermatosis	Use with caution.	No data
16	Iron sulfate	C	V	Treatment & prevention of iron deficiency anemia	The drug is prescribed according to indications	No
17	Ketorolac	C	V	For short-term relief of acute pain of moderate & severe intensity in postoperative period	Contraindicated in serum creatinine over 160 µmol/L. The maximum daily dose of 60 mg per day for intramuscular or intravenous administration.	Yes
18	Magnesium sulfate	C	V	Poisoning, constipation, bowel cleansing, cholangitis, cholecystitis before diagnostic procedures	Contraindicated in renal dysfunction.	No data
19	Metamizole sodium	C	V	Over the past decades, use of metamizole & drugs containing this active substance (baralgin, novalgin, pentalgin, spazgan, & others) has been banned in Sweden, the US, Japan, Australia, & other countries in due to the fact that one of its side effects may be development of agranulocytosis, a life-threatening pathological condition characterized by a low content of neutrophilic granulocytes in the blood	Orally-If creatinine clearance below 30 ml/min, the interval between injections of the drug should be at least 6 hours, while the frequency of administration is 2-3 times a day. Intravenous infusions are contraindicated in patients with creatinine clearance below 30 ml/min. Pay attention to the sodium content of paracetamol effervescent tablet.	No data
20	Metoclopramide	C	V	Vomiting & nausea of various cause, prevention of postoperative nausea & vomiting, gastric paresis in diabetes mellitus patients	In patients with severe hepatic impairment, the dose should be reduced by 50%. It is necessary to observe for the development of side effects. In case of their occurrence, the use of the drug is immediately stopped.	No

Table 2 (Continued). List of frequently purchased INNs for the period from 2018-2021

No	INNs purchased every year from 2018-2021	ABC group	VEN by KNF	KNF diagnosis in nephrology	Renal failure according to KNF	Nephrotoxicity*
21	Metronidazole	C	V	Trichomoniasis in women (vaginitis & urethritis) & in men (urethritis); giardiasis; amoebic dysentery; anaerobic infections caused by microorganisms sensitive to drug; severe mixed aerobic-anaerobic infections as part of combination therapy; prevention of anaerobic infection during surgical interventions (especially on the abdominal organs, urinary tract)	If creatinine clearance less than 10 ml/min then reduce the daily dose by 2 times. Does not require dose adjustment when administered intravenously.	No
22	Nystatin	C	V	Treatment & prevention of fungal diseases (with long-term treatment with drugs of the penicillin & tetracycline series, chloramphenicol, etc.)	No data	No
23	Folic acid	C	V	For the treatment of folic acid deficiency anemia, hypovitaminosis, & vitamin deficiency of folic acid, incl. with tropical & non-tropical sprue	No data	No
24	Fosfomycin	C	V	Acute bacterial cystitis, acute attacks of recurrent bacterial cystitis; bacterial nonspecific urethritis; asymptomatic massive bacteriuria in pregnant women; postoperative urinary tract infections; prevention of urinary tract infection during surgery & transurethral diagnostic studies	In case of renal insufficiency, reduce the dose and lengthen the intervals between injections. Contraindicated if creatinine clearance is less than 10 ml/min.	No data
25	Furosemide	C	V	Edema of various origins, arterial hypertension (as part of complex therapy)	In patients with severely impaired renal function (serum creatinine >5 mg/dl), it is suggested not to exceed an infusion rate of 2.5 mg/min. Contraindicated in renal failure with anuria refractory to treatment with furosemide.	No
26	Enalapril	C	V	Arterial hypertension; symptomatic heart failure (as adjunct therapy)	During treatment, cholestatic jaundice can occasionally be observed up to fulminant hepatic necrosis (sometimes fatal). If symptoms of liver failure appear (jaundice or marked elevation of liver enzymes), the ACE inhibitor should be discontinued & treated appropriately.	No

The most expensive drug by 2021 and the most frequently purchased drug throughout the entire period is Heparin sodium (group A), the share of expenses from total costs of which increased systematically (by 26.2%) from 2018 to 2021, amounting to 5.43% in 2018, 7.14% in 2019, 11.33% in 2020, and 20.7% in 2021, respectively (**Table 3**). In 2021, group A included a drug not covered by the KNF, with a 2.39% share of total costs (407.6 USD).

Group “B” medicines like lactulose, omeprazole, and ciprofloxacin were purchased annually, the total costs of which for the study period amounted to 775,516.05 Kazakh Kazakh Tenge (USD=1,812.6) (**Table 4**).

Table 3. Formal VEN analysis for KNF of the most expensive group “A” in the context of INN for 2018-2021

VEN by KNF	Group A according to INN	2018, %	2019, %	2020, %	2021, %
V	Albumen*	2.54	3.80	2.20	9.41
V	Amlodipine*	3.32	2.70	2.42	1.68
V	Amoxicillin & beta-lactamase inhibitor*	2.85	3.08	2.34	4.81
V	Vitamin C			2.63	
V	Valsartan	2.27			2.31
V	Valsartan in combination with diuretics		3.43		
V	Vancomycin				1.23
V	**Heparin sodium***	**5.43**	**7.14**	**11.33**	**20.70**
V	Drotaverine			1.39	1.30
V	Imipenem with cilastatin				1.88
V	Candesartan				1.80
V	Amino acid complex	1.50	3.66	1.75	
V	Levofloxacin	3.18			1.53
V	Meropenem				7.01
V	Methylprednisolone*	3.26	7.42	5.48	6.31

Table 3 (Continued). Formal VEN analysis for KNF of the most expensive group "A" in the context of INN for 2018-2021

VEN by KNF	Group A according to INN	2018, %	2019, %	2020, %	2021, %
V	Mycophenolic acid	4.10	5.13		
V	Moxonidine*	2.78	2.06	1.62	1.42
V	Nadroparin calcium		10.56	11.90	10.51
V	Sodium chloride	4.27	3.11	3.27	
N	Nitroxoline				2.39
V	Pentoxifylline	1.59			2.71
V	Iron preparations for parenteral administration			1.38	
V	Cefazolin	3.60	2.16	1.95	
V	Ceftazidime				1.06
V	Ceftriaxone*	7.91	6.64	7.54	4.71
V	Cyclosporine	2.98	1.53	4.52	
V	Enoxaparin sodium	3.68	6.01	7.69	
V	Epoetin alfa, beta, & zeta*	17.94	10.37	13.56	1.38
V	Eprosartan	5.44		1.93	

Note. *Medicines purchased every year

Table 4. Formal VEN-analysis of KNF of the most expensive group "B" in the context of INN for 2018-2021

VEN by KNF	Group B according to INN	2018, %	2019, %	2020, %	2021, %
V	Azithromycin				0.47
V	Amino acids				0.51
V	Aminophylline	1.48	0.96	0.89	
V	Vitamin C	0.50	0.45		0.72
V	Atorvastatin				0.53
V	Acetylsalicylic acid	0.77			
V	Valsartan			0.88	
V	Valsartan in combination with diuretics			0.77	
V	Valsartan & amlodipine	0.81			
V	Glucose	0.67	0.61	0.56	
V	Doripenem		1.22		
V	Imipenem with cilastatin			1.16	0.89
V	Irbesartan	0.57		0.80	
V	Calcium gluconate	0.53			0.87
V	Candesartan		1.32	0.83	
V	Lactulose*	1.47	0.91	1.08	0.91
V	Levofloxacin		0.63		
V	Lornoxicam				0.53
V	Multienzymes (lipase, protease, etc.)	0.71	0.45		
V	Nadroparin calcium	0.89			
V	Sodium chloride				0.86
V	Nitrofurantoin	0.41	0.41	0.56	
V	Omeprazole*	1.40	1.17	0.87	0.83
V	Ofloxacin	0.71			
V	Pantoprazole				0.54
V	Papaverine		0.48		
V	Pentoxifylline		0.94		
V	Perindopril	1.29			
V	Prednisolone	0.46			
V	Iron preparations for parenteral administration	0.44	1.49		
V	Simvastatin		0.85		
V	Torasemide	0.55			
V	Fosinopril		0.65		
V	Cefazolin				1.05
V	Ceftazidime	1.17			
V	Cyclophosphamide		1.20	0.73	
V	Ciprofloxacin*	1.28	0.93	0.83	1.01
V	Enoxaparin sodium				0.91
V	Eprosartan		1.22		

Note. *Medicines purchased every year

15 INN items are annually purchased from drugs of group "C": ampicillin, bisoprolol, diclofenac, diphenhydramine, iron sulfate, ketorolac, magnesium sulfate, metamizole sodium, metoclopramide, metronidazole, nystatin, folic acid, fosfomycin, furosemide, and enalapril. All 15 INNs are included in KNF.

The share of costs for antibiotics was in 2018-21.95%, 2019-15.82%, 2020-15.32%, 2021-26.64%, respectively. The share of costs for other drugs in 2018-78.05%, 2019-84.18%, 2020-84.68%, 2021-73.36%, respectively (**Table 4**).

According to the results of a comparative analysis based on the WHO AWaRe antibiotic classification for the entire study period, the total costs for the watch group were 3,300,190.49 Kazakh Tenge (66%), 1,538,907.89 Kazakh Tenge (31%), and the remaining 3% was a drug that was not included in the AWaRe classification due to insufficient data-nitroxoline, with a total cost of 174,370.00 Kazakh Tenge.

Table 5. Comparative cost analysis for antibiotics according to the WHO AWaRe classification for 2018-2021

AWaRe	No	ATC	INN	Amount, KZT	Amount, KZT
Access	1	J01CR02	Amoxicillin and beta-lactamase inhibitor	841,494.85	1,538,907.89
	2	J01DB04	Cefazolin	515,631.34	
	3	J01XE01	Nitrofurantoin	81,722.40	
	4	J01XD01	Metronidazole	56,847.50	
	5	J01CA01	Ampicillin	42,931.60	
	6	J01GB03	Gentamicin	280.20	
Watch	1	J01FA10	Azithromycin	61,442.88	3,300,190.49
	2	J01XA01	Vancomycin	89,460.56	
	3	J01DH04	Doripenem	82,460.00	
	4	J01DH51	Imipenem with cilastatin	142,221.67	
	5	J01MA12	Levofloxacin	306,683.04	
	6	J01FF02	Lincomycin	221.50	
	7	J01DH02	Meropenem	511,799.05	
	8	J01MA01	Ofloxacin	33,780.00	
	9	J01XX01	Fosfomycin	38,508.99	
	10	J01DD01	Cefotaxime	6,442.54	
	11	J01DD02	Ceftazidime	133,100.23	
	12	J01DD04	Ceftriaxone	1,637,986.66	
	13	J01DC02	Cefuroxime	6,379.80	
	14	J01MA02	Ciprofloxacin	249,703.57	
No data	1	J01XX07	Nitroxoline	174,370.00	174,370
General costs, KZT				**5,013,468.38**	**5,013,468.38**

In terms of quantity (the number of INNs), antibiotics from the watch group accounted for 67%, antibiotics from the access group accounted for 28%, and nitroxoline accounted for 5% (**Table 5**).

The top three most expensive antibiotics in 2018 were, according to the results of calculating the share of costs for antibiotics in the context of INN: ceftriaxone-36.02%, cefazolin-16.39%, levofloxacin-14.49; in 2019: ceftriaxone-41.96%, amoxicillin and beta-lactamase inhibitor-19.49%, cefazolin-13.66%; in 2020: ceftriaxone-49.22%, amoxicillin and beta-lactamase inhibitor-15.30%, cefazolin-12.74%; in 2021: meropenem-26.31%, amoxicillin and beta-lactamase inhibitor-18.06%, ceftriaxone-17.70%.

DISCUSSION

ABC analysis of pharmacotherapy financial spending revealed a positive trend in increasing the availability of medicines in the department of nephrology to an approximate 1.5-fold increase in costs in 2021 compared to 2018. VEN analysis of ABC groups revealed five drug positions with a total cost for four years of 197,295.26 Kazakh Tenge (approximately 461.1 USD) (0.78% of total costs) that were not included in KNF includingAtropine sulfate, sodium bicarbonate, sodium chloride (crystalline salt), nitroxoline, and nitrofural. This means that these drugs do not have a sufficient level of evidence in clinical practice in Kazakhstan. Thus, they are excluded from the the KNF, which includes drugs with proven clinical safety and efficacy only [5, 11].

The results showed that the cost of these drugs is low, but there is a need to justify the choice of medication therapy based on evidence of drug safety and efficacy. Thus, it is important that the hospital employ a certified clinical pharmacist whose sole responsibilities include evaluating the rational use and prescription of medications. Consequently, this would make it easier for physicians to focus their attention on high-quality diagnostics, which is one of the most important tasks. Furthermore, the results of the AWaRe-21 analysis of antibacterial drug spending revealed a decrease in the%age of spending on antibiotics from 21.95% in 2018 to 15.32% by 2020, followed by a sharp increase in the costs to 26.64% in 2021. We assume the increase in the need for antibiotic therapy may partly be due to the increased COVID-19 infections that occurred during the pandemic. However, the increase in the usage and cost of antibiotics during this period might be justified [8, 12, 13]. In addition, an analysis of the costs of antibiotics in the context of INN showed that throughout the entire study period, the top three most expensive antibiotics included ceftriaxone: 2018-36.02%, 2019-41.96%, 2020-49.22%, 2021- 17.7%. It should also be noted that there was a sharp decrease in the perentage of costs for ceftriaxone in 2021, where the top purchase drugs were meropenem-26.31% and amoxicillin and beta-lactamase inhibitor-15.30%. The main reason for the increase is due to the inclusion of Meropenem in the clinical guidelines for the treatment and diagnosis of COVID-19 for secondary bacterial infections caused by complications of coronavirus infection in Kazakhstan.

The analysis allowed us to determine the percentage of pharmacotherapy expenses for each drug during the study period and showed the dynamics of financial costs for medicines. The comparative analysis of the list of antibiotics according to the AWaRe classification showed an increase in antibiotic consumption. Increasing the use of antibiotics will increase the risk of developing persistent multi-resistance and so is reducing the range of antibiotic options. However, the sharp increase in the antibiotic use appears to be a common international practice during the COVID-19 pandemic [14, 15].

Despite its contraindication in renal failure, we noticed an increase of costing for sodium heparin, which is proportional to their prescription and usage. Therefore, it warrants further research into the clinical feasibility of the drug with particular consideration into their indications and contraindications in the nephrology department. The findings in this study demonstrated the trend of medication consumption and the level of cost of drugs in a particular healthcare setting. The results of ABC/VEN analyses and AWaRe antibiotic classifications as benchmarking tools for identifying the rational drug use, indicated several of antibiotic misuses at the hospital itself, which is not unexpected. Such issues can be detected and possibly corrected by clinical pharmacy and

clinical pharmacology services. Thus, shows the need for more regulated and wider use of clinical pharmacy services in the healthcare services in Kazakhstan.

CONCLUSION

The ongoing pharmacotherapy and antibacterial therapy in the department of nephrology in Turkestan requires a comprehensive optimization of approaches to drug rationalization, as well as the introduction of a clinical pharmacy service to improve pharmaceutical care. Some of the clinical pharmacy services' responsibilities include conducting regular systematic assessments of the appropriateness of prescribing and using medicines, including antibiotics, monitoring adverse drug reactions, reducing the cost of pharmacotherapy, and advising patients and healthcare workers on the safe and effective use of medications. Such activities will improve the quality of medical care and decrease associated financial costs.

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Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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