Cost Analysis of Pharmacy Education Using Time-Driven Activity-Based Costing (TDABC) at The Pharmacy School of Isfahan University of Medical Sciences

Farimah Rahimi Mogoei[1], Mohammadreza Amirsadri[1,2*], Mohammadreza Rezayatmand[1], Mohammadreza Karimi[2]

[1]*Health Management and Economics Research Center, Isfahan University of Medical Sciences, Isfahan, Iran.*

[2]*Department of Clinical Pharmacy and Pharmacy Practice, Isfahan University of Medical Sciences, Isfahan, Iran.*

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Abstract

Aims: This study aims to calculate the total cost of educational services delivered by the School of Pharmacy at Isfahan University of Medical Sciences, focusing on the cost associated with training pharmacy students using time-driven activity-based costing (TDABC).

Methods: Data were collected through designed forms, interviews, and direct observations. Financial, budgetary, and educational experts ensured compliance with administrative guidelines. A cost accounting system via TDABC was designed and implemented to allocate costs accurately.

Results: In 2019, the Faculty of Pharmacy at Isfahan University of Medical Sciences allocated an average of 2 billion and 50 million and 29 thousand rials per pharmacy student for educational and research purposes. This figure increased to 2 billion and 997 million and 845 thousand rials in 2020 and slightly decreased to 2 billion and 730 million and 260 thousand rials in 2021.

Conclusion: This study delves into a crucial issue of accurately estimating the cost of pharmacy education at the School of Pharmacy, Isfahan University of Medical Sciences. The research emphasizes the optimal utilization of resources, which can be achieved through data analysis and the adjustment of certain costs.

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Keywords: Time-Driven Activity-Based Costing (TDABC); Pharmacy Education; Cost Analysis; Resource Allocation

Introduction

The education sector, especially in healthcare, faces significant challenges in resource management and cost allocation. Traditional costing methods, often reliant on standard cost allocations, fail to capture the nuanced expenditures associated with different educational activities and resource utilization (1). This inadequacy leads to inefficient resource use and challenges in strategic planning and financial sustainability. In recent years, Time-Driven Activity-Based Costing (TDABC) has emerged as a robust method to provide more accurate cost information (1). Unlike traditional costing methods, TDABC calculates costs based on the actual time required to perform activities and the resources consumed, offering a more granular and dynamic view of cost distribution (1).

Various studies have been conducted in fields related to the TDABC method. For example, there is a study about the deposit receipt process in a university library in Belgium using TDABC, helping library management to better understand cost factors and improve processes (1). Similar research has been conducted that TDABC is more appropriate in logistics operations (2, 3, 4). There are other several studies which also have explored TDABC applications (5, 6, 7).

*** Corresponding Author:** Dr Mohammadreza Amirsadri
Address: Health Management and Economics Research Center, Isfahan University of Medical Sciences, Hezar Jarib Street, Isfahan, Iran,
Post Code: 81746-73461
Email: m.amirsadri@yahoo.co.uk

Pharmacy education, with its diverse range of teaching methods, laboratory activities, clinical placements, and research projects, presents a complex costing landscape. Accurate cost determination is essential for ensuring that educational institutions can allocate resources efficiently, justify funding requests, and set appropriate tuition fees (8). Moreover, understanding cost structures can aid in curriculum development and improve educational quality by identifying areas where resources may be under or over-utilized (8).

The School of Pharmacy at Isfahan University of Medical Sciences (MUI) is committed to delivering high-quality education while maintaining financial sustainability. This study aims to implement TDABC to provide a comprehensive cost analysis of the pharmacy education programs at MUI. By doing so, the study seeks to highlight the inadequacies of traditional costing methods and demonstrate the benefits of adopting TDABC for improved resource management and strategic planning in educational institutions (8).

Methods

This descriptive-analytical study aimed to estimate the training costs of students at the School of Pharmacy, Isfahan University of Medical Sciences, and compare annual costs from 2019 to 2021.

Data Collection

Data were gathered using accounting documents, interviews, and direct observations. To ensure the accuracy and relevance of the data, data collection forms were designed with expert consultations. The expert team included professionals from educational, research, financial, administrative, management, and economic fields.

Time-Driven Activity-Based Costing (TDABC)

The TDABC system was implemented in the following steps:

1. **Identification of Activities and Resource Objects:** Relevant activities and resource objects within the organizational chart of the School of Pharmacy were identified. The chart consists of five main sections: Interim Presidency, Student Services, Finances and Services, Research, and Education.
2. **Calculation of Total Activity Costs**: Total costs associated with each identified activity were calculated, considering all necessary resources. Costs included: Personnel, Administrative, Energy, Consumables, Depreciation, and Others.
3. **Estimation of Practical Capacity:** Practical capacity was estimated based on operational data, and the total costs were distributed among various faculty departments using appropriate cost drivers, such as the number of faculty and non-faculty members, occupied rooms, and total individuals.
4. **Calculation of Unit Cost of Capacity Supplied:** The unit cost of capacity was determined by dividing the total cost of activities by the estimated practical capacity. Costs of support departments (interim Presidency, Student Services, and Finances and Services) were then allocated to the Educational and Research departments.
5. **Calculation of Activity Rates:** Activity rates were computed by multiplying the rate per unit of capacity with the observed activity time for each activity. The total activity time was calculated based on teaching and research hours, which served as the cost driver to allocate costs among PharmD, and other students.
6. **Calculation of Product/Service Costs:** Theoretical, practical/thesis, and internship hours for undergraduate students were identified, and their share of total hours was used to determine the cost per unit for pharmacy students. This enabled the calculation of costs for various courses and semester offerings, as well as the total annual cost per undergraduate student.

All costs are reported in Rials and, for better comparison, also in PPP$ (PPP conversion factor sourced from World Bank). Purchasing power parity (PPP) is a popular macroeconomic analysis metric used to compare economic productivity and standards of living between countries.

Results

Identification of Activities and Resource Objects

The organizational chart of the School of Pharmacy at Isfahan University of Medical Sciences consists of five main sections (Figure 1):

1. Interim Presidency
2. Student Services
3. Finances and Services
4. Research
5. Education

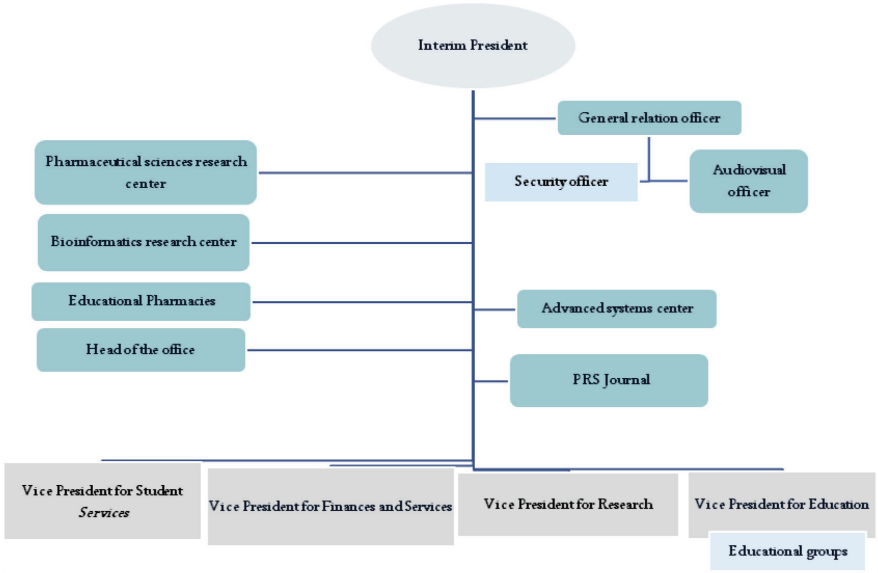

Figure 1: The organizational chart of the School of Pharmacy at Isfahan University of Medical Sciences

Calculation of Total Activity Costs

Table 1 presents the total costs incurred by the faculty for 2019, 2020, and 2021. Across all three years, personnel expenses consistently represented the largest portion of total expenses, followed by administrative costs. Energy and other costs accounted for a relatively smaller share of total expenditures.

Table 1: The cost components according to the year

Costs	Monetary unit	2019	2020	2021
Personnel	Rials	255,418,043,412	391,276,819,957	374,967,234,644
	PPP$*	10,846,219	11,873,212	7,426,834
Administrative	Rials	10,505,403,043	16,619,520,888	9,136,839,532
	PPP$	446,107	504,316	180,970
Energy	Rials	10,559,000	51,292,000	126,704,000
	PPP$	448	1,556	2,510
Consumable	Rials	11,260,553,782	10,149,992,913	8,693,510,683
	PPP$	478,175	307,999	172,189
Depreciation	Rials	8,989,251,139	9,121,554,431	13,941,829,618
	PPP$	381,725	276,792	276,141
Other	Rials	466,076,166	1,458,225,617	115,314,396
	PPP$	19,792	44,250	2,284
Total	Rials	286,649,886,542	428,677,405,806	406,981,432,873
	PPP$	12,172,466	13,008,124	8,060,927

*PPP; Purchasing power parity. PPP Conversion factor year 2019: 23549.04. PPP Conversion factor year 2020: 329954.59. PPP Conversion factor year 2021:50488.17.

Estimation of Practical Capacity

Table 2 demonstrates that the Research and Educational departments incurred the highest costs. Meanwhile, the Office of the School Presidency, Student Services, and Finances and University Services were categorized as support departments.

Table 2: Total costs allocated into different faculty departments

Departments	Unit	2019	2020	2021
Interim Presidency	Rials	23,311,996,776	35,162,605,588	29,656,499,502
	PPP$*	989,934	1,067,002	587,395
Vice Presidency for Finances and Services	Rials	40,491,471,195	59,449,649,184	45,353,498,414
	PPP$	1,719,453	1,803,987	898,300
Vice Presidency for Research	Rials	102,447,365,632	154,601,304,459	157,248,114,663
	PPP$	4,350,384	4,691,344	3,114,554
Vice Presidency for Education	Rials	117,907,954,876	175,717,565,928	171,440,408,296
	PPP$	5,006,911	5,332,112	3,395,655
Vice Presidency for Student Services	Rials	2,491,098,062	3,746,280,639	3,282,911,997
	PPP$	105,783	113,680	65,023
Total	Rials	286,649,886,541	428,677,405,798	406,981,432,872
	PPP$	12,172,466	13,008,124	8,060,927

*PPP; Purchasing power parity. PPP Conversion factor year 2019: 23549.04. PPP Conversion factor year 2020: 329954.59. PPP Conversion factor year 2021:50488.17.

Calculation of Unit Cost of Capacity Supplied

Table 3 illustrates the distribution of support department costs between educational and research activities.

Table 3: Allocation of costs between educational and research departments

Costs	Unit	2019	2020	2021
Educational	Rials	151,533,545,326	225,368,515,660	210,002,284,590
	PPP$*	6,434,808	6,838,760	4,159,435
Research	Rials	135,116,341,216	203,308,890,137	196,979,148,282
	PPP$	5,737,658	6,169,365	3,901,491
Total	Rials	286,649,886,542	428,677,405,797	406,981,432,872
	PPP$	12,172,466	13,008,124	8,060,927

*PPP; Purchasing power parity. PPP Conversion factor year 2019: 23549.04. PPP Conversion factor year 2020: 329954.59. PPP Conversion factor year 2021:50488.17.

Calculation of Activity Rates

Table 4 outlines the distribution of costs among PharmD and other students. This distribution was based on the ratio of teaching and research hours.

Table 4: Allocation of educational and research vice president costs between PharmD, Ph.D., and undergraduate students

Type of cost	Cost share	Unit	2019	2020	2021
Educational	Total	Rials	151,533,545,326	225,368,515,660	210,002,284,590
		PPP$*	6,434,808	6,838,760	4,159,435
	Pharm.D. ¥	Rials	127,704,382,396	192,342,004,787	176,577,540,688
		PPP$	5,422,912	5,836,577	3,497,404
	Ph.D. and undergraduate	Rials	23,829,162,930	33,805,277,349	33,805,277,349
		PPP$	1,011,895	1,025,814	669,568
Research	Total	Rials	135,116,341,216	203,308,890,137	196,979,148,282
		PPP$	5,737,658	6,169,365	3,901,491
	Pharm.D.	Rials	73,053,633,290	120,433,161,787	105,776,917,821
		PPP$	3,102,192	3,654,519	2,095,083
	Ph.D. and undergraduate	Rials	62,062,707,926	83,356,644,956	83,356,644,956
		PPP$	2,635,467	2,529,440	1,651,013
Educational & Research	Total	Rials	286,649,886,542	428,677,405,797	406,981,432,872
		PPP$	12,172,466	13,008,124	8,060,927
	Pharm.D.	Rials	200,758,015,685	312,775,166,575	282,354,458,510
		PPP$	8,525,104	9,491,096	5,592,487
	Ph.D. and undergraduate	Rials	85,891,870,857	117,161,922,305	117,161,922,305
		PPP$	3,647,362	3,555,254	2,320,582

*PPP; Purchasing power parity. ¥Pharm.D.; Doctor of Pharmacy. PPP Conversion factor year 2019: 23549.04. PPP Conversion factor year 2020: 329954.59. PPP Conversion factor year 2021:50488.17.

Calculation of Product/Service Costs

The cost per unit for undergraduate pharmacy students was determined by identifying their theoretical, practical/thesis, and internship hours and calculating their share of total hours. Table 5 presents the annual cost and cost per

student for each investigated year.

Table 5: The total annual cost and the total cost per undergraduate student

Cost		Unit	1398	1399	1400
Semester	1	Rials	15,560,620,457	21,995,696,666	19,793,795,965
		PPP$*	660,775	667,455	392,048
	2	Rials	16,251,791,252	24,114,770,129	21,641,136,749
		PPP$	690,125	731,758	428,638
	3	Rials	17,340,692,979	25,727,945,469	24,022,365,851
		PPP$	736,365	780,709	475,802
	4	Rials	16,251,445,841	23,452,846,687	22,557,716,119
		PPP$	690,111	711,672	446,792
	5	Rials	13,381,704,297	18,679,755,113	19,069,403,927
		PPP$	568,248	566,833	377,700
	6	Rials	16,104,051,254	21,915,371,819	21,489,648,249
		PPP$	683,852	665,017	425,637
	7	Rials	17,367,966,601	23,223,060,217	21,056,281,051
		PPP$	737,523	704,699	417,054
	8	Rials	16,593,367,468	28,667,737,873	26,965,677,333
		PPP$	704,630	869,916	534,099
	9	Rials	18,074,244,645	32,428,610,983	30,495,002,650
		PPP$	767,515	984,039	604,003
	10	Rials	28,657,114,719	49,642,442,578	36,394,974,113
		PPP$	1,216,912	1,506,389	720,861
	11	Rials	13,629,226,030	20,634,989,261	21,005,949,033
		PPP$	578,759	626,164	416,057
	12	Rials	11,545,790,142	22,291,939,779	17,862,507,471
		PPP$	490,287	676,444	353,796
Total		Rials	200,758,015,685	312,775,166,575	282,354,458,510
PPP$			8,525,104	9,491,096	5,592,487
Number of Students		Student	98	104	103
Cost per Student		Rials	2,050,294,628	2,997,845,047	2,730,260,679
PPP$			87,065	90,969	54,077

*PPP; Purchasing power parity. PPP Conversion factor year 2019: 23549.04. PPP Conversion factor year 2020: 329954.59. PPP Conversion factor year 2021:50488.17.

Discussion

This study offers a detailed cost analysis of the School of Pharmacy at Isfahan University of Medical Sciences, highlighting significant trends and insights into the allocation of resources within the institution over a span of three years.

The findings underscore the importance of meticulous financial management in maintaining and enhancing the quality of education and research.

The application of Time-Driven Activity-Based Costing (TDABC) in this study provided a robust framework for cost allocation. TDABC allowed for precise identification and allocation of costs based on the actual time spent on various activities (10). The use of activity-based costing models in higher education has been advocated for their ability to provide more accurate financial insights compared to traditional costing methods (8).

TDABC is the most apt for the dynamics and services found in hospitals/health centers and libraries, distinguishing itself from the ABC model primarily through its temporal focus and differentiation between resource supply and consumption, According to Keel et al. (11).

TDABC can be classified into six categories, with accurately capturing the cost of care having the highest percentage (39%) of expected strengths, followed by supporting operational improvement (26%), managing inherent complexity (22%), being more efficient (9%), and being simpler than traditional ABC and informing reimbursement policy (2%) (12).

The current analysis revealed that personnel expenses consistently account for the largest portion of the total costs. This trend aligns with findings in other higher education institutions, where faculty and staff salaries typically represent a major expenditure due to the critical role of human resources in delivering educational services and conducting research (10). The substantial investment in personnel underscores the institution's commitment to attracting and retaining qualified professionals, which is essential for sustaining high academic standards. Nikjoo et al. evaluated the cost of educational courses for medical students in eight independent educational medical centers in Iran. In total, 24 graduate courses (Master of Science; MSc, and Doctor of Philosophy; PhD) of the post-graduate departments in the medical school of Iran University of Medical Sciences in the academic year of 2018-2019 were included in their study. The total current cost spent on graduate education services in the medical school was 1173 United States dollars (USD). Despite our study in which staff cost had the largest share among the different categories of costs, in the Nikjoo et al. study, the cost of consumables consisted of the largest cost type accounting for 63% of the total cost. In the Nikjoo et al. study, the microbiology PhD incurred the highest per capita cost. These students with more than 950 USD and medical education PhD students with approximately 7 USD represented the highest and lowest costs, respectively (13). In another study, Moradi et al. displayed that the sum of the expenses incurred in 2015 in the medical school of Mazandaran University of Medical Sciences was estimated to be 142,766,676 United States dollars (USD). In this study, as with our study, the highest share of cost was related to the cost of staff, which consisted of 63.58% of the total costs. In this study, the evaluated faculty had 1507 students at different levels and 240 faculty members, providing 609 courses in 9560 hours. The authors concluded that the average total cost for graduation of one student was 9,474 (USD), which is lower than our evaluation for graduation of each Pharm.D. student, possibly due to the differences in the type of educational courses, research activities, level of the students and the year of calculation (14).

A cross-sectional study was conducted between March 20, 2018, and March 20, 2019, at Alborz University of Medical Sciences in which the current and capital cost data were extracted from the university's financial database, and the cost price of services provided was calculated using the activity-based cost model. The mean annual cost of services per student was estimated to be $4778, and the mean cost of education per hour was evaluated as $113. Like our study, the highest share of costs in this study was related to wages and salaries (65%) while 26% of costs were related to depreciation of building and equipment, and 9% to consumable goods and services. In this study, 82% of costs were associated with educational services, 11.9% with student welfare services, and 6.1% were linked to research services (15). Again, the lower cost of student graduation in this study, compared to ours can be because of the differences in the type of educational courses, research activities, level of the students, and the year of calculation.

Based on the study findings Tenured faculty members experienced a steady rise in compensation during this period, with similar increases observed for contract faculty and those on the "k" coefficient salary plan.

The increase in salaries and benefits can be attributed to several factors, including the end of the COVID-19 pandemic and the return to in-person classes, as well as rising inflation. Non-faculty staff also benefited from increased compensation, particularly in 2020 due to retirements and associated bonuses.

The faculty's infrastructure, dating back several decades, required significant repairs and replacements due to wear and tear. This resulted in a substantial increase in maintenance and consumable costs starting in 2020.

Remote learning, implemented during the pandemic, initially led to cost savings due to reduced salaries, equipment depreciation, energy consumption, and laboratory usage. However, to maintain or improve the

quality of remote learning, the faculty needs to invest in a more robust electronic infrastructure and provide additional training.

Conclusion

This study revealed a significant increase in salaries and benefits for all staff members of the Faculty of Pharmacy at Isfahan University of Medical Sciences between 2019 and 2021. The findings of this study provide valuable insights into the cost structure of the School of Pharmacy at Isfahan University of Medical Sciences. The detailed cost analysis using TDABC highlights the significant investment in personnel and core educational and research activities. By adopting this comprehensive approach to cost allocation, the institution can ensure efficient resource management, transparency in financial operations, and strategic planning to enhance its educational and research capabilities.

The implications of this study extend beyond the specific context of the School of Pharmacy, offering a model for other higher education institutions to adopt similar methodologies for cost analysis and resource allocation. The commitment to transparency and accuracy in financial management underscores the institution's dedication to providing high-quality education and research while maintaining financial sustainability.

This research, however, is subject to several limitations. It was difficult to obtain some information accurately and it may have caused some errors predicted in the study. To reduce it as much as possible, micro-financial and non-financial information has been extracted from the available sources. The hours of providing some services might have been different depending on different people and different conditions, for which the average time has been used. It was possible that a number of students have chosen one or more units more than once or some students have withdrawn from their studies, which due to the high number of students and the units passed by them, is unlikely to have a significant effect on the results.

The generalizability of these findings is limited to universities with similar educational programs, equipment, and human resources within the country. Consequently, the application of these results in other countries should be done with caution.

Conflicts of Interest

The authors reported no conflicts of interest.

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