Cost-Volume-Profit Analysis and Expected Benefit of Health Services: A Study of Cardiac Catheterization Services

Mustafa Z. Younis, Samer Jabr, Pamela C. Smith, Maha Al-Hajeri, and Michael Hartmann

Aim: Academic research investigating health care costs in the Palestinian region is limited. Therefore, this study examines the costs of the cardiac catheterization unit of one of the largest hospitals in Palestine. We focus on costs of a cardiac catheterization unit and the increasing number of deaths over the past decade in the region due to cardiovascular diseases (CVDs).

Methods: We employ cost-volume-profit (CVP) analysis to determine the unit’s break-even point (BEP), and investigate expected benefits (EBs) of Palestinian government subsidies to the unit.

Results: Findings indicate variable costs represent 56 percent of the hospital’s total costs. Based on the three functions of the cardiac catheterization unit, results also indicate that the number of patients receiving services exceed the break-even point in each function, despite the unit receiving a government subsidy.

Conclusions: Our findings, although based on one hospital, will permit hospital management to realize the importance of unit costs in order to make informed financial decisions. The use of break-even analysis will allow area managers to plan minimum production capacity for the organization. The economic benefits for patients and the government from the unit may encourage government officials to focus efforts on increasing future subsidies to the hospital.

Key words: cost analysis, cost-volume-profit (CVP) analysis, break-even point (BEP), health care costs.

Academic research investigating health care costs in the Palestinian region is limited. This study seeks to add to the literature concerning hospital costs in the Palestinian territories. The objective of this study is to examine the costs of the cardiac catheterization unit of one of the largest hospitals in Palestine. We focus on costs of a cardiac catheterization unit and the increasing number of deaths over the past decade in the region due to cardiovascular diseases (CVDs).

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costs of the cardiac catheterization unit of one of the largest hospitals in Palestine. We employ cost-volume-profit (CVP) analysis, also known as break-even analysis, to determine the fixed and variable costs of the hospital’s cardiac catheterization unit. We also estimate whether the Palestinian government subsidizes the costs of the cardiac catheterization unit.

Palestine allocates a significant part of its resources to the health sector. The escalation of health expenditure has been a universal phenomenon over the past decades, and while its extent has been significant in high-income countries, low- and middle-income countries have similarly experienced much the same. Many factors may have affected the escalation of health expenditure, such as:

- Evolving high-cost medical technologies;
- Changes in disease patterns; or
- Increasing demand for health care services.

An analysis of health care costs in the Palestinian region is timely and necessary due to the region’s economic impact. 2008 data indicated that the gross domestic product (GDP) of Palestine was estimated to be US $6,108.2 million (current price) or about US $1,697 per capita. The health expenditure in 2008 is estimated to be 15 percent of the GDP. These economic indicators, coupled with rising global health care costs, support further analysis of hospital operations. Kiy-maz et al. analyze the relationship between health care expenditures and GDP, and their findings support prior findings that a positive correlation exists between a country’s GDP and its health expenditures. This article seeks to contribute to the discussion of global health care expenditures.

We focus on costs of a cardiac catheterization unit and to the increasing number of deaths over the past decade in the region due to cardiovascular disease (CVD). Data indicate that in 2003, 3,894 people died from various CVDs, with the distribution of deaths due to CVD approximately the same between males and females (52.4 percent for males, 47.6 percent for females). Palestine and its neighboring countries are facing increasing mortality rates due to diseases of the circulatory system. For example, in Jordan, CVD was the leading cause of death.

The incidence of coronary heart disease is growing significantly in the region, including Bahrain, Egypt, Iraq, Kuwait, and Qatar. Data from these countries indicate deaths attributable to diseases of the circulatory system range from 25 percent to 40 percent of all deaths. Mataria et al. find that the overall quality of life of Palestinians is very poor, yet “the Palestinian people provide a valuable public health lesson with respect to the broader understanding of health and the problem of ‘medicalization’ of health.” Giacaman et al. point out the importance of examining both fatal and non-fatal health outcomes in order to guide health policy in the region.

This article focuses on a treatment of CVD, where cardiac catheterization services are the most expensive, most accurate, and most advanced as a diagnostic and therapeutic tool and thereby the most cost effective when considering the significant reduction in mortality and morbidity with its socio-economic consequences.

We employ a case-study analysis of the costs of a hospital’s cardiac catheterization unit. We concentrate on the level of patient activity needed for the facility to break even.
The use of cost analysis by administrators and regulators may improve the quality of financial information, as well as enhance the efficient use of scarce resources. Our findings, though based solely on one hospital, permit hospital management to realize the importance of unit costs in order to make informed financial decisions within the unit. Furthermore, the economic benefits for patients and the government from the cardiac catheterization unit may encourage government officials to focus efforts on the unit and increase future subsidies to this unit.

Prior Literature

Prior literature examines health care break-even analysis in numerous settings—from the expansion of dental practices to long-term care facilities. Stritecky and Pubal note that break-even analysis is one of many managerial tools that help a hospital survive under market competition and forces management to reply to flexible market circumstances. Chotiwan et al. probe the laboratory costs of a Thai hospital, and find the material costs of the unit comprise the highest proportion of direct and total costs.

Despite this variety of break-even analysis in prior literature, research investigating cost allocation in Middle Eastern hospitals exists on a limited basis. Younis et al. employ CVP analysis in a Palestinian multi-service hospital for the period from 2005 to 2007, and Chodick et al. assess the direct medical cost of CVD in an Israeli health maintenance organization (HMO).

The impact of the Palestinian region’s economic resources, combined with the need for fiscal responsibility, supports the need for further research on health care costs. We seek to expand upon the use of CVP analysis through a case-study format in order to add to the literature concerning hospital costs in the Palestinian region.

Methods

Overview

This study is a case study of the cardiac catheterization unit of the Ramallah Hospital. The hospital, originally built in 1961, is located in Ramallah City, West Bank. The hospital employs 62 physicians, 129 nurses, 46 paramedics, and 87 administrative employees. The hospital is owned and operated by the Ministry of Health (MoH), has a capacity of 150 beds, and its primary objective is to provide general and surgical services to the community. As a MoH hospital, Ramallah hospital operated under MoH regulations and guidelines. It is a general hospital providing numerous units of specialty, including orthopedics, internal medicine, surgical operations, cardiac catheterization, burns, neonatology, general surgery, intensive care unit, intermediate care unit, delivery, and specialized surgery. The occupancy rate was estimated at about 90 percent in 2009.

In 2010, the hospital became part of the Palestine Medical Complex (PMC). The PMC consists of two newly established hospitals and two existing facilities with the addition of the central blood bank. The consolidation of the five facilities into one entity serves as a national center of excellence and as a pilot approach to decentralized hospital management. The cardiac catheterization unit of the hospital performed over 2,000 procedures in 2004. Without this unit, these procedures would have been transferred to Jordan or Israel.
The objectives of the cardiac catheterization unit are to:

1. Provide a local, essential, and life-saving service;
2. Alleviate the burden of travel to the heart disease patient;
3. Save money for the facility;
4. Provide further training in invasive cardiology for Palestinian doctors and nurses; and
5. Provide necessary support for local cardiovascular surgeons.\textsuperscript{15}

The cardiac catheterization unit has two main purposes:

1. The diagnosis of various CVDs; and
2. Therapeutic treatment of CVDs.

**Cost-Volume-Profit Analysis**

Cost-volume-profit (CVP) analysis allows hospital management to discern the probable effects of changes in sales price, product mix, or sales volume.\textsuperscript{16} We focus on CVP analysis of the cardiac catheterization unit of the Ramallah hospital during 2003. Cost allocation involves the transfer or allocation of costs from one department to another. These cost allocations assist in determining unit price, which can be used for price setting. Cost allocations also help determine the relationship of total revenue and total cost for a department or service, and to determine profitability on a product line or departmental basis. In health care, most allocations involve cost transfers from overhead centers (non-revenue department) to revenue centers (revenue department).\textsuperscript{17} The costs of any overhead departments are distributed to the intermediate and final service departments through a step-down method, according to allocation criteria devised to resemble as closely as possible the actual use of resources by each of the departments. The step-down method is a more advanced cost-findings technique than the direct distribution method because it involves the distribution of costs from overhead departments and finally to intermediate and final service departments.\textsuperscript{18}

The step-down cost accounting (SDCA) approach identifies the range of resources needed to run a facility, and then assigns these resources to chosen “cost centers” on an allocation basis. Those costs in turn filter down until the final cost centers of interest are left. The following are necessary considerations to compute unit costs:

1. Rank the support cost centers in order; the one that is consumed the most by others would be ranked the first, and next would be the second;
2. Allocate direct costs from the first rank down unit, the last support cost center;
3. Allocate denominators—the sum of allocation criteria of all cost centers that are not yet allocated; and
4. Never allocate back to the previous support cost centers.\textsuperscript{19}

Figure 1 contains the allocation criteria for the various cost centers of the Ramallah Hospital.

The costs of the cardiac catheterization unit can be classified into two elements: fixed cost and variable cost. Fixed costs are those costs that tend to remain constant over the course of many accounting periods, and are not influenced by changes in volume or intensity of service. Thus, fixed costs are incurred regardless of how much service is
provided. Four main cost items are taken into consideration to calculate fixed costs:

1. Cost of medical equipment;
2. Cost of furniture and equipment;
3. Salary of doctors, nurses, and all staff in the cardiac catheterization unit; and
4. Overhead allocation from overhead centers to the cardiac catheterization unit.

Variable costs are those that relate to the direct cost of providing care, and are expressed as costs per unit of service delivered. Variable costs thus rise and fall in relation to changes in the level of activity. Examples include disposable supplies; for example, intravenous tubing, contrast dye, and stents. Variable costs may be paid from the cardiac catheterization unit’s earnings or from government subsidies.

We use the following formula to calculate unit variable costs for each function inside the cardiac catheterization unit:

\[ TC = \gamma_1 \text{Diag} + \gamma_2 \text{Ball} + \gamma_3 \text{Pace} + FC \]  

Where

- \( TC \) = total cost.
- \( \gamma \) = gamma (unit variable cost).
- Diag = number of Diagnosis patients.
- Ball = number of Balloon patients.
- Pace = number of Pacemaker patients.
- FC = fixed cost.

Ordinary least square (OLS) or linear least square is a method for estimating the unknown parameters in a linear regression model. It has been used to analyze the results that determine the unit cost per each function by entering the data on a monthly basis. We convert Equation 1 to find the equivalent number of patients (total output) for all unit functions (diagnosis, balloon (angioplasty), and pacemaker), which will be used to estimate the break-even point for the cardiac catheterization unit.

\[
\frac{\gamma_2}{\gamma_1} \text{Ball} = \text{Diag} \\
\frac{\gamma_3}{\gamma_1} \text{Pace} = \text{Diag} \\
\gamma_1 Q = \gamma_1 \text{Diag} + \gamma_2 \text{Ball} + \gamma_3 \text{Pace} \\
Q = \text{Diag} + \frac{\gamma_2}{\gamma_1} \text{Ball} + \frac{\gamma_3}{\gamma_1} \text{Pace}  
\]

Where \( Q \) means equivalent diagnosis (output) patients

We assume that \( \gamma_1 \) is the unit variable cost. Equivalent diagnosis has been used because the majority of patients are diagnosis patients; this also should minimize statistic error. However, using \( \gamma_2 \) or \( \gamma_3 \) as unit variable cost will give the same result.

The cardiac catheterization unit earns revenue from patient and government payments (out-of-pocket, copayments, and global budget allocation). Therefore, the total revenue (TR) for the unit is as follows:

\[ TR = f \text{ (patients charges, government)} \]

Thus the following formula is used to set the price for services:

\[
\text{Equivalent Diag} = \text{Diag} + \frac{\gamma_2}{\gamma_1} \text{Ball} + \frac{\gamma_3}{\gamma_1} \text{Pace} \]
Average price = \( \Sigma \) Total revenue/ Equivalent Diag

The Break-Even Point with Constant Price and Linear Costs

Our analysis is based on data obtained from the following sources within the Ramallah hospital—the cardiac catheterization unit, medical storage, finance department, central storage, and maintenance department. Other data were also obtained from the Palestinian Health Information System. It holds that, with constant price, the revenue develops according to this relation:

\[
R = p*q
\]

Where
\( R \) = revenue.
\( q \) = number of patients.
\( p \) = price.

And the expenses with linear (proportional) develop according to this relation:

\[
TC = FC + b*q
\]

Where
\( TC \) = total cost.
\( FC \) = fixed cost.
\( b \) = unit variable cost.

Then, if that is true, then profit is the difference between revenues and expenses

\[
P = R - TC
\]

It is obvious that we get profit when \( R > TC \); in the opposite situation there is loss. When \( R = TC \), there is neither profit nor loss. We can analytically derive it from the equations above:

\[
R = TC; \quad (4)
\]

\[
p*q = FC + b*q
\]

\[
q = \frac{FC}{p - b}
\]

The break-even point (BEP) is an analytic technique that helps determine the level of volume needed to reach the financial break-even point, the point at which net revenue exactly equals cost. At this point there is neither a loss nor a profit. After calculating the BEP, the number of patients where total costs = total revenue is allocated on the functions of the cardiac catheterization unit to estimate the number of patients for each function by using Equation 3 above.

Break-even analysis assumes that the firm’s average variable costs are constant in the relevant output range; hence, the firm’s total cost function is assumed to be a straight line. Since average variable cost is constant, the extra cost of an additional unit of output—marginal cost—must be constant too, and equal to average variable cost.

Government Expected Benefit (GEB)

In this article, we also calculate how the government subsidizes the cardiac catheterization unit if the patient BEP is more than the real number of patients who visited the cardiac catheterization unit. Thus, we analyze whether or not the government covers any difference between costs and total revenue. We base our analysis on the following:

\[
\text{Operation loss} = \text{Total cost} - \text{Total revenue} + \text{(any cost subsidy that is included in fixed cost and variable cost)}.
\]

We analyze the economic value of the cardiac catheterization unit over several periods. The difference between the price and the unit
cost is estimated. Depending upon the difference obtained, the government may need to cover the cost if the new price is less than unit cost, but the government may benefit if the new price is more than unit cost. The expected benefits (EB) for the government, in terms of GDP, from extending patient life, is estimated using sensitivity analysis over a five-, ten-, 15-, and 20-year period. We use the following for EBs:

(a) Economic value for patient (EVP) = number of years saved * GDP per capita
(b) Economic value for government (EVG) = price – cost for treatment = difference subsidy from government compare with EB
(c) EB

\[
EB = (1 - x)^* - 23 + \frac{\text{years saved} \times \text{GDP per capita} - 23}{\text{employee / population}}
\]

\[x = \text{proportion of population with CVD}
\]

\[-23 = \text{Transportation ($6.4) and Time Loss ($16.6)}\]

Equation 5 shows for the average patient who visits the cardiac catheterization unit. The probability of this patient without CVD is (1-x), and the probability with CVD is x; (1-x) is multiplied by -$23 because some patients without CVD disease may use diagnostic tests, which means the cardiac catheterization unit doesn’t save the life of these patients. But the patients incur transportation costs and the loss of time. The individual employee is divided by the total population because it is assumed that not all patients work; for example, some patients are less than 15 years of age. (The working age in Palestine starts above 15 years of age.) By excluding patients under 15 years of age, GDP per worker can be obtained by dividing GDP per capita upon working age (more than 15 years of age). Overall, the third formula estimates the government benefit using sensitivity analysis for five, ten, 15, and 20 years.

Results

Total Costs

In the analysis of fixed costs and variable costs of the cardiac catheterization unit, this study reveals that variable costs represent the greatest portion of total costs (56 percent), and fixed costs are 44 percent. Total costs for the cardiac catheterization unit during 2003 are $613,544 (see Figure 2).

Expanding Equation 1 above, we derive total variable costs (VC) as follows:

\[VC = \gamma_1 \text{Diagnosis} + \gamma_2 \text{Balloon} + \gamma_3 \text{Pacemaker} \]

Using the unit’s data, it was found that unit variable cost is
- $140,5139 for diagnosis;
- $532,3362 for balloon; and
- $1,689,898 for pacemaker.

Regression analysis using the OLS method has been used in estimating the result for

Figure 2. Fixed Cost and Variable Cost of Cardiac Catheterization Unit in Ramallah Hospital, 2003

<table>
<thead>
<tr>
<th>Cost Categories</th>
<th>Amount in US $</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed cost</td>
<td>$270,903.42</td>
<td>44%</td>
</tr>
<tr>
<td>Variable cost</td>
<td>$342,641.21</td>
<td>56%</td>
</tr>
<tr>
<td>Total cost</td>
<td>$613,544.63</td>
<td>100%</td>
</tr>
</tbody>
</table>
unit variable cost of diagnosis, balloon, and pacemaker (see Figure 3). However, in testing the significance of individual independent variables, t-tests indicate that none of the independent variables is statistically significant at the 5 percent level. Further, high standard errors revealed that the independent variables are not good estimators in explaining variable costs. When t-tests indicate that all independent variables are statically insignificant, it’s important to check the overall significance of the model using the F-test. From the F-test, it can be seen that the overall result is statistically insignificant. Therefore, this model is not statistically significant in explaining the variable cost of patients. The coefficient of determination, $r^2$, is 0.185624, which means that only 18.56 percent of the variation in the total variable cost can be explained by the explanatory variables (diagnosis, balloon, and pacemaker).

In examining the results in Figure 3, the model is not statistically significant; this is because the number of observations ($n=12$ based on a monthly analysis) is not adequate to run a regression model. Despite the lack of statistical significance, this model has practical findings, since these three variables (diagnosis, balloon, and pacemaker) play a significant role in determining total variable cost. Therefore, in our break-even analysis, the above estimated unit variable cost will be used. From this result, the variable cost formula can be written as follows:

$$VC = \gamma_1 \text{Diagnosis} + \gamma_2 \text{Balloon} + \gamma_3 \text{Pacemaker}$$

$342,641.21 = 140.5139 \text{Diagnosis} + 532.3362 \text{Balloon} + 1,689.898 \text{Pacemaker}$

### Break-Even Analysis

According to the previous formula, equivalent diagnosis (output) can be estimated by converting each balloon and pacemaker to diagnosis. Equivalent diagnosis (output) will be used to calculate variable cost, total revenue, and BEP for all functions together in the cardiac catheterization unit. Cost ratio has been used to calculate equivalent diagnosis (output) by dividing unit variable cost for each balloon and pacemaker by the unit

---

**Figure 3. Regression Analysis of Variable Costs**

<table>
<thead>
<tr>
<th></th>
<th>Diagnosis</th>
<th>Balloon</th>
<th>Pacemaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>se</td>
<td>(121.3900)</td>
<td>(870.3585)</td>
<td>(3939.648)</td>
</tr>
<tr>
<td>t</td>
<td>(1.15754)</td>
<td>(0.611629)</td>
<td>(0.428947)</td>
</tr>
<tr>
<td>Prob</td>
<td>(0.2768)</td>
<td>(0.5559)</td>
<td>(0.68780)</td>
</tr>
<tr>
<td>$r^2$</td>
<td>0.185624</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj $r^2$</td>
<td>0.004651</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$n$</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
variable cost for diagnosis. The result will then be multiplied with the number of patients (the number of balloon patients for the year is 163, and the number of pacemaker patients is 23).

\[
\frac{532.3362}{140.5139} = 3.7885
\]

\[
\gamma_2/\gamma_1 \times \text{Balloon} = 3.7885 \times 163 = 617.5255
\]

\[
\gamma_3/\gamma_1 = \frac{1,689.898}{140.5139} = 12.0266
\]

\[
\gamma_3/\gamma_1 \times \text{Pacemaker} = 12.0266 \times 23 = 276.612
\]

Equivalent Diagnosis (output) = Diag + \( \gamma_2/\gamma_1 \times \text{Ball} + \gamma_3/\gamma_1 \times \text{Pace} \)

\[
= 1557 + 617.5255 + 276.612 = 2451.1375
\]

This result means that there are 2451.1375 equivalent diagnosis (output) patients visited the cardiac catheterization unit in 2003.

We then calculate the average price for equivalent diagnosis by using the following formula:

\[
\text{Average price} = \frac{\sum \text{Total Revenue}}{\text{Equivalent Diagnosis}}
\]

\[
= \frac{987,500.00}{2451.1375} = $402.874
\]

The amount $402.874 represents the average price per patient for equivalent diagnosis (output).

We calculate the break-even point by using the following formula:

\[
\frac{\text{Fixed Cost}}{\text{Price/unit} - \text{VC/Unit}}
\]

\[
= \frac{\$270,903.00}{402.874 - 140.5139} = \frac{\$270,903.00}{1032.562} = \$262.36
\]

From this result, the BEP where total cost = total revenue were received with 1,032.562 equivalent number of patients. Figure 4 explains BEP for the cardiac catheterization unit.

We next calculate the break-even point for each function (Diagnosis, Balloon, and Pacemaker). To calculate break-even point for each function, the following steps are used.

**Step 1:** Calculate the equivalent number of patients for each function by dividing the equivalent diagnosis (output) that represents for BEP by the equivalent number of patients requested. The result will be multiplied by the equivalent number of patients requested for each function (number of patients requested for diagnosis is 1557, number of

<table>
<thead>
<tr>
<th></th>
<th>Total Revenue</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed cost</td>
<td>$270,903.00</td>
<td>$145,089.32</td>
</tr>
<tr>
<td>Variable cost = 1032.562*140.5139</td>
<td>$145,992.32</td>
<td>$145,992.32</td>
</tr>
<tr>
<td>Total revenue = 1032.562*402.874</td>
<td>$415,992.32</td>
<td>$415,992.32</td>
</tr>
<tr>
<td>Total</td>
<td>$415,992.32</td>
<td>$415,992.32</td>
</tr>
</tbody>
</table>
patients requested for balloon is 617.5255, and number of patients requested for pacemaker is 276.612).

**Equivalent number of diagnostic patients**

\[
\frac{1032,562}{2451.1375} \times 1557 = 655.899
\]

**Equivalent number of balloon patients**

\[
\frac{1032,562}{2451.1375} \times 617.5255 = 260.138
\]

**Equivalent number of pacemaker patients**

\[
\frac{1032,562}{2451.1375} \times 276.612 = 116.525
\]

**Step 2:** Convert equivalent patients to real number of patients for each function in the cardiac catheterization unit to estimate the BEP for each function by using cost ratio. To receive at BEP for each function, unit variable cost for diagnosis \( (\gamma_1) \) is divided upon unit variable cost for balloon and pacemaker \( (\gamma_2, \gamma_3) \), the result will be multiplied by the equivalent number of patients for balloon and pacemaker (equivalent number of patients for balloon is 260.138, and equivalent number of patients for pacemaker is 116.525).

\[
\gamma_1 / \gamma_2 = \frac{140.5139}{532.3363} = 0.26396
\]

\[
\gamma_1 / \gamma_2 \times \text{Equivalent Balloon} = 0.26396 \times 260.138 = 68.665
\]

\[
\gamma_1 / \gamma_3 = \frac{140.5139}{1689.898} = 0.08315
\]

\[
\gamma_1 / \gamma_3 \times \text{Equivalent Pacemaker} = 0.08315 \times 116.525 = 9.689
\]

From these results, this study reveals that the BEP for patients in the cardiac catheterization unit in 2003 actualize with approximately 656 diagnostic patients, 69 balloon patients, and ten pacemaker patients. Figure 5 demonstrates the BEP for each function and illustrates the number of patients served by each function was higher than the BEP.

**Expected Benefit**

The EB from the cardiac catheterization unit includes the economic value for both the patients and the government. By using sensitivity analysis for five, ten, 15, and 20 years, EB can be calculated for each CVD patient and for the government. Calculating the EB of a patient can be obtained by multiplying the years saved by GDP per capita in 2003.

<table>
<thead>
<tr>
<th>Cardiac Catheterization Unit Function</th>
<th>Break-Even Point (Number of Patients)</th>
<th>Number of Patients Served</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis</td>
<td>656</td>
<td>1,557</td>
</tr>
<tr>
<td>Balloon</td>
<td>69</td>
<td>163</td>
</tr>
<tr>
<td>Pacemaker</td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>735</td>
<td>1,743</td>
</tr>
</tbody>
</table>
(which is $896). If the treatment in the cardiac catheterization unit results in preserving the patient’s life (years saved) for five years, then the EB is $4,480.00; for ten years it is $8,960.00, and for 15 years it is $13,440.00. Finally, if the treatment results in preserving the patient’s life for 20 years, the EB is $17,920.00.

The EB for the government can be calculated by using Equation 5 above:

\[ EB = (1 - 20\%) \times -23 + 20\% \times \frac{5 \text{ years} \times 896 - 23}{54\%} = 1,636.25 \] (5)

This shows that the government achieves an EB in addition to the benefit obtained from the difference between the revenues and the costs. Everyone is expected to visit the cardiac catheterization unit, patients having CVD make 20 percent and the EB will be $1,636.25 if the patient’s life is preserved for five years. For ten years the benefit is $3,295.50, for 15 years it is $4,954.75, and for 20 years it is $6,614.

Discussion

From the study of the cardiac catheterization unit in fiscal year 2003, we find that variable costs are the highest cost. By analysis of the variable cost, it was shown that materials from the hospital’s central storage unit contributed the highest portion (51 percent). We also find that the number of patients who visited the cardiac catheterization unit in 2003 was more than the required number so as to reach the BEP. The cardiac catheterization unit works more efficiently than the required BEP to cover the expenses. These results are similar to findings by Souzdalnitski et al.22 and Chotiwan et al.23—where the number of patients served is higher than the hospital’s BEP.

In terms of governmental subsidies (which consists of salaries, and other operating costs for the unit), the Palestinian government offered a subsidy of $480,548.50 to the cardiac catheterization unit in 2003, taking into consideration that the economic revenue of the cardiac catheterization unit was $987,500.00. Considering this revenue level for the unit, the government’s subsidy to the cardiac catheterization unit is covered by the revenue of the cardiac catheterization unit, leading to a difference between the revenue and the expenses of $373,955.37. This also shows that the government can support the cardiac catheterization unit revenues before spending on this unit from the government’s revenues as the facts manifest in 2003.

Conclusion

From this study, results reveal that variable costs represent 56 percent of the total costs, while fixed costs are 44 percent of the total costs. Further, we find that the number of patients who visited the cardiac catheterization unit in the year 2003 exceeded the BEP. Despite the subsidy offered by the government of $480,548.50 to the cardiac catheterization unit for 2003, earnings from the three functions of the unit were sufficient for the unit to exceed their BEP.

This study’s use of CVP analysis of the cardiac catheterization unit within the Ramallah hospital can be applied to other units and other hospitals in the region. The use of break-even analysis will allow area managers to plan minimum production capacity for the organization. However, our focus on the
cardiac catheterization unit may not allow our results to be generalizable to other Middle Eastern health care facilities. Our results are beneficial to hospital administrators and government regulators. Policy makers may find these results beneficial in future planning and potential revision of the government subsidies offered to health care facilities.

**Expert Commentary**

CVP analysis is an often overlooked financial measurement tool. Health care administrators and managers must know all aspects of providing care to patients, not simply measured by health outcomes. Cardiac catheterization services continue to be one of the most expensive, yet accurate, treatments of CVD. Middle Eastern hospitals must use these advanced diagnostic treatments to save lives while simultaneously providing treatment that is cost effective for the unit and hospital as a whole. We support the use of CVP analysis for hospital units, not merely the cardiac catheterization unit. All units of a health care facility will benefit from such a useful cost analysis tool.

The overall health system in Palestine is predominantly provided by the Ministry of Health (MOH), with a centralized governance structure. Recent broad-scale public financial management reforms were initiated by the Palestinian National Authority (PNA). The goal of these reform measures is to improve accountability and financial control of operations. Through these initiatives, the MOH will disburse funding to area health care facilities in the hope of improving accountability and financial performance. This focus by the PNA on accountability supports the need for further research of health care costs and cost allocation.

CVP analysis is one of the tools necessary to allow hospital managers to discern any probable effects of changes in price, product mix, or sales volume. The use of cost analysis by regulators and administrators should improve a facility’s use of scarce resources.

**Five-Year View**

The current economic condition of Palestine, including other Middle Eastern countries, is in a constant state of change. Therefore, a five-year project is complicated; however, one crucial element needed for change is the stabilization of global health care costs.

Due to current economic conditions, health care facilities must strive to operate at their most efficient level. Combined with the increasing incidence of coronary heart disease, hospital administrators must become more involved in determining their costs of facility operations and efficiency levels. Assuming some degree of economic stability in the region, health care managers, in conjunction with the MOH will be able to allocate resources to increase the level of hospital efficiency.

It is projected that government subsidies to hospital units may increase and health care financing should be reformed in three ways—revenue collection, risk pooling, and purchasing—in order to sustain efficient use of resources over the next five years. This projection is supported by our findings of exceeding necessary BEP despite government subsidies. An increase in hospital efficiency will optimistically lead to improved cardiac care in the region.
REFERENCES


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