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REVIEW ARTICLE

Value Engineering in Health Care: Part I. Basics and Methods

Dr. Hamidreza Dehghan[1], Maryam Nikfard[2]*, Mozhgan Salamatian[2]

[1]*MPH, MD, Head of Dep. of Medical Informatics, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran*

[2]*MSc., Health Care Management, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran*

Corresponding Author: Maryam Nikfard, E-mail: m.nikfard@gmail.com

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ABSTRACT

Nowadays, value engineering (VE) has been regarded as a strategic means to reduce the organizational costs in terms of purchases and value chain. Health care costs are increasingly growing, and the quality and effectiveness of healthcare services become more and more important. Healthcare providers such as hospitals, pharmaceutical companies, and medical equipment manufacturers can benefit from value engineering as a technique to present the highest quality while maintaining the patient volumes and affording the costs of success assurance.
The present article is the output of a project about applying value engineering in health care. Since VE has been less studied in services and particularly in health care, the authors decided to present their work in two parts. The first section of this paper addresses the introduction, application and implication of value engineering in healthcare and the second chapter, in the form of a scoping review, presents savings made by value engineering in various healthcare departments.

INTRODUCTION

Value engineering has become a strategic means for reducing the costs of purchasing and value chain in healthcare organizations. In health care, the main challenge is to provide quality services while preserving capital and making money. Given the complexity of medical invoices and the overall process of income cycle as well as increasing costs of services, a hospital cannot bear any inefficiencies in earning money. Any defect in medical and administrative processes, IT systems, and infrastructures play a critical role in financial status of the hospitals (1).

Various definitions are presented for value engineering. The most comprehensive definition which is mostly relevant to the health care is as follows: Value engineering is a systematic, function-oriented, team-based, and innovative technique using various specialties in which life cycle costs (LCC) are taken into consideration. This method identifies and analyzes the function of a product, service or technology in a value chain and establishes financial values for that function to be performed at the lowest cost, while maintaining the desired reliability and quality (2).

Lawrence Milles clarifies the function analysis under the title "*All costs is for the function*". He believes that the heart of a situation is that "the customer wants a function." The customer wants needs something to be done, transferred, maintained, cleaned, warmed, or cooled under certain conditions. He expects a shape, color, smell, sound, or material to achieve the desired utility. This is all what he wants, that is what matters to him and makes him satisfied.

The customer can expect one or two functions called "use function" and "aesthetic function". The use functions are followed by an action expected by the customer, while aesthetic functions yield no action and just make the customer satisfied.

Many of the products or services require both use and aesthetic functions, though, some only need one of them. Refrigerators, cars, clothes, shoes, pipes and pots are the products requiring both use and aesthetic functions. Nails inside a wall, wires hidden inside an engine and machine oil are the products requiring only the use function. Some products such as diamonds and perfumes only have aesthetic function. High concentration on any product or service in this way increases its value (19).

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The value engineering approach to reduce costs has not been sectional and short-term, however, it examines the costs of project lifespan. The costs include the construction period costs and the present value of all probable maintenance, operation, and repairs costs.

This method is broadly associated with the methods of documentation and data collection, techniques of creativity and decision-making as well as advanced planning. Management experts believe that value engineering has emphasized creativity and innovation much more than other techniques.

Value engineering is defined as a method "to do more with less" (4). In general, the objectives of value engineering are lowering the life cycle costs, increasing profits, improving quality and efficiency (function) or increasing the ratio of function to costs, enhancing the market share, performing tasks in a shorter time and using resources more efficiently. Further, the ultimate goal is to achieve a value increase (1).

To short, value engineering tries to select the best option among the possible alternatives to execute the same function, concerning the fact that there is always a better and less expensive alternative to perform tasks.

The scientific principles of value engineering, if applied correctly and consistently, enable the healthcare organizations to reduce all costs (not just purchasing costs) and improve quality significantly.

The latent rationales of value engineering are mentioned below:

1. A method to concern and analyze the function of each product and service but not to reduce the costs merely.

The priority is to enhance the value of a product or service, which may be achieved through increasing the costs.

2. Lowering costs for an item has its limits.

The costs of a product or service can never be lowered down to zero.

3. Providing the function desired by the customer at the lowest cost (1)

"Value" is very simple and, at the same time, very complicated. What the consumer requests is "value". According to Miller and Hayman, no one buys a product but the customers buy a "function" which, they think, a product will perform for them. If a product or service has a definite function and cost, its value can be determined by value analysis.

It is required to define three key terms of "cost", "price", and "value":

Cost is the amount of money spent on producing products or services;

Price includes production costs plus the benefits for the provider of the product or service;

Value is the price a customer is willing to pay for the product or service.

"Value" increases as the performance enhances or cost decreases. In other words, the value of a product or service has a direct relationship with its performance and an inverse one with the cost:

Value = (Performance + Capability)/Cost = Function/Cost

Value engineering is effective because it creates a balance among time, cost, and function. In the past, only the cost and price were of concern in purchasing products; however, value engineering links cost and price to the function. In fact, function is of paramount importance. In health care, various products and services are purchased to have a specific or a group of functions. And that is why value engineering is effective in the health care (1). According to Lawrence Milles (the founder of value engineering), this technique can be applied in all economic or commercial fields including industry, public sector, construction, and services (5).

Value engineering is also referred to as "value analysis", "value methodology", and "value management".

HISTORY OF VALUE ENGINEERING

The implementation of "value engineering" dates back to 50 years ago. Value analysis took place as a special technical method over the years after World War II. During the war and because of the urgent need for military equipment, the United States was to fight against the shortage and reduction of some strategic materials, especially those prepared outside the country (16). General Electric Company (GEC) also experienced a shortage of metals to manufacture the alloys. Henry Erlicher, technical vice-president of General Electric's procurement department, commanded the design and development of this method (4). He argued that some of the alternative materials and designs which were urgently required due to shortages during the time of war, had better performance at a lower cost. A comprehensive effort was made based on his command in the company to provide materials and alternative methods for costly materials. In 1947, the task was entrusted to Lawrence Milles, the General Electric's senior engineer. Milles examined the available methods and techniques and employed some of the conventional methods for the value analysis. Milles, the founder and inventor of value engineering, implemented a formal approach through which several groups of employees reviewed the function of GE products. Relying on collective creative methods and without efficiency loss of the product, they made some changes in the products and reduced the manufacturing costs. "Value analysis" method was accepted as a standard for GE. Gradually other companies and state organizations used this method as a means to reduce their costs (14). The changes in the total price of machines enhanced the profitability and subsequently improved the quality of these machines. As a result, research on alternative materials became a hotbed for debate and converted into a single goal for more economic savings in form of value engineering.

This approach was originally called "value analysis" later renamed as "value engineering" (9). In 1959, American Value Engineering Company was established and later in the same year, the Society of American Value Engineers (SAVE) was founded in Washington (14).

When the concept of value analysis was raised by Milles, no one could perceive that the savings obtained from such a method would be so huge and the scope of its application would be so wide that the concept of value engineering rapidly spreads all around the world. For the first few years, the use of value engineering was exclusive to the US GE saving above $200 million over 17 years of adopting value engineering. Following the successful implementation of

the concept of value engineering by GE, industries and other sectors also used this method to improve their products. In the Department of Defense, savings obtained from the use of value engineering amounted to $9 billion and the interesting point was that the implementation cost of this method was only $100 million. The US Army Ground Force began its value engineering program in 1964, claiming for $600 million profits over a course of 13 years (17).

SIGNIFICANCE OF VALUE ENGINEERING

Value engineering leads to huge savings through reducing unnecessary costs. It is not merely a plan to reduce costs but a method to maximize the value of projects.

With regard to the market forces and price changes, valuation tools are of essence for organizations. Meanwhile, if organizations waste their scarce capital resources in areas where there is little potential for capital returns, they will observe diminishing of their capital and the drop of their organization's value. Most economists propose measuring profit to capital or return on investment as a means to value the activities. Studies have shown that one of the important reasons for the success of the value engineering, which has led to the increasing importance of this method, is the high rate of return on investment (ROI). The rate in healthcare organization is reported to range from 3:1 to 100:1 (9).

In a study conducted by SAVE on 26 value engineering programs, it was found that a dollar spent in value engineering saves about $27 of the project costs. In other words, the ROI rate of 27:1 is common; however, the savings obtained in some sectors, especially the transportation sector, also reveal higher returns (17).

VE IMPLEMENTATION STEPS

From the viewpoint of Lawrence Milles, value engineering is a six-step process which is known as the "Value Engineering Job Plan". In other industries, these steps are changed to be compatible with their constraints. Depending on their application, the steps may be 4, 5, 6 or more.

The four steps of the process suggested by Lawrence Milles are as follows:

Information gathering

What do we need to produce a product or service? Function analysis, as the most important technique in value engineering, is usually carried out in this initial stage (1). This approach is unique to this method and is the most distinguishing aspect of the value engineering, comparing with other cost reduction methods. This step aims at determining the expected function of a product or service. It finds answers to the following questions:

- What does it do?
- What must it do?
- What should it do?
- What could it do?
- What must it not do?

Alternative generation or creation stage

At this stage, these questions are raised: What are the alternative ways of meeting requirements? What other services or products will perform the desired function?

Evaluation

At this stage, the ideas presented in the previous step are evaluated. The evaluation criterion is the rate of achieving the desired function and saving costs.

Presentation

In the final stage, the best ideas and solutions are selected and presented for final decision (1).

Figure 1 presents the schematic implementation of value engineering (8):

VALUE ENGINEERING IN HEALTHCARE

This study aimed at investigating the implementation of value engineering in the healthcare. Value engineering has been proved to be effective in health care. On the one hand, healthcare costs are increasingly growing, and on the other hand, the quality and effectiveness of healthcare services have become more and more important. Healthcare providers such as hospitals, pharmaceutical companies, and medical equipment manufacturers would benefit from value engineering. Value engineering could help service providers to present the highest quality while maintaining the patient volumes and affording the costs of success assurance. The value engineering process can assist this sector in achieving its objectives through reducing the costs, increasing the quality of services, and improving trust-based communication with the clients. Managers and staff can also benefit from the efforts to enhance efficiency and effectiveness and reduce costs.

In 1987, an association called SVAH (Strategic Value Analysis in Healthcare) was established in Pennsylvania, with the aim of helping healthcare organizations to manage and control the supply/value chain costs and providing relevant strategies, tactics, tools, software, and advanced technology. According to a SVAH reports, hospitals and healthcare centers could achieve nearly $500 million savings over the first 20 years using value-based solutions.

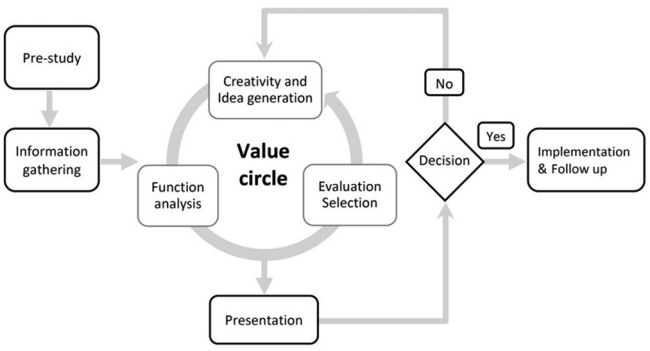

Figure 1: Schematic implementation of value engineering

SVAH plan provided significant savings for the healthcare centers in various fields, including surgical resources, hospital contracts, hospital nutrition department, laundry process, hospital management resources, standardization. ROI was reported to be 3:1 at the onset to 10:1 in 2008. This means that these centers obtained millions of dollars in savings, and also benefited from at least 300% return of capital. In other words, the cost of value engineering implementation was equal to zero (1). Table 1 shows the results of SVAH savings for some US hospitals over a year:

VALUE ENGINEERING STEPS IN HEALTH CARE

The process of value engineering in health care based on a model presented by Robert Yokl, is known as "Value Analysis Funneling" Showing Figure 2.

A) Understanding Phase: meticulous observation of products or services
B) Investigative Phase: Tracking the utilization of products or services and sensitive investigation of clients needs.
C) Speculation Phase: Finding alternatives for materials and services in a way that they meet the customers' needs and expectation from the function with the lowest cost and highest quality.
D) Analytical Phase: Developing and expanding two or three alternatives among the ideas proposed, prioritizing and ranking them based on their costs and selecting the best option.

Table 1. SVAH savings for some US hospitals over a one-year period

	State	Bed	Saving
A	Connecticut	300	$673,000
B	Ohio	150	$258,000
C	Florida	2000 IDN	$3.2 Million
D	Connecticut	350	$408,000
E	Indiana	100	$275,000
F	Pennsylvania	123	$173,000
G	California	90	$356,000
H	California	400	$4 Million

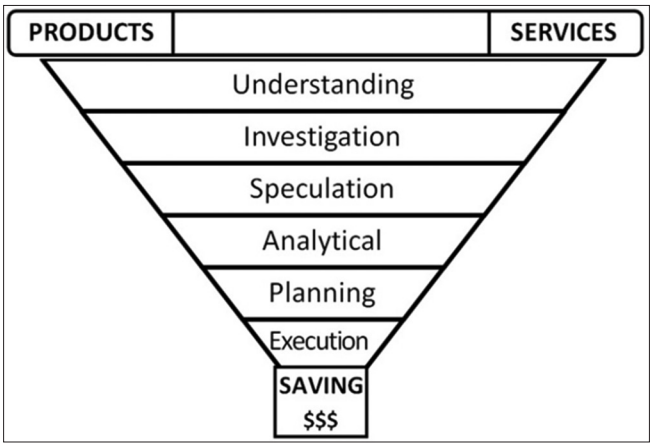

Figure 2: Value Analysis Funneling Technologies

E) Planning Phase: Piloting the project in a controlled environment to ensure the efficiency of the selected alternatives. A variety of alternatives are usually recommended and the best one is selected by the team.
F) Execution Phase: Implementation of the project in the organization.
G) Follow-Up Phase: To investigate whether the alternatives are used continuously and whether they act as the best option or not (2).

Firstly, the data should be collected (including costs, process instruction sheets and their features and customer (patient) requirements in each particular case) and the function of different parts of a product should then be checked. For a service, it is necessary to provide a flowchart containing the details of the service. Value engineering is to achieve the most important function factors and this raises a lot of questions: What is the aim of this particular part in this product? What must this part do? What should it do?

The next step is to consider different innovative and creative methods to achieve the desired goal in a more economic way. In other words, it is to examine which similar products can be used alternatively with the same function at a lower cost. During the analysis stage, the information obtained from the creativity stage (the use of various ideological techniques like brain storming to provide the best solutions), evaluation and idea development determine which method, how, why, and when should be carried out. These steps are completed in less than two weeks and the proposals are then made, however, analyzing, testing, and executing the proposals are more time consuming depending on the project complexity. The approved design must be piloted and, if the goals are achieved, the results should be generally implemented and controlled (15-18).

VALUE ENGINEERING TEAM

The Steering Committee is supposed to set up an organizational structure to make all employees aware of the value engineering structure in the organization and inform them about the relationship of the value engineering committee with their organizational role. Therefore, VE committee members should be introduced to all staff.

VE committees should be dynamic and flexible, and static fixed committees should be avoided for the VE projects. A VE team should be composed of experts in all key fields of the project. On average, 15 to 20 relevant hospital staff should participate in the team. For example, for a project to increase hospital income, there should be the personnel from the admission, discharge, and cash desk sectors as well as insurance advisers and staff from financial affairs, IT system, medical and nursing sectors. Then, some counselors are also involved to complete the team. Three specialists in the fields of hospital income, managed care, and hospital IT system should be invited. Other experts can also take part in the team as needed (15). The VE process should be well recognized in the organization so that all employees involved in the project would understand it.

When VE planning is done, the appointed staff are employed, the steering committee is formed, the goals are set

and the written program is prepared, the program can be initiated in a variety of ways. It is suggested that for the first year, VE program should focus on the prodcuts. Acquiring quick wins is vital in the first year and we should avoid going deep in problems in order to create further ideas. Obviously, the program does not focus on a large number of low cost-low impact projects. During the first year, value engineering agents must communicate with the procurement department and the hospital's physicians. It is of necessity to identify the hospital information system, the procedure of entering products into the system and the consumption of products and bottlenecks. It is recommended that working on VE projects should not last more than two weeks for simple projects and two months for complicated ones.

Value engineering studies are carried out during an intensive and short (8 to 10 days) timeframe, compared with many counseling approaches in the area of income chain analysis in healthcare. Because of the limited nature of these studies, recognizing key areas for saving in a process or hospital is of particular importance (18).

Innovative and practical aspects of value engineering differentiate this method from traditional and conventional cost-cutting methods which generally follow the past experiences, attitudes and habits that have repeatedly occurred with no sign of creativity.

Fields of VE projects in hospital:

- Admission
- Registering Outpatients information
- Ambulatory operations
- Pre-surgical tests
- Patient information, insurance counseling, patient registration management
- Encoding the services
- Health information management (medical records)
- Revision of utilization
- Information technology
- Documentation of medical records
- Invoices/receivable accounts/management of request rejection (35).

WHY VALUE ENGINEERING RESULTS ARE STRIKING?

- Value engineering group approach
- The hospital managers and staff are recognized as primary resources and team members.
- Analysis based on the function of the current processes
- Value engineering sessions are held in an environment separate from the workplace in order to maximize the project focus and impact (5).

The cost of resources can be considered as an iceberg floating in water. Healthcare organizations can annually save only up to 2% to 3% through cost-effective approaches such as group purchase orders, standardization and initial contracts with sellers. This saving is just the tip of the iceberg, which is projected out of the water and visible to the managers, however, the real potential saving is under the water and can only be achieved through the concepts, tools and techniques of value engineering.

Robert T. Yokl believes: "This is a process that needs to be completed on a permanent basis. It should become a part of the culture of the organization, not a cult within it" (15).

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