

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

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ABSTRACT

Objectives: The aim of this study is to explore the cost analysis of pediatrics anticonvulsant formulations in Saudi Arabia. **Methods:** It is a retrospective cost analysis of pediatrics 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 of providing to healthcare staff over eight hours per days for five days per a week. The pediatrics formulations consisted of selected four anticonvulsant medications. The analysis of the cost included the variable expenses included personal cost, material and supply cost, Costs fixed including direct cost, 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 anticonvulsant pediatrics formulations through the Microsoft Excel sheet version 10th. **Results:** The estimated average total standard cost of pediatrics formulations per hour was (53.82 USD). The average estimated cost of Levetiracetam per each one preparation was (53.313 USD). The total annual cost of Levetiracetam was (18,126.42 USD). The average estimated cost of Topiramate per each one preparation was (22.66 USD). The total annual cost of Topiramate was (1,087.68 USD). The average estimated cost of Rufinamide per each one preparation was (29.342 USD), while the total annual cost of Rufinamide was (293.42 USD). **Conclusion:** This is the first study about cost analysis of anticonvulsant pediatrics formulations in KSA and Middle East. There are some differences in the cost analysis between the pharmacy preparations and manufactured related to internal and external reasons. The pharmacist should select the cheapest one among them the preparations. The cost analysis of pediatrics formulation meets the Saudi vision 2030 strategic plan in the Kingdom of Saudi Arabia.

Keywords: Cost, Clinical, Compounding, Anticonvulsant, Pediatrics, Formulations, Ministry of Health, Saudi Arabia.

INTRODUCTION

The medications came on several dosages, including oral, parenteral and topical. The oral medications dosage forms of tablets, capsules for adults and syrup or suspensions pediatrics or geriatric.

^[1] Development of age suitable medicines for children needs not only an considerate of their partialities for different formulations, flavors and textures of products but also an understanding of the physical and biochemical differences between children and adults. The clearest variance between adult and pediatric drug therapy is the complication of dose change and the algorithms used to compute dosages pertinent to sub-populations within the general pediatric population. It is straightforward for them to swallow and digest. Most of the medications initially approved indication for adults and used as tablets or capsules. After such time they have been used for pediatrics. Not all medications came as syrup or suspension for pediatrics. In these problems, most of the pharmacist try to make them syrup or suspension through extemporaneous methods.

^[1] There are several drug classes that need to be prepared as syrups or suspension that's including,

for instance; antibiotics, anti-hypertension, anti-tuberculosis and anticonvulsant medications.^[1] The neurological diseases distributed in the Mediterranean region.^[2] The WHO reported that's 6.5 per 1000 was the prevalence of epilepsy. The most medications used in Mediterranean region were phenobarbital, phenytoin, carbamazepine and Valproic acid.^[2] Most of those medication came as syrups pediatric formulations.^[3] Some new drugs Topiramate do not come in pediatric formulations while others like Rufinamide pediatrics formulation not registered in Kingdom of Saudi Arabia.^[3] Besides, the cost of new pediatrics formulation not available all the time.^[3] In the past four years, the updated Pharmacy static with new Saudi vision 2030 plan had been released. The design of an perfect pediatric formulation desires to reflect the following factors: (i) making minimal influence on the lifestyle of the child, establishing as the lowest dosage incidence and a palatable product, (ii) delivery of individualized dosing or dose banding suitable for active therapy, (iii) adequate bioavailability, (iv) non-toxic excipients in the formulation, (v) suitable

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and dependable management and (vi) vigorous manufacture process at negligible cost.^[4] As part of the pharmacy plan to implement the Pharmacoeconomic program. The health economic project consisted of a cost analysis of extemporaneous medications, cost analysis of pharmacy services, cost avoidance of the clinical pharmacy. There are numerous appraisals that feature formulation options and their suitability for children across a range of ages. 4-8 there is also controlling leadership on formulation preference with age within a pediatric population. 9-11 However, there is still a need for evidence-based data to guide the growth of formulations that are suitable and satisfactory to children and young people. As a result, several publications about cost analysis of pharmacy services discussed in Saudi Arabia. For instances; pediatrics total parental nutrition, cost analysis of drug information services and cost analysis of clinical pharmacy services.^[5-8] However, the cost analysis of extemporaneous pediatrics formulations is seldom found them nationally or internationally. The authors were not aware of cost extemporaneous, including anticonvulsant medications in the Kingdom, Saudi Arabia, or Gulf and Middle East countries. The aim of this study is to explore the cost analysis of pediatrics anticonvulsant formulations in Saudi Arabia.

METHODS

It is a retrospective cost analysis of drug information 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, pediatrics and women health disease. The hospital had pharmacy serve the patient including inpatient pharmacy with unit dose drug distribution system, outpatient pharmacy and extensive evidence-based extemporaneous pediatrics section and drug information center. The pharmacy computerized physician order entry with an electronic prescription in addition to the pharmacy had medications safety program. The pharmacy trained clinical and pharmacy student training programs. The extemporaneous section had very comprehensive pediatrics formulations for neonates and pediatrics in the central region of Ministry of Health hospitals. The section received the specific formulation from physician then the expert pharmacist applied the international standard of clinical compounding through of providing to health-care staff over eight hours per days for five days per a week. The pediatrics formulations consisted of antibiotics, anti-tuberculosis (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, costs fixed include direct cost, non-salary cost and overhead cost.^[6,7] In addition to the cost of compounding substances, number of preparations and time of preparations. The price was derived from the Ministry of Health information database. All cost was used as US dollar currency. The study analyzed anticonvulsant pediatrics 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 Levetiracetam per each preparation was (53.313 USD) which consisted of standard cost (0.158 USD) and the direct cost was (53.16 USD). The total annual cost of Levetiracetam was (18,126.42 USD) (Table 2). The average estimated cost of Topiramate per each preparation was (22.66 USD) which consisted of standard cost (0.84 USD) and the direct cost was (21.82 USD). The total annual cost of Topiramate was (1,087.68 USD) (Table 3). The average estimated cost of Rufinamide per each preparation was (29.342USD) which consisted of standard cost (10.782 USD) and the direct cost was (18.56 USD). The total annual cost of Rufinamide was (293.42 USD) (Table 4).

DISCUSSION

Over the past years, several anticonvulsants released in the market.^[9] The majority of the dosage form as tablets or capsules. However, it is rare to find an appropriate dosage form for pediatrics.^[11] As a result, the extemporaneous preparation section at local hospitals tries to prepare some anticonvulsant suitable for pediatrics.^[11] The part of extemporaneous preparation implemented the pharmacy strategic plan with new Saudi vision 2030.^[10] They wished to make a cost analysis for the anticonvulsant pediatrics formulations. In the current study part of strategic plan implementation is the pharmacy practice. The finding of the study showed indirect cost preparations came from the personal cost followed by overhead cost. That's related to staff personnel prepare the formulations and equipment used for the produce

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 Levetiracetam 100mg/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 60 min per one bottle	53.82
Total of preparation 340 per year, the cost per one 100 ml	0.158
Direct cost	
Levetiracetam 500mg = 60 tablets	37.07
Oral Plus= 50 ml	5.87
Oral Sweet To 100 ml	5.87
Total	53.16
Grand Total 100 ml per bottle	53.313
Annual Grand Total cost	18,126.42

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Ensom MH, Decarie D, Rudolph S. Stability of Levetiracetam in Extemporaneously Compounded Suspensions. Can J Hosp Pharm 2011;64(3):207-211

Table 3: Cost of Topiramate 6mg/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 48 per year, the cost per one 100 ml	0.84
Direct cost	
Topiramate 100mg = 6 tablets	10.08
Oral Plus= 50 ml	5.87
Oral Sweet To 100 ml	5.87
Total	21.82
Grand Total 100 ml per bottle	22.66
Annual Grand Total cost	1,087.68

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Table 4: Cost of Rufinamide 40mg/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 120 min per one bottle	107.64
Total of preparation when needed per year (around 10), the cost per one 120 ml	10.782
Direct cost	
Rufinamide 400mg = 12 tablets	4.48
Oral Plus= 60 ml	7.04
Oral Sweet To 120 ml	7.04
Total	18.56
Grand Total 120 ml per bottle	29.342
Annual Grand Total cost	293.42

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DJ Hutchinson *et al.* Stability of Extemporaneously Prepared Rufinamide Oral Suspensions. Ann Pharmacother 2010;44:462-5.

the final product. The finding of Levetiracetam showed high direct price because the substance was expensive itself. Besides, Levetiracetam considers the highest cost among the budget of the anticonvulsant pediatrics formulations because of high utilization in the practice. The cost of Levetiracetam was higher than manufactured and registered in KSA, while lower than USA and UK (Table 5)^[3,11-13] and should not prepare it in the pharmacy and get use for local market. The most cost of Topiramate came from direct. Topiramate lower cost than Levetiracetam and considered as a second product consumed the anticonvulsant Pediatrics formulations budget. Topiramate is not registered in KSA or USA and UK (Table 5).^[3,11-13] The pharmacist should prepare the pediatric formulation in the pharmacy. The Rufinamide cost considered as the average cost between Levetiracetam and Topiramate and least cost of anticonvulsant formulations for pediatrics. The product was cheaper than the product manufactured and the pharmacist should considered that and keep continue prepare the pediatrics formulation if needed (Table 5).^[3,11-13] The study was the first cost analysis of new anticonvulsant pediatrics formulations in the Kingdom of Saudi Arabia, Gulf and Middle East countries. Cost analysis of all pediatrics formulations of

medications had indicated for convulsions is highly recommended in the pharmacy strategic planning in Saudi Arabia.

CONCLUSION

The most oral pediatrics formulation of old medications of commonly used anticonvulsant is available in the local and international market. Pediatric formulations need to be suitable for the child in terms of dose, suitability and adequacy to ensure obedience with the medication. However, the oral pediatrics formulation of new medication is not available in the market, including the prices. The extemporaneous preparation of new products for pediatrics and analysis of the cost is beneficial for the patients and the pharmacy department. The cost analysis of all pediatrics anticonvulsant formulation is required in the hospital practice and meet pharmacy strategic plan with new Saudi vision 2030 in the kingdom of Saudi Arabia.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.


Table 5: The cost comparison of anti-epileptics pediatrics formulations.

Medications name	Cost Current study		Cost in SA (USD) ^[3]		Cost in US (USD) ^[10]		Cost in UK (USD) ^[11,12]	
	Conc. mg/ml	Volume	Conc. mg/ml	Volume	Conc. mg/ml	Volume	Conc. mg/ml	Volume
Levetiracetam 100mg/1ml	1mg/ml= 0.005316 \$	100 ml =53.16 \$	1mg/ml= 0.00184 \$ 1mg/ml= 0.00165 \$ 1mg/ml= 0.00250 \$ 1mg/ml= 0.00148 \$ 1mg/ml= 0.00056 \$	100 mg/ml 150ml = 27.64\$ (100 ml=18.426 \$) 150ml = 24.77\$ (100 ml=16.513 \$) 300ml = 75.28\$ (100 ml=25.09 \$) 300ml = 44.59 \$ (100 ml=14.86 \$) 300ml = 16.83\$ (100 ml=5.61 \$)	1mg/ml= 0.00415 \$	100 mg/ml 300ml = 124.6 \$ (100 ml=41.53 \$)	1mg/ml= 0.002669 \$	100 mg/ml 300ml = 80.09 \$ (100 ml=26.696 \$)
Topiramate 6mg/1ml	1mg/ml= 0.03776 \$	100 ml = 22.66 \$	Non available	Non available	Non available	Non available	Non available	Non available
Rufinamide 40mg/1ml	1mg/ml= 0.0061 \$	120ml=29.342 \$ (100 ml=24.451 \$)	Non available	Non available	1mg/ml= 0.0849 \$	40 mg/ml 350ml = 1188.99 \$ (100 ml=339.71 \$)	1mg/ml= 0.00648 \$	40 mg/ml 460ml = 119.27 \$ (100 ml=25.928 \$)

ABBREVIATIONS

WHO: World Health Organization; **KSA:** Kingdom of Saudi Arabia; **USD:** United State Dollars; **GI:** gastroin-testinal; **GERD:** Gastro-esophageal reflux dis-eases; **MOH:** Ministry of Health; **TB:** tuber-culosis; **SFDA:** Saudi Food and Drug Authority; **USA:** United States of America; **UK:** United Kingdom.

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