Cost Analysis of Clinical Compounding in Saudi Arabia: Nephrology Pediatrics Formulations

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ABSTRACT

Objectives: To explore cost analysis of selected renal pediatric formulations in Riyadh city, Saudi Arabia. **Methods:** It is a retrospective cost analysis of pediatric formulations at 300-beds pediatrics and maternity hospital in Riyadh city, Saudi Arabia. The pharmacy section received the specific formulation from physician then the expert pharmacist applied the international standard of clinical compounding through by providing to healthcare staff over eight hours per days for five days per a week. The pediatric formulations consisted selected renal products. The analysis of the cost included the variable expenses included personal cost, material and supply cost. Fixed costs, including, direct costs, non-salary cost and overhead cost. The cost was derived from the Ministry of Health information database. All cost was used US dollar currency. The study analyzed the cost of Nephrology pediatrics formulations through the Microsoft Excel sheet version 10th. **Results:** The estimated average total standard cost of pediatric formulations per hour was (53.82 USD). The average estimated cost of Hydrochlorothiazide per each preparation was (5.204 USD) and the total annual cost of Hydrochlorothiazide was (2,071.2 USD). The average estimated cost of Acetazolamide per each preparation was (5.72 USD) the total annual cost of Acetazolamide was (366.1 USD). The average estimated cost of Spironolactone per each preparation was (2.513 USD) and the total annual cost of Spironolactone was (1,507.8 USD). The average estimated cost of Sodium citrate per each preparation was (1.23 USD) with a total annual cost of Sodium citrate was (599.01 USD). The average estimated cost of Citric Acid per each preparation was (1.136 USD) with a total annual cost of Citric Acid was (81.782 USD). **Conclusion:** Cost analysis of pediatrics formulation with emphasis on medications used for renal diseases is primary tool of pharmacoeconomic and health insurance. The pharmacist play role in the preparation of renal medications and cost analysis related issue. This is new study in Kingdom of Saudi Arabia and Gulf or Middle East countries with and meet the new Saudi vision 2030 in the Kingdom of Saudi Arabia.

Key words: Cost, Clinical, Compounding, Nephrology, Pediatrics, Formulations, Ministry of Health, Saudi Arabia.

INTRODUCTION

The pediatrics or neonates Nephrology one of the well-known specialists in the medical and pharmacy field.[1,2] The pediatrics or neonates suffer from several diseases of Nephrology including but not limited to the nephrology system, acute glomerulonephritis and nephrotic syndrome, while the most common diseases in Saudi Arabia were the following, congenital renal diseases, urinary tract infection and congenital and infantile nephrotic syndrome were.[3,4] Several medications used for the management of the kidney disease, for instance immunosuppressant agent (Hydrocortisone, Prednisolone) or diuretics (Hydrochlorothiazide, Spironolactone) for cardiovascular diseases.[5,6] Most of the medications came as a tablet's dosage form, while oral syrup or suspension not marketed in most places. Several pediatric formulations of those medications can be done.[7] As results, most of those medications not registered and subsequent there is not registered prices. It badly demands to calculate the cost of those pediatrics formulations as part of a pharmacoeconomic project of the updated Pharmacy strategic with new Saudi vision 2030.[8] It seldom to find cost analysis of pediatric formulations of immunosuppressant agent and diuretics or other renal products. The authors based on the best of their knowledge they are not familiar with any publications about cost analysis of pediatric formulations of kidney diseases. The aim of the current study is to explore the cost analysis of nephrology pediatrics populations in the Kingdom of Saudi Arabia.

METHODS

It is a retrospective cost analysis of renal pediatrics formulation services past one year at 300-beds pediatrics and maternity hospital in Riyadh city, Saudi Arabia. It had inpatient admission and ambulatory care clinics and Emergency departments. The hospital had a different specialty for women, adults and pediatrics. The hospital treats the common neonatal, pediatric and women's health disease. The hospital had pharmacy serve the patient, including inpatient pharmacy with unit dose drug distribution system, outpatient

pharmacy and extensive extemporaneous pediatrics section and drug information center. The pharmacy computerized physician order entry with an electronic prescription in addition to the pharmacy had a medication safety program. The pharmacy trained clinical and pharmacy student training programs. The extemporaneous section had very comprehensive pediatric formulations for neonates and pediatrics in the central region of the Ministry of Health hospitals. The section received the specific formulation from physician then the expert pharmacist applied the international standard of clinical compounding through by providing to healthcare staff over eight hours per days for five days per a week. The pediatric formulations consisted of antibiotics, antituberculosis (TB) medications, anticonvulsant medications and Gastrointestinal (GI) drugs, anti-hypertension medications, electrolyte supplements, renal preparations, diuretics formulation, steroid perorations and other supportive substances formulation. The analysis of the cost included the variable expenses included personal cost, material and supply cost. Fixed costs, including direct costs, non-salary cost and overhead cost.[9,10] In addition to the cost of compounding substances, a number of preparations and time of preparations. The price was derived from the Ministry of Health information database. All cost was used US dollar currency. The study analyzed antibiotics pediatric formulations through the Microsoft Excel sheet version 10th.

RESULTS

The estimated average total standard cost of pediatrics formulations per hour was (53.82 USD) and consisted of 58.58% (31.53 USD) for personal cost, 25.14% (13.53 USD) for overhead cost, 3.34% (1.8 USD) for material and supply cost, 12.93% (6.96 USD) for non-salary cost (Table 1). The average estimated cost of hydrochlorothiazide per each preparation was (5.204 USD) with consisted of standard cost (0.034 USD) and the direct cost was (5.17 USD). The total annual cost of hydrochlorothiazide was (2,071.2 USD) (Table 2). The average estimated cost of acetazolamide per each preparation was (5.72 USD) with consisted of standard cost (0.63 USD) and the direct cost was (5.09 USD). The total annual cost of acetazolamide was (366.1 USD) (Table 3). The average estimated cost of spironolactone per each preparation was (2.513 USD) with consisted of standard cost (0.033 USD) and the direct cost was (2.48 USD). The total annual cost of spironolactone was (1,507.8 USD) (Table 4). The average estimated cost of sodium citrate per each preparation was (1.23 USD) with consisted of standard cost (0.083 USD) and the direct cost was (1.147 USD). The total annual cost of sodium citrate was (599.01 USD) (Table 5). The average estimated cost of citric acid per each preparation was (1.136 USD) with consisted of standard cost (0.187 USD) and the direct cost was (0.949 USD). The total annual cost of citric acid was (81.782 USD) (Table 6).

DISCUSSION

Several medications had been used for kidney diseases in pediatrics. The diuretic and some pediatrics formulations used for that is an indication. Most of Diuretic and renal medications came as tablets or capsules and Parenteral dosage form (Table 7).[11-14] As a result, the extemporaneous preparation section at the current site Pharmacy prepares those formulations to meet the demand of the patients.[7] As a result, the pharmacy wishes to calculate the cost foundations of all pediatrics formulations, including the renal products. In all renal pediatrics formulations, the most indirect cost came from personal cost and overhead cost. Because of the preparation need more of pharmacy staff without much demand for equipment. In the current study three pediatrics formulations including the cost analysis of Hydrochlorothiazide, Acetazolamide and Spironolactone. The most expensive medications were Hydrochlorothiazide, followed by Acetazolamide and Spironolactone. The most consumed from Diuretic budget was Hydrochlorothiazide and Spironolactone. All the Diuretic pediatric formulations the direct cost more than indirect cost because the number of preparations were high lead to the reduction in the indirect cost. All of the medications not registered in Saudi or the UK and USA and the pharmacist should continue to prepare all diuretic pediatrics formulations (Table 7).[11-14] Two medications used for acidification of the urine for renal stone Sodium citrate and Citric Acid. One of them Sodium citrate 0.3 Molar solution more expensive than registered in UK (Table 7),[13,14] while Citric Acid 25% Solution similar cost to the UK. Both of product not registered in KSA or USA (Table 7).[11,12] That is maybe not high utilization in the country or pediatrician not used for their patients. If the pharmaceutical company can sell the medication with lower prices may the pharmacist can get them, if the prices don't change the pharmacist may continue prepare both medications if the medications were seldom found in the market. Renal pediatrics formulation, cost analysis is essential for the financial budget and explores the income and expenses in a particular hospital.

CONCLUSION

Although several products ready-made though pharmaceutical companies, still the pediatric

Table 1: Standard cost analysis of pediatrics formulations (USD).

	Cost per hour
Personal	
Head compounding pharmacist	27.27
staff compounding pharmacist	4.26
Total	31.53
Over Head cost	
Rent	0
Bed	0
Offices	0.46
Chairs	1.54
Computer	0.68
Printer	1.43
Zebra label printer (Direct Thermal)	3.08
Refrigerator	1.66
Balance	0.17
Beakers	0.14
Stainless steel spoon	0.21
Measuring cup	0.25
Measuring Cylinder	0.15
Silicone spoon	0.05
cooker	0.03
Funnel	0.04
Bunchner	0.05
Test tube brush	0.04
Kettle	0.15
Mortar and Pestle	0.11
Glass rode	0.02
Shelf	3.23
Pen/pencils	0.04
scissors	0.02
Total	13.53
Material and supply	
Large	0.65
Amber bottle	0.21
Syringe	0.12
gloves	0.49
Blue sheet	0.31
Face mask	0.02
Total	1.8
Non Salary cost	
Education and Training head	6.61
Education and Training staff	0.34
Total	6.96

Table 2: Cost of Hydrochlorothiazide 5mg/1ml (USD).	
Personal	31.53
Over Head cost	13.53
Material and supply	1.8
Non Salary cost	6.96
Total	53.82
Preparation time 15 min per one bottle	13.455
Total of preparation 398 per year, the cost per one 100 ml	0.034
Direct cost	
Hydrochlorothiazide 25mg = 20 tab	2.51
Simple Syrup to 100 ml	2.67
Total	5.17
Grand Total 100 ml per bottle	5.204
Annual Grand Total cost	2,071.2

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Table 3: Cost of Acetazolamide 15mg/1ml (USD).	
Personal	31.53
Over Head cost	13.53
Material and supply	1.8
Non Salary cost	6.96
Total	53.82
Preparation time 45 min per one bottle	40.365
Total of preparation 64 per year, the cost per one 100 ml	0.63
Direct cost	
Acetazolamide 250mg= 20 tab	4.21
Citric Acid 25%= 1 ml	0.01
M.S.V to 100 ml	0.87
Total	5.09
Grand Total 100 ml per bottle	5.72
Annual Grand Total cost	366.1

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Table 4: Cost of Spironolactone 5mg/1ml (USD).	
Personal	31.53
Over Head cost	13.53
Material and supply	1.8
Non Salary cost	6.96
Total	53.82
Preparation time 22.5 min per one bottle	20.18
Total of preparation 600 per year, the cost per one 100 ml	0.033
Direct cost	
Spironolactone 25mg= 20 tablet	1.60
Universal vehicle to 100 ml	0.88
Total	2.48
Grand Total 100 ml per bottle	2.513
Annual Grand Total cost	1,507.8

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Table 5: Cost of Sodium citrate 0.3 Molar solution (USD).	
Personal	31.53
Over Head cost	13.53
Material and supply	1.8
Non Salary cost	6.96
Total	53.82
Preparation time 45 min per one bottle	40.365
Total of preparation 487 per year, the cost per one 300 ml	0.083
Direct cost	
Sodium citrate powder= 26.5 GM	1.067
Distell water to 300 ml	0.080
Total	1.147
Grand Total 300 ml per bottle	1.23
Annual Grand Total cost	599.01

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renal formulation not available in the local or international market with product prices. The cost analysis of extemporaneous preparation of renal product is the primary tools of Pharmacoeconomics goal of new pharmacy strategic with Saudi vision 2030. Regular measures of a cost analysis of the renal extemporaneous product are highly recommended of pediatric pharmacy services in the kingdom of Saudi Arabia.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

SFDA: Saudi Food and Drug Authority; **KSA:** Kingdom of Saudi Arabia; **USD:** United State Dollars; **GI:** gastrointestinal; **GERD:** Gastro-esophageal reflex diseases, **MOH:** Ministry of Health; **TB:** tuberculosis; **USA:** United States of America; **UK:** United Kingdom.

Table 6: Cost of Citric Acid 25% Solution (USD).	
Personal	31.53
Over Head cost	13.53
Material and supply	1.8
Non Salary cost	6.96
Total	53.82
Preparation time 15 min per one bottle	13.455
Total of preparation 72 per year, the cost per one 100 ml	0.187
Direct cost	
Citric Acid powder= 25 GM	0.896
Distell water to 100 ml	0.053
Total	0.949
Grand Total 100 ml per bottle	1.136
Annual Grand Total cost	81.782

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Table 7: The cost comparison of renal pediatrics formulations.

Medications name	Cost Current study		Cost in SA (USD)[11]		Cost in US (USD) [12]		Cost in UK (USD)[12,13]	
	Conc. mg/ml	Volume	Conc. mg/ml	Volume	Conc. mg/ml	Volume	Conc. mg/ml	Volume
Hydrochlorothiazide 5mg/1ml	1mg/ml= 0.0104 $	100 ml =5.204 $	Not available	Not available	Not available	Not available	Non available	Non available
Acetazolamide 15mg/1ml	1mg/ml= 0.00381 $	100 ml = 5.72 $	Not available	Not available	Not available	Not available	Non available	Non available
Spironolactone 5mg/1ml	1mg/ml= 0.005 $	100 ml=2.513$	Not available	Not available	Not available	Not available	Non available	Non available
Sodium citrate 0.3 molar solution	1 ml = 0.0041 $	300 ml =1.23 $ (100 ml = 0.41 $)	Not available	Not available	Not available	Not available	1 ml = 0.189 $	88.23 mg per 1ml 30 ml= 5.67 $ (100 = 18.9 $)
Citric Acid 25% Solution	1 Gm/ml = 0.0164 $	100 ml = 1.136 $	Not available	Not available	Not available	Not available	1mg/1 ml = 0.025 $	25 mg per 1ml 200 ml= 1.25 $ (100 = 0.625 $)

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