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Estimating Unit Cost for Dental Services: Evidence from Community Health Centers in Iran

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Objectives Cost information can help policy makers to set user fees, public and private tariffs and budgets and also to conduct an economic evaluation to provide health care with acceptable quality and affordable price. This study aimed to do a cost analysis for the Iranian Comprehensive Health Centers (CHCs), to estimate the unit cost of different dental services.
Methods This was a cross-sectional study. Capital and recurrent cost information of three urban CHCs in Mashhad was collected. Cost identification was based on the provider's perspective. The step-down costing method was adopted from Konte and Waker and applied in five steps: defining cost centers, identification of operational activities, assigning inputs to cost centers, allocate all costs to final centers, and compute unit costs.
Results In dental services, the most important cost driver was human resources that comprised 69% of the total cost. The unit cost of a relative K for dental care was 12,189 Rials (1 USD: 31,407 Rials as in 2016). Accordingly, the unit cost for different dental services varied from 182,834 Rials for dental radiography to 1,589,570 Rialsfor class II composite restorations. The mean cost of a dental visit for examination and diagnosis estimated 247,436 Rials.
Conclusion Comparison between the estimated unit cost and the current dental tariffs reveled considerable differences. Integration of dental services to primary health care in the Iranian CHCs would result in the economies of scope.
Keywords Economics, Medical; Dental Care; Costs and Cost Analysis

Introduction

Dental care accounts for 4.6% of the global health expenditure[1], and its financing and affordability are major issues for the health care systems.[2,3] Cost information of dental services can help the policy makers to set user fees and tariffs, develop budget plans and conduct economic evaluation to provide health care services with acceptable quality and affordable price.[4-6] Sustainable financing and efficient use of available resources are among the arising concerns for dental delivery system in Iran and other developing health systems.[2,6,7] Cost information has a key role in response to this concern, and some studies[8-12] have addressed dental cost analysis. The unit cost of dental services varies according to the context of different countries[12] and dental service delivery setting.[5] Tianviwat et al. reported variations of dental service cost between the community-based mobile dental clinics and hospital setting in Thailand.[8] Khairiyah et al. (2009) estimated different costs per restoration for urban and rural clinics in Malaysia.[11] It still seems that the economics of dental services is a global issue and each country needs specific evidence to address it. The health outcome has dramatically improved in Iran after the Islamic revolution in 1979. This success is mainly attributed to the good establishment of Health Networks[13], that cover the Comprehensive Health Centers (CHCs), district hospitals and health houses. At present, CHCs are distributed throughout the country. The number of dental schools in Iran has greatly increased in the last decade and the number of dentists per population outpaced the global average and reached to 1 in 2500.[14, 15] Nowadays, the Iranian health system experiences a huge demand for dental care in both public and private sectors. In the rural areas, 70% of dental care is provided by the public sector via CHCs.[14] Many oral and dental health programs of the Iranian Ministry of Health are included in CHCs from national to district levels especially for women and children under 12 years. Cost studies have been few in Iran to estimate the unit cost of dental procedures to provide evidence for improving the efficiency of limited available resources. This study aimed to analyze the cost structure of a CHC to estimate the unit cost of different dental services in the Iranian public sector.

Materials and Methods

This study had a cross-sectional design and conducted at Mashhad University of Medical Sciences (MUMS), which has the largest medical university of the Ministry of Health in the east of Iran. Health Center No. 1 covers 27 CHCs; out of which, 12 CHCs deliver dental services. Although,

the unit cost analysis could be conducted in a single center, to increase the generalizability of the results, we selected three CHCs at different locations and with different populations for the costing design. Standard forms were formulated to collect data. Annual capital and recurrent expenditures were collected from the three centers. This study was conducted in 2016 and the values were calculated according to the US Dollar to Iranian Rial exchange rate of 1 USD: 31,407 Rials as in 2016.

Five categories of cost including human resources, building, equipment, consumable materials and energy were identified from the provider's perspective. The applied costing method was adopted from Conte and Waker[16] and included five steps:

Step 1: Defining the cost centers

The existing organizational structure of CHCs was assessed and a variety of cost centerswere identified. Based on their operation, the cost centers were put into two categories: Indirect (overhead) cost centers and direct (final) cost centers.

Step 2: Identification of operational activities

In all overhead and final cost centers, operational activities were identified. This information helped to determine the service input-output process of cost centers.

Step 3: Assigning inputs to cost centers. Five cost drivers including human resources, building, equipment, medical and nonmedical materials and energy were allocated directly to each cost center.

Step 4: Allocating all costs to final cost centers. The indirect costs were allocated from the overhead cost centers to dental service cost centers according to the appropriate criteria. The allocation criteria were derived based on expert consensus.

Step 5: Computing the total and unit costs for each final cost center

The full costs of dental departments (as a final cost center) comprised of direct costs from their inputs plus indirect costs allocated form overhead units. For allocating these costs among different dental services, the relative K of each service from the Iranian relative value book was applied. The total cost was divided by the total number of K, so the cost per dental K was calculated as follows:

$$\text{cost per dental K} = \frac{\text{total cost of dental department}}{\text{total K of delivered services}}$$

In the next step, the K number of each service was multiplied by the cost per one dental K to estimate the unit cost of each service as follows:

$$\text{Unit cost of a dental service} = \text{cost per one dental K} * \text{K number of dental service}$$

Results

The cost drivers of dental service delivery in the CHCs are summarized in Table 1. According to the results, the total cost of dental service delivery in three CHCs was 2,405,136,413 Rials in 2016. The human resource cost accounted for 69% of the total cost. Indirect cost as the cost absorbed from the overhead activity departments, accounted for 17.3% of the total cost (Table 1). The findings revealed delivery of 5,843 dental services that included 199,032 K in one year. Base on the second equation, the cost per one K was calculated as follows:

$$\text{Cost per one dental K} = \frac{2,405,136,413}{197,321} = 12,189 \text{ Rials}$$

Table 1- Cost items of dental service delivery (in Rials)

Cost Items	Mashhad Health center No. 1			Total
	CHC 1 (%)	CHC 2 (%)	CHC 3 (%)	
Human Resources	602,498,913 (68.5)	545,294,611 (74.6)	512,051,819 (64.5)	1,659,845,343 (69)
Medical and Nonmedical Materials	60,959,110 (6.9)	57,747,176 (7.9)	67,978,747 (8.5)	186,685,033 (7.8)
Equipment Depreciation	42,454,145 (4.8)	25,280,294 (3.4)	27,720,794 (3.5)	95,455,233 (4)
Building Depreciation	18,176,895 (2.1)	4,666,667 (0.6)	5,000,000 (0.6)	27,843,562 (1.2)
Energy and Civil Facility	9,757,822 (1.1)	3,276,500 (0.4)	4,636,362 (0.6)	17,670,683 (0.7)
Indirect (Overhead) Cost	146,084,575 (16.6)	94,861,072 (13)	176,690,911 (22)	417,636,558 (17.3)
Total Cost	879,931,460 (100)	731,126,320 (100)	794,078,633 (100)	2,405,136,413 (100)

By multiplying the cost per one K by the number of K for each service, the unit cost for 15 service types was estimated (Table 2). The unit cost for different dental services varied from 182,834 Rials for dental radiography to 1,589,570 Rials for class II composite restoration. The mean cost of a dental visit for examination and diagnosis as the most common dental service was estimated to be 247,436 Rials.

Comparison between the estimated unit cost and the current tariffs revealed a high deviation both in public and private sectors (Table 2).

Table 2 - Unit cost of dental services and comparison with the current tariff (in Rials)

	Dental Services	K in Relative Value Book	Current Tariff		Number of Services Delivered			Estimated Unit Cost				Deviation from Tariff	
			Public Tariffs	Private Tariffs	zCHC 1	CHC 2	CHC 3	CHC 1	CHC 2	CHC 3	Mean of Three CHCs	Public (%)	Private (%)
1	Examination and Diagnosis	20.3	106,000	220,000	1,743	895	1294	288,824	256,097	207,941	247,436	141,436	27,436
2	Dental Radiography	15	78,000	190,000	18	7	12	213,417	189,234	153,651	182,834	104,834	7,166
3	Fluoride Varnish	20	104,000	600,000	317	90	62	284,556	252,313	204,868	243,779	139,779	356,221
4	Fissure Sealant	44	228,800	528,000	4	5	27	626,022	555,088	450,710	536,314	307,514	8,314
5	Anterior Tooth Extraction	41	213,200	492,000	17	62	127	583,339	517,241	419,979	499,747	286,547	7,747
6	Posterior Tooth Extraction	88	234,000	540,000	43	89	129	1,252,045	1,110,176	901,419	1,072,628	838,628	532,628
7	Third Molar extraction	55	286,000	660,000	8	0	5	782,528	693,860	563,387	670,392	384,392	10,392
8	Class I Amalgam Restoration	71	369,200	852,000	48	166	197	1,010,173	895,710	727,281	865,416	496,216	13,416
9	Class II Amalgam Restoration	97	504,400	1,164,000	42	71	75	1,380,095	1,223,716	993,610	1,182,328	677,928	18,328
10	Class III Amalgam Restoration	108	561,600	1,296,000	4	12	25	1,536,601	1,362,488	1,106,287	1,316,407	754,807	20,407
11	Tooth Scaling	76	395,200	1,824,000	11	11	25	1,081,311	958,788	778,498	926,360	531,160	897,640
12	Class I Composite Restoration	78	405,600	936,000	19	52	26	1,109,767	984,019	798,985	950,738	545,138	14,738
13	Class II Composite Restoration	104	540,800	1,248,000	38	12	18	1,479,689	1,312,026	1,065,314	1,267,651	726,851	19,651
14	Class III Composite Restoration	126	655,200	1,512,000	2	8	8	1,792,701	1,589,570	1,290,668	1,535,808	880,608	23,808
15	Pulpotomy and Dressing	80	416,000	960,000	4	2	13	1,138,223	1,009,251	819,472	975,116	559,116	15,116
	Total	-	-	-	2319	1482	2043	-	-	-	-	-	-

Discussion

In this study, human resources accounted for 69% of the total cost of dental procedures in CHCs. The results of past studies also indicated that dental delivery systems are labor-intensive. Oscarson et al. (1998)[17] reported the cost components of the total costs of dental care in Sweden. In their study, labor was the major cost driver, comprising 67% of total costs. In a recent study[8], in Thailand, labor accounted for 67.4% of the direct costs. In dental restoration procedures in nine European countries, the labor cost was the major cost component in all practices; comprising 58% of total costs.[12] Dental services in the Iranian CHCs are preventive and result in higher share of human resources in the total cost. Dental services are integrated in the comprehensive health package of the Iranian CHCs[14], thus, they benefit from the economies of scope. However, in costing scenarios, the cost of overhead and supporting centers should be allocated carefully. In this study, the overhead costs were the second most important cost items, accounted for 17.3% of the total cost.

The government tariff for one K was 5,200 Rials in 2016. On the other hand, the cost incurred per K was calculated to be 12,189 Rials. Accordingly, the revenue to cost ratio was 42%. Other studies in Iran reported lower ratios. Fallahzadeh et al. (2012)[9] in Yazd and Gheisari et al. (2006)[10] in Fars Province analyzed the revenue to cost ratio of oral health departments and reported 34% and 23%, respectively. The increase in this ratio in Iran may be due to the advent of systematic approaches for setting tariff or the improvement of efficiency of dental care delivery systems. The calculated unit cost varied among the three CHCs. Although the total cost in CHC 3 was more than CHC of 2, more services were provided by CHC 3 and hence lower unit cost was extracted.

Dental visit for examination and diagnosis was the most used service and its unit cost was estimated to be 247,436. In brief, the study findings showed that the estimated unit cost of dental services outpaced the public and private tariffs in the Iranian CHCs. Tan et al. (2008) also reported that dental restoration incurs costs in excess of reimbursement in the European countries. [12]

Conclusion

The unit costs were mainly influenced by the service

utilization and labor cost. The cost structure of CHCs followed the same pattern as the cost components. This study provided cost and utilization of information about public dental services in Iran. This information may be applied to estimate the financial burden of oral health coverage. The study findings are also useful in setting tariffs and reimbursement mechanisms for developing strategic purchasing plans which is an arising concern in developing health systems.

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Conflict of Interest

None Declared ■

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