

# Review Article: Improving Health System with Health System Engineering and Industrial Engineering Applications in the Field of Health

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## ABSTRACT

**Introduction:** Evaluation in health services has a long history. The application of quality standards to hospitals or other facilities first became common in the United States and gradually spread to other countries.

**Materials:** Evaluation and inspection of health care services in the form of different approaches (ISO, superiority models, accreditation and peer group) are used voluntarily or compulsorily around the world and are gradually expanding. There is a concern that all approaches should take into account the use of valid standards, quality improvement, transparency and public accountability.

**Discussion and Conclusion:** All methods are dynamic and evolving, but the validity of some of them is faster. At the same time, their origins are different. There is a kind of convergence between them.

## Introduction

Health care, like other industries, is increasingly affected by external pressures such as labor and resource shortages and the difficulty of coordinating its various parts, which leads to the loss of organizational resources [1]. Approximately 6 percent of GDP and about 5-

10 percent of government spending in developing countries are allocated to health care [2].

This figure reached 5.5% of GDP for Iran in 2000 and 14.7% for the United States in the same year [3], and reached 6.5% in 2015 (the final year of the Fifth Development Plan) with the implementation of the Health Transformation Plan [4-5].

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According to the available documentation, investing in public health is the most profitable investment for a developing society, with cost-effectiveness studies showing that a dollar investment in the health sector has a \$6.5 return on investment [6].

A look at the important investment indicators of the general budget of the country and a part of the gross domestic income in the health sector, shows that this field has been neglected in recent years and Iran's ranking in this field among the countries in the region and the whole of world has been low [7].

Finding a way to achieve such a goal is one of the most important human issues that requires more. The indicator of catastrophic health costs and falling into poverty due to health costs has also been inadequate. According to the out-of-pocket health care payment index, before the implementation of the health system transformation plan in Iran, the share of private health expenditures in total treatment expenditures is on average 55%, while in Kuwait, despite allocating a lower percentage of GDP to health (2.8%), the share of private to public health expenditures is about 22% [6].

According to the World Bank's extensive studies on the share of public hospitals in government resources in developing countries, hospitals account for approximately 50 to 80 percent of the total cost of the health sector and have a large share of educated staff. Therefore, the economic study of health and treatment to control costs, analyze the performance of costs and adopt appropriate policies to increase efficiency and effectiveness and optimal allocation of resources and improve the quality of services will be particularly necessary [8].

In a recent study published by the Bloomberg economics website, 48 countries compared the health of the health system in three criteria, in which the United States is ranked 41st in the world, while the United States with \$ 8,608 after Switzerland (\$ 9121), the highest cost per person for health care. Therefore, spending more alone does not indicate better performance for countries like the United States, ranking it 46 th in the table [10].

Of the billions of dollars spent annually on purchasing technology in health care organizations, millions of dollars are wasted in additional costs due to poor quality decision systems. Additional costs are costs that are not related to the quality, operation, useful life and aesthetics and specifications requested by the employer. These costs can usually occur for a variety of reasons, including lack of sufficient time to design, lack of information, lack of ideas, negative bias, lack of experience, poor human relations, ambiguity, design, and overestimation [11].

The use of industrial engineering techniques in healthcare began with the improvement of methods that were part of Frederick Taylor's teachings, known as the "Principles of Modern Management." Frank Gilbert was also the first to use the improvement of methods in the hospital environment through the technique of studying his movement in the surgical procedure. In 1940, Lillian Gilbert encouraged hospitals to use industrial engineering tools and techniques. In 1951 and 1952, Lillian Gilbert, Rudd Cohen, and Harold Smelly collaborated in an organized effort to improve methods in All hospital organizations worked together. The result was a two-week workshop held in 1952 at the University of Connecticut [12].

The American Hospital Association (AHA) formed the Methods Improvement Committee in 1952 because of the interest of a large number of hospital heads in improving techniques. The committee prepared several articles on measures taken to improve methods and published its 1954 report [13].

After 1950, the AHA promoted improved methods through various service programs and workshops throughout the country and various university courses. Industrial engineering courses were offered in the education of hospital heads. Gradually, other industrial engineering techniques were studied and implemented in various hospital issues. The Society for Hospital Management Systems (HMSS) was founded in 1961 with Harold Smiley as its first CEO in Atlanta. In 1964, HMSS affiliates moved to the AHA building in Chicago. In 1987, recognizing the importance of

information systems and its role in the medical care system, the association was renamed the "Association of Medical Care Information and Management Systems". The Society of Industrial Engineering also acknowledged the increasing role of industrial engineering techniques in healthcare, and in 1964 formed a hospital ward. Industries pay in this regard. In 1988, the "Society of Medical Systems" was formed to replace the "Health" section [14].

Changes in the health system over time have made it a complex and changing system. This complex system also accounts for a large portion of government spending. Therefore, the need for improvement in these systems is very much felt and the existence of a systemic vision is considered. Despite experienced physicians, skilled manpower, and appropriate facilities, health-related organizations such as hospitals, clinics, and other centers still face many problems. Although all departments and individuals perform their responsibilities correctly and flawlessly, in most cases, the main problems are due to the lack of a systematic view of these centers. Systems engineering helps identify, review, and analyze existing health systems, then provide solutions to make the system more efficient and increase system efficiency. This makes hospitals more patient-centered, responsive and flexible [15].

Quality improvement teams can play a very important role in different parts of the hospital, and due to the requirements, which have recently emerged with the use of accreditation standards in hospitals, the need for these teams in these centers is felt more [16-17].

Waiting queues in hospitals are one of the most important causes of patient dissatisfaction, which causes many problems. Waiting queues are more prominent in areas such as admission and clearance. Also, the paraclinical ward of hospitals often suffers from this problem. In most cases, this problem can be solved or reduced as much as possible with a systemic and process view and using re-engineering [18-20].

### *Supply Chain Integration for Medical Equipment*

In today's world, customer demand for high quality and fast and appropriate service has led organizations to conclude that the implementation of operations and processes to meet these demands and needs, requires cooperation with other members of the supply chain [21]. As a result, issues such as supply chain management and supply chain integration have been raised in recent years. Supply chain integration means the organization's partnership with its partners to manage internal and inter-organizational processes in order to achieve effective flow and physical, information, financial and decision-making efficiency, with the aim of providing maximum value at low cost to customers. Supply chain integrity has two dimensions, internal and external. Internal integration means cooperation between internal departments and external integration means cooperation between the organization and the organization's suppliers [22].

Many studies have been done on the effect of supply chain integration on performance and this effect has been evaluated positively. This indicates the important role of supply chain integration in improving performance [23-24].

A review of research on supply chain integration shows that most of these studies have been conducted in industry. For example, Baofeng et al. examined the impact of human resource involvement in decision-making on the supply chain integration of machinery factories [25]. In another study, Luxrom et al. examined factors affecting supply chain integration in the automotive industry. However, supply chain management and integration in the service sector, including health, has not received enough attention from researchers [26].

Since the health system is related to the lives of citizens and if the medical and equipment needs of patients are not met in a timely manner, dangerous results and consequences will occur, for example, the lack of equipment or timely access to it in surgery can lead to the loss of a human life. Therefore, the health supply chain in the health system has a high risk and also high complexity. The supply chain

in hospitals includes internal chains (such as care units, warehouses, etc.) and external chains (vendors, manufacturers, etc.). These two general chains are connected by the flow of materials and information [27-28].

External and internal supply chain in hospitals and as a result of lack of coordination and integration between chain members, the quality of service in the hospital decreases. Hospitals' performance is measured by criteria such as the quality of service and the reduction in public costs.

As a result, if hospital supply chains are unable to provide their desired services, public spending has risen, and citizens are ultimately dissatisfied [29].

Due to the importance of the health supply chain, in this study we have focused on the hospital supply chain to provide medical equipment and supplies. Hospitals need to be able to respond to patients' demands faster, cheaper and more effectively by increasing their supply chain integration.

Medical equipment and supplies include any tools and equipment, supplies, biomaterials, devices, software, implants, materials, reagents and laboratory calibrators for medical diagnosis [30]. Given that the domestic production of this equipment is less than their imports, the issue of supply and its supply chain integrity is of great importance [31].

Health and treatment systems at all levels are highly complex. Various clinical, organizational, informational, research, educational and professional factors have led to the creation of a multiple system with interrelated relationships. A complex system is a set of factors with uncertain relationships whose performance is generally unpredictable. The existence of probabilities and uncertainties in complex systems causes some issues to remain unknown.

Over the past thirty years, the dramatic increase in health care costs has forced researchers and health care professionals to look at ways to improve operational efficiency or reduce costs. These changes are a major challenge that requires proper decision-making

logic to properly manage. Simulation models are auxiliary decision-making tools that increase our understanding of the problem and its various solutions by animating the health and treatment system [32-33].

Simulation is an imitation of the performance of a real process or system. Simulation is, in fact, a simplified example of a system that provides a true picture of the system by providing a dynamic analysis of the system. Simulation models are able to show the variability, interactions, and complexities of a system. Therefore, a simulation model can predict the behavior of such systems and measure the impact of different policies on system performance. As a result, this tool provides the analyst with an understanding of real system relationships improves and enhances the analyst's ability to design a new system or modify an old system. The undeniable benefits of simulation instead of experiencing solutions in the real world are saving time and money and completing control of experience conditions, making it possible to perform some experiences that are impossible to perform in the real world [34-37].

In recent years, the application of simulation in the healthcare sector has become increasingly widespread. The reason for this is on the one hand the success of studies conducted with the help of simulation in identifying and solving health and treatment problems, and on the other hand the remarkable progress of simulation software. However, the use of simulation in health care sector decisions, like other areas of industry, military and support, has not been developed and is a good base for study and implementation in this field [38-42].

Health care organizations, like other systems, are made up of a group of components that are interconnected and regular in order to achieve certain goals. These organizations, like other systems, have inputs that are affected by system processes and are removed from the system. However, due to the provision of services that deal directly with the physical and mental health of human beings, health care organizations have features that significantly

outperform their functions and goals from other service or manufacturing systems. The most important of these features are as follows:

- 1- Health systems have different inputs, but the most important inputs of these systems are humans.
2. Defining the goals of these organizations is problematic and complex.
- 3- Specialized and professional manpower has an important role in health and treatment processes.
4. It is difficult to measure the effectiveness of health care systems due to the lack of valid scales [43, 44].

### *Blood supply chain*

Blood supply chain management is one of the major challenges of health systems. Human blood is a scarce resource that is produced only by man himself and there is currently no other chemical product or process that can be used as a substitute and there is currently no other chemical product or process that can be used as a substitute. In the blood supply chain, this product is usually broken down into five main parts: Red blood cells, plasma, white blood cells, blood serum, and blood platelets. Different components have different lifetimes, and this breakdown enables us to use each blood product for the needs of a particular patient. For example, plasma is used to treat burns [45].

### *Drug supply chain*

The growth of the drug market in the world in recent years and the expansion of the range and diversity of these products in the global consumer market and the importance of its close relationship with human health, has led to an increased need to optimize distribution methods to reach consumers as easily as possible [46].

Supply chain management is one of the fields that has entered this field in recent years with the growth of the market of pharmaceutical products. One of its important goals is to move towards more objective decisions and evaluations along with identifying and evaluating internal and environmental changes

that use scarce resources that have become essential to organizations as efficiently as possible [47]. On the other hand, these changes have increased the uncertainty in the supply chain and organizations in order to reduce the vulnerability of the chain, have been forced to spend resources to predict demand, supply and internal uncertainties of the organization. Attention to these uncertainties and risk factors led to the issue of risk management in the supply chain [48].

Although supply chain management has always placed great emphasis on risk, in recent years due to global competition, the pursuit of competitive advantage, increasing supply chain complexity, and the use of global suppliers, the issue of supply chain risk management has attracted much attention [49]. As trade competition in the pharmaceutical industry increased, pharmaceutical companies also had to improve efficiency in many aspects of their business. Managers of this industry also realized that the production of a quality product alone is not enough, but in addition to the supply of products according to customer requirements (when, where, how) and changes in the internal and external environment and the resulting risks to achieve higher efficiency [50].

The relationship between risk management and efficiency in the pharmaceutical industry was first proposed by the FDA in 2002 as a risk management approach. After that, efficiency in most pharmaceutical companies became the main goal of managers and these companies increasingly realized the importance of identifying and managing the risks of the drug distribution industry and examining its impact on efficiency and consequently the survival of the company [52].

The purpose of risk management is to balance profit and risk in order to maximize the expected profit by assuming risk minimization, and this will be achieved when the importance of recognizing risk factors and their management and its impact on improving the performance of these companies in Identify the drug supply chain [53].

### *Quality management in health*

Evaluation has a long history. Evidence such as the Hippocratic Oath traces its history to the third century BC [54]. In the past, the quality of care services was guaranteed by having professional medical and nursing staff, but health care institutions are complex organizations of which every professional's job is only a part, and change is the basis for improvement throughout the system [55].

Before developing approaches and measurement systems to improve the process, for decades, managers only cared about product quality. With increasing competition in quality, the next step in the evolution of the above idea was to try to determine and measure quality at the organizational level. The manager was looking for a model to determine the depth and breadth of quality actions in the organization and a tool to assess progress on the path to world alignment in quality products and services [56].

The application of quality standards to hospitals or other facilities first became common in the United States in 1917 and gradually spread to other countries. Since the early 1990s, health sector reforms in developed and developing countries have led to increased privatization, increased powers for health care institutions, and the transfer of services. This is accompanied by a desire to increase efficiency and improve quality in the public and private sectors, and one of the results has been the rapid growth in the use of external quality evaluation by governments as a way to improve the quality of services provided by health care organizations [57].

External evaluation affects the provision of health care services. Governments, clients, professionals, managers and insurance organizations have to come up with new plans for public accountability, transparency, quality improvement and value for money [58]. Some countries use evaluation approaches to limit costs [59]. External evaluation is increasingly used to monitor, improve, and market health care institutions, especially hospitals [60].

### *Common approaches*

Most countries have voluntary or mandatory mechanisms for periodically evaluating health care organizations against specific standards. All of these mechanisms are ways to ensure or improve some of the quality elements performed by different and independent organizations. Because of the overlap in the use of different evaluation methods, the WHO has recently applied the term "quality-free assessment" to all types of organizational surveys used in written standards. The purpose of applying different approaches by governments, insurance organizations, managers and professionals is to have transparency and accountability to society, self-monitoring, quality improvement and value creation for money, and it is necessary that the approach used have the necessary and effective features to achieve the above goals (Table 1).

A European Union-sponsored study [1] demonstrated systematic approaches that apply national (or international) standards locally and apply to the public and private sectors. Some of these approaches, such as ISO certification and superiority models with superiority of industrial roots and basis, and some, such as homogenous group and accreditation of health origin have treatment and are voluntary and independent of the organization providing health care services to varying degrees. In addition to the usually voluntary programs mentioned, there are generic (general) and specialized inspection systems as required by law and licensing [61].

### *International Organization for Standardization (ISO)*

Its roots are related to the post-war industries, and the International Organization for Standardization came into being following the sense that the development of the global economy requires the standardization of products and services. Standards were created to diversify the elements of the quality system and implement them to create an effective quality system.

Its job is to provide standards by which organizations or units can achieve certification. The above standards are used in health care

services, especially in units such as imaging and laboratories, and generally in quality systems in clinical wards [61].

**Table 1.** Characteristics of an effective external evaluation program

- Providing a clear framework for values ≤ Describe the elements of quality and determine their weight, such as areas of empowerment and results in the European model of superiority
- Dissemination of valid standards ≤ Provide an objective basis for evaluation
- Attention to the patient ≤ Emphasis on reflecting horizontal clinical trajectories instead of vertical management units
- Having clinical processes and results ≤ Reflect the views of patients, staff and the community
- Encouraging self-assessment ≤ Provide adequate opportunities and tools to institutionalize evaluation and development
- Evaluating training ≤ Provide valid evaluations and reports
- Creation of Motivate ≤ Encouragement to improve and review suggestions
- Connecting with other applications ≤ Cohesion and two-way communication and reduction of rework and inspection costs
- Improving quality over time ≤ Demonstrate program effectiveness
- Providing public access to standards, processes, and evaluation and results ≤ Having transparency and accountability to society

### *Superiority models*

The Baldrige model has been the basis of other national and international programs, such as the Australian commercial superiority model and the European superiority model. Its main goals are to participate in improvement activities and ultimately excellence in customer satisfaction, employee satisfaction, impact on society and results [61]. The Baldrige model has a standalone version for health sector evaluation. The model of European superiority is used by European countries and other countries. In the 1999 revised version, specific areas of the results area are devoted to clinical outcomes, staff and patient satisfaction [62].

The results of the following table show the significance or non-significance of the whole model as well as the separate effect of each independent variable on the dependent variable.

### *Accreditation*

Accreditation relies on independent voluntary programs and has shifted from a focus on education to multidisciplinary evaluation of health care units, organizations, and networks. This approach spread from Western countries to Latin America, Africa, and Southwest Asia in the 1990s. The term accreditation, which applies more to organizations than specialized clinical education, refers to the systematic evaluation of hospitals against certain standards, and was created in 1917 as a mechanism for approving training positions in surgery. This method was used in Australia after Canada in 1970 and spread to Europe in the 1980s [63-65].

It also spread from Western countries to Latin America, Africa, and Southeast Asia in the 1990s. Hospital accreditation standards specify all activities in a hospital in both patient and management departments and detail the services provided by the organization [61].

### *Homogeneous group*

Based on academic programs and usually for the formal evaluation and accreditation of educational programs, it is a special field that is now also used in the field of clinical services. In this method, standards are implicitly extracted from personal experiences [65] and work instructions and the emphasis is on clinical performance in the form of knowledge, skills and attitudes [61].

### *Inspection and obtaining a license*

In addition to the four methods, there is usually voluntary over-inspection, and in fact it is a legal requirement that ensures that the staff or provider organizations meet the minimum standards of competency. In some countries, there are also specialized inspection offices to ensure public health and safety, such as fire, infection control, radiation protection, etc. [62].

### *Strengths and weaknesses of approaches*

The advantages of superiority models such as European superiority model are simplicity, low implementation cost and its empirical validity in some countries and its compliance with organizational development goals. Its disadvantage is that it is generic and, apart from being awarded, does not end up receiving accreditation from a foreign organization such as ISO or accreditation. Conceptually, the European model of superiority is more complete than the concepts in ISO, accreditation and homogeneity in meeting specific objectives.

Homogeneous group initially focused on selecting and monitoring specialized medical education. But now it also pays attention to service quality, professional development and clinical work [65].

In the past, the use of ISO in the health sector has been criticized for not paying enough attention to staff, clinical or health outcomes, and the impact of care services on the population [66-70]. In the field of health, the application of ISO strengthens the process orientation of services, but there is no guarantee that the choice of elements is appropriate for patients or health-related

outcomes. ISO does not cover the whole treatment process and mainly identifies the management (executive) processes related to clinical decision making. Therefore, it is easier to use in technical units such as laboratory or radiology than a medical unit. 2000: 9000 ISO is more inclined from a systemic approach to a process-oriented approach [8], which increases its segregation in care services institutions. ISO 2000: 9000 is more similar to other systems such as accreditation and superiority models.

Compared with ISO, accreditation has a special status. ISO is limited to the quality system, while accreditation addresses specific issues such as nosocomial infections. Another advantage of ISO accreditation and superiority models is the emphasis on performance indicators. Therefore, it has a lot of formal validity for use in the health sector and is very attractive to fans of "evidence-based medicine" [62]. The current evaluation system in health care service institutions has not been able to satisfy its stakeholders and is failing in areas such as performance improvement, quality improvement, satisfaction of service providers and recipients and improving the information management system [68].

In the evaluation system used, more emphasis is placed on quantitative indicators and the establishment of hospitals, so only 5% of the evaluation indicators of the country's public hospitals are qualitative and functional. Excessive emphasis on creative and quantitative indicators has led to a decline in the performance of medical centers and lack of motivation to improve their treatment processes. In recent years, quality has been considered by officials and the previous evaluation guidelines have been supplemented with more qualitative indicators [71].

Each method has its own advantages. ISO is fully integrated into the accreditation approach or superiority models. Homogeneity and accreditation group is more consistent with the provision of health care services, while ISO and superiority models consider most of the organizational and managerial conditions in which processes are implemented. In sum, it



can be said there is a lot of overlap between the above methods.

The above methods seem to be more complementary. Their main difference is in their roots, views and goals. None of the methods is static and each of them is evolving and at the same time there is convergence between them and it is more rapid in the development of accreditation.

As mentioned, the purpose of applying different approaches by governments, insurance organizations, managers and professionals is transparency and accountability to society, self-monitoring, quality improvement and value creation for money, and it is necessary that the approach used have the necessary characteristics and be effective in achieving the above goals [72].

### *Industrial engineers and Cancer*

Industrial engineers with their training and experience in improving factors such as productivity, safety and efficiency are in a position to play a key role in improving the efficiency of health systems in many developed countries. Industrial engineering techniques in the hospital system help to improve the efficiency of the system in various areas such as: Improving communication between patients, nurses and physicians, provide more information to patients, and shortening the transfer time between patient visits [73].

Cancer is one of the diseases that seriously threatens human life. It can be treated with surgery, radiation therapy, chemotherapy, hormone therapy and hormone therapy. According to the IARC, by 2030, 4.21 million new cases of cancer and 4.13 million deaths from cancer are expected. Surgery and radiation therapy are the most common direct treatment for tumor treatment. However, when cancer metastasis occurs, that is, when cancer cells from the primary tumor to other parts of the body spread, chemotherapy should be applied. However, when chemotherapy as treatment is used, the number of cancer cells over time evolves. In fact, because of chemotherapy, such as a sword, two-way acts

from one side of normal cells destroys the other side to kill cancer cells. Chemotherapy drugs cannot be injected regularly, so the use of chemotherapy requires a light and heavy weight. There is a reduction in the number of cancer cells and the toxicity of the tissue, which is a function of the size of the normal cells destroyed and the dose limits of the drug. For this reason, optimizing cancer chemotherapy is doubly important. In addition, during chemotherapy, some cancer cells may develop an innate resistance to the drug through accidental mutations, which can lead to other causes. Due to this inherited resistance, these cancer cells cannot be completely eradicated, leading to long-term failure in the course of chemotherapy [74-75].

Recently, development work in the prevention, diagnosis, treatment and management of cancer has progressed considerably. Mathematical modeling of cancer is one of the most important methods in this field, which in recent years has attracted the attention of industrial engineers working in the field of optimization. Mathematical models based on clinical studies and evaluations help researchers to understand the effects of various factors such as tumor growth and the rate of drug injection in the program. In fact, these models are optimizing the treatment of cancer as a problem. Cancer cell count, toxicity, and drug resistance are key factors in planning chemotherapy treatment. Therefore, it is best to destroy the cancer cells as soon as possible using a high dose of the drug. On the other hand, a high dose of the drug will lead to undesirable poisoning. As a result, the complex and lightweight dependence between these aspects determines the best development of a chemotherapy treatment program, which will make it a time to arrange and attend chemotherapy sessions as well. In fact, the interaction of natural and cancer cells varies according to the type of treatment. The relationship between treatment dose and the number of normal and safety cells in the mathematical models that describe the evolution of these cells can be clearly seen. Randomized clinical trials are the standard method for evaluating chemotherapy projects

that, with the exception of dose and duration of treatment, are a combination of drugs in combination with other drugs. Although clinical trials are used to determine reliable and effective chemotherapy programs, they have been delayed due to high costs, long-term treatment, and delayed testing. Mathematical models also help researchers understand the effects of various factors, such as tumor growth and the amount of medication injected into the performance of optimal treatment programs. Therefore, this field of research requires close collaboration with an oncologist to improve the model and make the research more practical and meaningful [76-77].

Studies in this area are needed to optimize treatment protocols, and even if the parameters of the problem need to be identified, optimization methods can be devised. However, clinically, a lot of experience is needed to identify the parameters. A review of the studies confirms that in order to create the right model, there is a need for more interaction between mathematicians, physicians, and biologists [78].

Other applications of industrial engineering in chemotherapy include the planning of medical clinics. Cancer treatment clinics are often faced with scheduling large numbers of cancer patients for chemotherapy treatments under limited resources such as the number of nurses and beds.

In addition, the duration of appointments, the level of accuracy of each appointment, and the availability of clinic nurses are uncertain. Timing constraints, random parameters, increased healthcare costs and increased demand for services, the need to create efficient schedules. In the engineering industry, using optimization techniques, different models have to solve this problem in order to improve in the schedule of patients' visits. Finally, due to the fact that the process of chemotherapy is a long and costly process for the patient, reducing the costs of the patient in the process of chemotherapy is not worth the effort. Hence, many models have been developed with the aim of minimizing the cost while maintaining the quality of the treatment [78-80].

## Conclusion

Finally, In the field of systems engineering, all the focus and purpose are to identify potential health system problems, provide efficient and effective solutions, use advanced methods, research operations to help make better decisions, identify, use tools and industrial engineering applications, and use health informatics as effective and cost-effective basic safety tools.

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