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Cost analysis of Medical diagnostic Services of Hormone section of the central laboratory in Iran's East Azerbaijan Province using activity-based costing method in 2013

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Background and objectives: **The most basic financial data required for a laboratory manager consist of costs allocated to the cost units. The analysis of cost can promote the management performance in budgeting, strategic planning, privatization, accrual accounting and in overall performance of an organization. This study analysis and estimated the unit cost of laboratory services of hormone sector of East Azerbaijan central laboratory using activity-based costing in 2013.** ***Material and methods:*** **This study is conducted as cross-sectional and retrospective. For this purpose resources and activities of the hormone sector were selected as received high tariffs against the other sectors. The data gathered using forms, financial and laboratory software, interviews and direct observation which eventually an analysis were performed using the software Excel 2010 and the finally unit cost were calculated.** ***Results:*** **The results from East Azerbaijan central laboratory (EACL) shows that the highest and lowest references are Labor costs 59%, Depreciation expense 1.25% of total costs related to Hormone sector respectively. The highest cost was due to Growth hormone (GH) testing and the lowest cost was due to Thyroid (TSH) testing. And finally calculated average cost differs 11% from the tariffs approved by the Iranian Ministry of Health (MOH).** ***Conclusion:*** **According to the high volume of testing operations and consequently the deployment of skilled human resource and specialized equipment, central laboratory will be faced with a budget deficit if the tariff is not amended.**

INTRODUCTION

Health care systems are faced with great pressure globally for the provision of services or high performance to the increasing demand for these services. These pressures led to many actions to improve the management and health service efficiency (1). Evidence shows that health care costs will be faced with a significant increase in the following years. This increase is due to changes in the age distribution of the population, this increase is due to changes in the age distribution of the population, high levels of expectations for health care and increase satisfaction of health service delivery techniques. This would require the economic evaluation method to consider the cost and effectiveness of different interventions and more efficient use of resources for individual patients with different expertise in different sectors of the health system (2). One of the key challenges in healthcare organizations is development of appropriate cost information that can be the basis for strategic decisions and appropriate pricing. Nowadays, with the development of advanced technologies in various aspects associated with the increased complexity and variety of activities, understanding these changes and evaluate their impact on organizational costs is important. Considering that their diversity and changes are more than productive activities. Obviously, the recognition of these activities and assessing its impact on organizational costs requires designing a suitable costing system (3).

Costing and cost analysis can help managers as a management tool in access to information and accounting data to make informed decisions in relation to investment for actions, improving current activities and eliminating unnecessary process (4).

Managers need real information to improve the efficiency of its management. They also have a lack of information in response to the two very important questions, which resources are profitable and how we can improve organizational performance. Managers without having enough information about the cost and effectiveness cannot make optimum decisions, so they need a good costing and evaluation systems to calculate and assessment the cost and effect of products and services (5). The rapid rise in health care costs has faced the health care providers with great pressure to provide efficient services with an efficient manner to patients. To cope with the economic challenges that

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is involved with the industry and offering services with low cost and high quality, health care organizations need to develop detailed monitoring of their performance. Essential tools for the implementation of this target are costing system of the organizations. Ramsey points out that the costing system should follow three main objectives, should enhance cost efficiency, and allow organizations to manage their own

Table 1 assigning the resource driver to the activities

Resource driver	driver name (allocation basis)
Personnel costs	The number of people employed
The cost of shared consumables (stationery, copy, print, etc.)	The number of tests
The cost of consumables dedicated to each section	The number of tests
Common depreciation costs	The number of tests
Special depreciation costs	The number of tests
Hormone sector Specific equipment depreciation costs	The number of tests
The cost of renting the building	Square meters of office space
The cost of electricity	Square meters of office space
The costs of water	The number of tests
Phone	Square meters of office space
Transportation	Square meters of office space
Other costs	Square meters of office space
Gas consumption cost	Square meters of office space

Table 2 Total cost of Shared operations and exclusive centers in 2013

No.	Resources	Cost (M Rials)
1	Energy costs	346
2	Shared depreciation costs	125
3	The cost of shared consumables	1,567
4	The cost of hormone sector exclusive consumables includes all tests	1,023
5	Common parts personnel costs	14,643
6	Hormone sector personnel costs	1,401
7	Depreciation costs of hormone sector	213
8	Other costs (rental of buildings, taxi, phone, etc.)	943
9	Costs of the test kits of Hormone sector	6,813

resources by managing the services provided to patients and they focus on opportunities for continuous quality improvement. Traditional systems used by health care organizations were without these benefits (6).

FINDINGS

In this study unit cost of all performed tests in hormone tests were calculated. Accordingly, highest costs related to personnel costs (59 percent) and the lowest cost related to public depreciation costs (1.25 percent) (table 3). As noted, cost units are the outputs of each activity. In this study, 42 clinical tests of the hormone sector were investigated that were expensive compared to other sectors and from the number of tests carried out in 2013. TSH test with number of 76,638 had the maximum frequency and HAV Ab test with the number of 129 had lowest frequency. Of these tests, prime cost of 12 services was calculated lower than the approved tariffs that were analyzed in table 4.

DISCUSSION AND CONCLUSION

Unit cost of services is important tools for planning, monitoring, controlling and evaluating of laboratory services. That its calculation reduces waste and eliminates additional and non-routine costs. According to the available evidence, we can conclude that the tests with higher frequency had less unit cost than other tests. Based on this interpretation when more output is incurred less overhead therefore it should be profitable.

Because of the involvement of all the performed activities in health service provision centres it is difficult to collect information using ABC method. Therefore a better solution is to adapt the ABC software to the local needs in order to register all the information needed for calculation costs on a daily basis and being able to calculate final costs for any period. Through regular and consistent documentation of working process and deleting unnecessary data collection activities, data collection will be performed faster and with a higher precision.

Duffy suggested that ABC method data compared to traffic method is very suitable and applicable for decision-making(8). His study in Ireland hospitals showed the maximum 50% of cost price was related to indirect cost. In Canadian hospitals showed that the portion of indirect costs in cost price of services is near to 45%(9). Meanwhile, the study performed in one of the Indian laboratory, showed Cost price per test decreases as total number of samples increases. Cost price per test is higher for specialized tests, which are interpreted and done by a pathologist(10). These findings show in the situation in which this study was conducted the hospital did not use resources properly.

In a study in 2010 by Arab et al. using the ABC method the cost of a unit of radiology shows a significant difference as compared to other studies. The reasons can be cited in this study to calculate the cost of rent for the building, that in other studies, it is ignored. On the other hand, according to the high share of total costs for staff and building costs, special attention to the proper use of resources can be an important step to increase efficiency and save health costs(11).

Nasiripour et al., in 2009 with the use of activity based costing method concluded that the highest and lowest resources is assigned to human resources 44% and energy costs 5% of total costs. Also professional activity is 97% of total, respectively. Prime cost shows the importance of human resource specially skilled and professional ones. The highest and lowest resources are assigned to Urinalysis 11% and Sediman from chemistry group 5% of total costs, respectively. This shows the frequency of service will be reduced service cost. Finally, the average calculated prime has a difference of 63% with the Health

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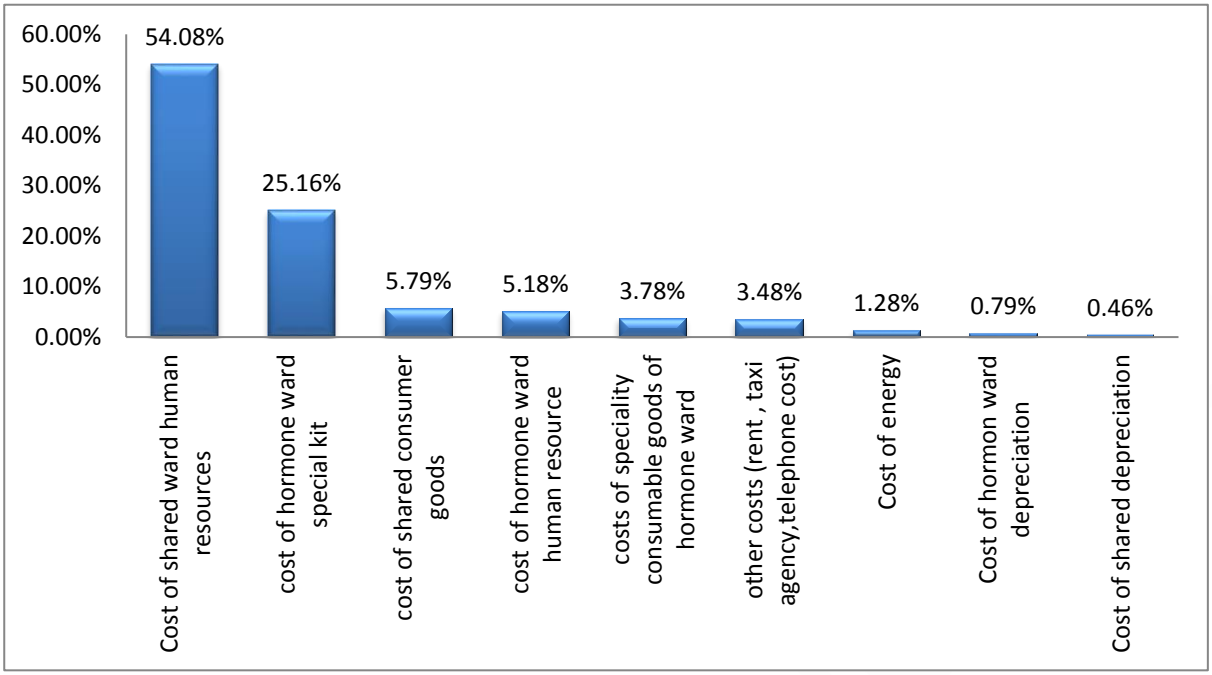

Figure 1 The contribution of each of the activity center's cost relative to the total calculated cost

Table 3 The share of each of the overhead, intermediate and final cost of total costs

Personnel costs	59.26%
consumable supplies cost	34.73%
Depreciation costs	1.25%
Energy costs	1.28%
Other costs (building rent, telephone, etc.)	3.48%

Table 4 Analyzing the unit cost of performed test in hormone sector in 2013 (Iranian Rials)

Test Name	NO	Each test consumer kit prices during 2013	Share of each test from its special kit	Share of each test from the cost of its human resources	Share of each test from indirect cost of human resources	Share of each test from consumables and indirect amortization	Share of each test from consumer goods of hormone test	Share of each test from direct depreciation cost of its section	ABC cost of each test	Tariff in 2013	Tariff difference whit unit cost
17 OH	805	37160000	46161	16857	8860	1425	3789	735	77827	60100	-17,727
AFP	873	35970000	41203	5619	8860	1425	3789	735	61631	56400	-5,231
HBC Ab	658	22800000	34650	5619	8860	1425	3789	735	55078	106100	51,022
Hbe Ab	324	9000000	27778	5619	8860	1425	3789	735	48206	106100	57,894
Anti TPO	2965	147500000	49747	5619	8860	1425	3789	735	70175	87600	17,425
CA 125	1083	35500000	32779	5619	8860	1425	3789	735	53207	75700	22,493
CA 15-3	423	16000000	37825	5619	8860	1425	3789	735	58253	75700	17,447
CA 19-9	612	25900000	42320	5619	8860	1425	3789	735	62748	75700	12,952
CEA	1564	55080000	35217	5619	8860	1425	3789	735	55645	63900	8,255
CMV IgG	5202	172800000	33218	5619	8860	1425	3789	735	53646	72800	19,154

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CMV IgM	5616	115600000	20584	5619	8860	1425	3789	735	41012	72800	31,788
Cortisol	410	32010000	78073	5619	8860	1425	3789	735	98501	45700	-52,801
Cyclosprin	919	81600000	88792	11238	8860	1425	3789	5478	119582	104500	-15,082
DHEA S	1519	21700000	14286	5619	8860	1425	3789	735	34714	50900	16,186
Estradiol	1004	24500000	24402	5619	8860	1425	3789	735	44830	60100	15,270
Ferretin	11096	379000000	34156	5619	8860	1425	3789	735	54584	61700	7,116
Free PSA	2138	77000000	36015	5619	8860	1425	3789	735	56443	70900	14,457
FSH	4836	86400000	17886	5619	8860	1425	3789	735	38294	41200	2,906
FT3	5374	131325054	24437	5619	8860	1425	3789	735	44865	37200	-7,665
FT4	23232	388626145	16728	5619	8860	1425	3789	735	37156	37200	44
HAV	129	7400000	57364	5619	8860	1425	3789	735	77792	106100	28,308
HBe Ag	480	9000000	18750	5619	8860	1425	3789	735	39178	106100	66,922
HBS Ab	1840	35500000	19293	5619	8860	1425	3789	735	39721	106100	66,379
HBS Ag	17653	4675500000	26486	5619	8860	1425	3789	735	46914	106100	59,186
Beta HCG	4031	157600000	39097	5619	8860	1425	3789	735	59525	50900	-8,625
HCV Ab	2465	189179149	76746	5619	8860	1425	3789	735	97174	143800	46,626
HGH	231	38200000	165368	5619	8860	1425	3789	735	185796	48900	-136,896
LH	3759	83700000	22267	5619	8860	1425	3789	735	42695	41200	-1,495
Progesterone	786	21000000	26718	5619	8860	1425	3789	735	47146	50900	3,754
Prolactin	4590	94500000	20588	5619	8860	1425	3789	735	41016	45200	4,184
PSA	5454	188800000	34617	5619	8860	1425	3789	735	55045	79600	24,555
PTH	2012	153000000	76044	5619	8860	1425	3789	735	96472	63800	-32,672
Rubella IgG	6757	218353000	32315	5619	8860	1425	3789	735	52743	72800	20,057
Rubella IgM	7129	266293000	37353	5619	8860	1425	3789	735	57781	72800	15,019
T3	18842	259926665	13795	5619	8860	1425	3789	735	34223	28400	-5,823
T3 Uptake	3589	574600000	16010	11238	8860	1425	3789	735	42057	28400	-13,657
T4	22613	357661576	15817	5619	8860	1425	3789	735	36245	28400	-7,845
Testosterone	1970	87500000	44416	5619	8860	1425	3789	735	64844	48900	-15,944
Toxo g	6181	247014000	39963	5619	8860	1425	3789	735	60391	72800	12,409
Toxo M	6448	250325000	38822	5619	8860	1425	3789	735	59250	72800	13,550
TSH	76638	1394339761	18194	5619	8860	1425	3789	735	38622	37200	-1,422
Vitamin D	5796	333200000	57488	5619	8860	1425	3789	735	77916	83900	5,984

Ministry's tariff. This difference is due to the unrealistic tariffs with the unit cost of services (12).

This study was performed in one of the largest clinical laboratories in the country that the total number of patient admissions was *217,103* people in 2013. The total number of tests was also *2049055*. Of this number, total tests were done in hormone sector in 2013 was *270,046* test. TSH test with the number *76,638* and HAV with the number of *129* had the highest and lowest frequency, respectively. The main limitation of this study is that all cost analysis done for a single year (2013 alone), may be is not an enough data to correlate the economic activity Hormone section with other years. The results of the current study showed that the biggest share belonged to human resources (59% of total) and the lowest belonged to depreciation (1.2% of total costs).

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MATERIALS AND METHODS

This study is an applied research that was conducted by the descriptive-analytic, cross-sectional and retrospective way in a central laboratory of the hormone sector for costing of 42 services. Sampling is done for the reason that the tests conducted in this sector has specific characteristics because of its specialized also devices and kits used in this sector have high prices compared to other sectors. Therefore estimated unit cost of this service can help authorities decide on future such as the elimination of tests with high cost; purchasing devices with high cost effectiveness, eliminating unnecessary processes and improving the quality of services. And since this is one of the largest outpatients laboratory services with a high volume of visitors can be extended the results of this research to other laboratory facilities.

Summary of activity-based costing model stages:

1. Identifying the target
2. Activities analyzing
3. Tracking sources used for activities
4. Selecting the appropriate activity costs
5. Calculating the cost of Activity
6. Tracking the costs used by activity
7. Performance Measurement (7).

The data for this study were collected through different forms, costs table, studying the related documents, and using new financial software, as well as interviews and observations. Generally methodology of this study is defined in 7 steps as:

First step: Documenting the process from acceptance to reporting phase. This helps to eliminate processes that do not affect the investigation process. And the time taken to collect technical information and accounting should be saved.

Second step: Identify the activity centers in the laboratory. Activity centers are places where an activity is performed and activity centers are direct cost making agents within the activity centers. To identify the activity centers, interviews and direct observation were used.

Third step: At this stage, activity centers were identified by separation operations. Laboratory's activity centers were divided into three groups based on their operations:

1. Operational centers or final centers: include the serology, hematology, blood and urine biochemistry, hormones, parasitology and microbiology.
2. Intermediate centers include admission, sampling Males and Female, the serum and responsiveness.
3. Overhead centers (centers which are not directly involved in patient care and are doing public service and support activities for operational activities and diagnostic centers Such as accounting, logistics, warehousing, management and computer).

Fourth step: At this point the output of the activity center was determined. In other words, at this point it becomes clear that each center provides what kind of output.

Fifth step: At this stage the costing of the hormone, as well as intermediate centers and overhead centers were performed. By studying the available documents, the cost of each center was set including cost of human resources, the cost of materials and supplies, depreciation costs and overheads.

Sixth step: At this stage, the cost of intermediate centers and support centers were attributed to major activity centers. Costs are divided into two groups based on the origin of the establishment: First: The costs that are created within each activity center, Second: The cost that is allocated to each center from the other activity centers. At this stage cost motivators were identified (table 1).

Seventh step: At this stage prime cost of hormone sector services was set and was compared with the approved tariff. After determining the cost of intermediate and overhead the total cost allocated to the main activity (Hormone) divided on the number of tests performed and through this the unit cost achieved according to any output. In this study 42 hormone services was estimated by calculating the direct costs of the sector and sharing the indirect costs from the other common parts based on financial information in 2013. The price of services was estimated using the following formula. In addition, for ease of calculation results from Excel 2010 software was used. Cost of service = direct costs + indirect costs (including the costs of sharing the findings of other sectors, etc.). Personnel costs are divided into four groups of expertise, supporter, management and services according to the number of activity.

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Key words
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