

# Application of Value Engineering to Improve Discharging Procedure in Healthcare Centers (Case Study: Amini Hospital, Langroud, Iran)

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**Abstract:** The main aim of the value engineering technique is to analyze project activities over all stages including design, implementation, operation and maintenance. Application of this technique is very efficient to identify and remove unnecessary costs in order to optimize both time and cost of production stages. The aim of the present paper is to develop a model to improve discharge process in hospitals using the steps of value engineering technique and its concepts. After studying a hospital discharge process, all involved components have been drawn as model using Visual Paradigm software. At the next step, wastes and problems of process have been identified followed by suggesting innovative ideas proposed by team members to improve procedures. In order to validate improving suggestions, the Amini's Hospital in Langroud (Guilan Province, Iran) has been selected as case study as well as simulating the current and proposed procedure through the well-known technique of simulation. Comparing results before and after study revealed that about three hours will be saved if innovative ideas are applied over discharging procedure. It is also concluded that value engineering technique is an efficient method to improve the performance of servicing activities on health care systems.

**Keywords:** Value Engineering, Function, Process Improvement, Healthcare, Discharge Process

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## 1. Introduction

### 1.1. Value Engineering

Value Engineering (VE for short) is an organized/systematic approach directed at analyzing the function of systems, equipment, facilities, services, and supplies for the purpose of achieving their essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, and Safety (Sharma & Belokar, 2012). The Society of Japanese Value Engineering defines VE as "A systematic approach to analyzing functional requirements of products or services for the purposes of achieving the essential functions at the lowest total cost". Value engineering is essentially a process which uses function analysis, team-work and creativity to improve value. Therefore, value Engineering is known as an effective problem solving technique.

Value Engineering simply answers the question "what else will accomplish the purpose of the product, service, or process we are studying?" (Sharma & Belokar, 2012). One of the sectors involved to service for patients is healthcare as well as other industries are increasingly influenced by external pressures such as shortage of staff, resources, and coordination of its various sections is difficult which resulted waste of organization's revenue. Millions dollars are wasted in unnecessary costs out of total budget assigned to buy technology in health care organizations. Value engineering in the healthcare industry is known as "value analysis" which is a set of tasks to perform value engineering when not started yet implemented. It is an efficient and well-known technique over the world and it is a strategic tool to reduce costs for health care organizations (Orr & Tom, 2008). Lack or improper uses of resources and increasing health care costs

as well as the requirements to carry out studies on the health and productivity of organizations applying modern techniques of management in this area show that studying VE in health care systems is getting to be more and more common comparing to the past (Orr & Tom, 2008).

The value engineering methodology is a systematic process that follows the Job Plan. The Job Plan consists of some phases. The recommended VE methodology (Job Plan) is used by the VE team during the Workshop has commonly five distinct phases. These phases are briefly as follow (Amruta et al, 2014):

*A. Orientation Phase:* In the orientation phase, the project is selected and those who are going to work the problem are familiarized with it (Fong, 1999).

*B. Information Phase:* The team is formed based on the present state of the project. All team members participated in a functional analysis of the project as a whole, and then of its component parts, to determine the real needs of the project. Areas of high cost or low worth are identified in this phase of VE technique.

*C. Functional Phase:* 'Function' can be defined, as the use of a part of a product and the esteem value that it provides. These functions therefore make the product work effectively or contribute to the 'salability' of the product. Functional analysis outlines the basic function of a product using a verb and a noun such as 'boil water' as in the case of our kettle.

*D. Creative Phase:* This step requires a certain amount of creative thinking by the team. A technique that is useful for this type of analysis is brainstorming. This stage is concerned with developing alternatives, more cost effective ways of achieving the basic function. All rules of brainstorming are allowed, and criticism needs to be avoided as it could cease the flow of ideas. List is simply down all ideas, not regarding whether they sound apparently ridiculous or not.

*E. Evaluation Phase:* In this phase, the VA team create and judges the ideas developed during the creative phase. The VA team also ranks the ideas. Ideas found to be irrelevant or not worthy of additional study are disregarded; those ideas that represent the greatest potential for cost savings and improvements are selected for development. Weighted evaluation may be applied in some cases (Sharma & Belokar, 2012). To account for project impacts other than costs (both capital and life cycle), the VA team would ideally like to evaluate all attractive ideas but time constraints often limit the number of ideas that can be developed during the VE procedures. As a result, the team focuses on the higher ranked ideas when the most significant ideas are prioritized.

*F. Development Phase:* In development phase, final recommendations or suggestions are developed from the alternatives selected during the analysis phase. Detailed technical and economic testing is conducted and the probability of successful implementation is later assessed.

*G. Presentation Phase:* The presentation phase is actually presenting the best alternative (alternatives) to those who have the authority to implement the acceptable proposed

solutions. It includes preparing a formal value engineering change proposal (VECP) or value engineering proposal (VEP) that contains the information needed to reach a decision and implement the proposal.

*H. Implementation and Follow Up:* During the implementation and follow-up phase, managers must assure that approved recommendations are converted into actions. Until this is done, savings to offset the cost of the study will not be realized (Sharma & Belokar, 2012).

## 1.2. Literature Review

In 2012, Sharma & Blokar used the concept of Value Engineering and its job plan to analyze the focus adjustment knob for slit lamp in microscope. The material was chosen such that the cost was reduced without affecting the quality of the product. The best feasible solution from the available alternatives was chosen through the feasibility ranking table. Profits were maximized without hindering the reliability of the product through the application of Value Engineering. Utilizing the above mentioned effective technique, the final outcomes come out to be a successful showcase of value engineering. With the critical evaluation of VE, they were able to increase the value of the product by substituting another material in place of the one that was currently in use.

In another case, Manjiv & Vohra (1991) applied value engineering (VE) principles and tools to evaluate and improve an environmental remediation process. The study participants used functional analysis to breakdown the complex process into its functional units, and used brainstorming technique to generate alternative approaches. The entire VE process (except for the post event phase) was performed in two days. Out of the 109 ideas generated, more than 20 were selected at the highest "gut feel index" level for further detailed evaluation and study pointed out the way for much focused use of VE by small teams in highly technical areas.

The basic fundamental of Value Engineering and its different phases have also been used in 2011 (Sharma & Srivastava, 2011). They studied a bath fitting product in which the material of the product was changed according to the value engineering methodology. The material was chosen such that the cost is reduced without affecting the value of the product and its design. To find the best possible alternative from the choices they incorporated a tool named as Decision Matrix which gives the most appropriate result and is even easy to use.

In 2001, Jakhanwal & Singh utilized (VE) as an industrial tool to successfully rationalize the cost of cataract surgery at Tata main Hospital. Results presented and discussed provided encouraging signal: an estimated saving of Rs. 250, 000 in one year with improved service to the patient, and without omitting or abandoning any essential Pre- or Post-Op medical procedure which is likely to affect result of surgery without sacrificing quality.

Processes in healthcare organizations or systems are not only limited to the organization itself but also involve a wide

range of different groups and organizations (Vassilacopoulos & Paraskevopoulou, 1997). Changes in the processes to improve and reduce wastes such as increasing the duration of process in service sectors are also necessary.

According to (Deraye, 2003), the patient discharge process is the most effective parts on patient satisfaction and this is the last part of contacting the patients and their attendant to the hospital. The results of all the actions for the patient reflected at this stage, increasing the duration of this process of financial, psychological and health care cause patients' dissatisfaction (Ketabi, 2003). The process used in this study is discharge process and time is considered as variable studying. Patients discharge with delayed indicate poor management of beds in the hospital. Discharge process is a basic challenge for hospital management and revise this process is an important strategy that hospital activities need it for achieving to success.

### 1.3. Vision

Following the above mentioned, the aim of this research work is to identify costly and time wasting procedures over discharging process at the service sector of hospitals and suggest solutions to improve the current situation utilizing value analysis/engineering techniques. The main concept is to eliminate or improve everything that would cause unnecessary costs, without any effect on the main functions. Answering the key question of whether value engineering technique can improve the Langroud Amini hospital discharge process and moreover savings time, causes improving services and increasing clients' satisfaction and the staff, is the main objective of the present research work.

All required data has been gathered through a systematic method of interview, observation and time saving in which the below data have been gathered.

- Discharge process is done for all clients equally.
- Approximate time of discharge activities are crucial.
- Discharge activities times are independent of each other.
- Hospital staffs know about value of new ideas.

## 2. Methodology Definition

In this section Value Engineering methodology which is used for improving the discharge process and includes pre-study and value study is described in details.

### 2.1. Pre-Study

Since, discharging process has remarkable influence on patient satisfaction, it has been selected for carrying out the study and receiving management coordination helps authors to gather data and required documents in appropriate shapes. Discharge process has been depicted using the well-known software of Visual Paradigm followed by identifying the weaknesses and wastes of the process. On the other hand in this section the time of each function was calculated and inserted in model of process to calculate total time by

simulation. For judging the ideas, the following criteria were considered:

- reduce the duration of the discharge process
- reduce waste and errors in the process
- increase patient satisfaction and hospital staff
- improve the quality of services

The next step is to form value engineering team which consists of experts in healthcare system. Team members have experiences and knowledge on hospital's procedures and also can offer effective suggestions for improving the procedures. Team should have a medical doctor (M. D.), a supervisor, head nurse, nurse and employee of discharge sector.

Investigating the processing time of discharge section in interior sector of hospital carried out for 5 days collected 20 cases, four cases per day in average. Using software to draw the process and timing showed that the duration of the process was calculated about 6 hours and 27 minutes.

Discharge process starts with the examination and writing discharge order by doctor, followed by sending paper and electronic files to complete reports which have been provided by nurses. Electronic files are sent to discharge department. Functions such as checking and checking papers and data submitted to electronic files and correcting errors are in the next step. Checking insurance documents, costs estimation, issuing receipt and issue a discharge form are completed after initial checking out of documents. Before costs estimation, if the patient insurance documents are not complete, paper file is transferred to the insurance sector. Insurance sector completes and confirms or reject them and send decision to the discharge sector. If there is no problem on document patient cost is calculated. The patient refers to the cashier and pays the receipt to receive discharge form. Following the above mentioned procedures, the patient is allowed to leave the hospital. Appendix 1 shows the current process model drawn by Visual Paradigm software.

Looking at appendix 1, time wastes can be observed in which some of the most important of them are as follows:

- Delay on doctors' patient examinations causes late to send patients' files to discharge sector.
- Errors in paper and electronic cases such as wrong information about the drugs because there is not any secretary in hospital and most of the time nurses are preoccupied.
- Increase functions of staff for matching and correction file's errors, completing the lack of insurance documents, Referring files to insurance sector, that often occur because of preoccupation of nurses.

### 2.2. Value Study

This step includes functional, creative, evaluation, development and presentation phases.

- Functional Phase

In this step all functions that related to the process including doctors, nurses, discharge and insurance staff and patient attendant identify that they are shown in Table 1. The questionnaire was distributed among 15 personnel involve in the process, the functions that need to be improved were

selected that presented effective solution for them in creative phase.

Having a careful look at the results of questionnaires, can be concluded that some functions that need to be changed and improvements were selected that include the following items:

The time of examination by doctors

- something that related to completing of cases by nurses
- transfer of the cases from internal ward to discharge sector

- complete the documents of cases
- tasks that related to discharge staff
- check the insurance documents
- something that related to discharge form
- tasks that related to cashier
- *Creative Phase*

In this step, creative team members use brainstorming technique. New ideas regarding each of the selected functions are drawn out through questionnaires. These ideas are tabulated in Table 2.

**Table 1.** The function of process component.

Function	Explanation	Average time (min.)
Doctor	Check up and present instructions for caring patient after discharge	5
	Insert explanation in case	2
Nurse	Do discharge's works	2
	Write nursing reports	5
	Complete patient's cases in the HIS system	8
	Complete paper cases	13
	Give the case to case transferor	2
	Deliver the case to discharge department	5
Discharge Employee	Get the case from case transferor	0.5
	Check and match paper and electronic case	13
	Eliminate the case defects	9
	Examine the case's insurance	4
	Send case to the insurance department to completing documents	1
	Separate financial documents that is related to insurance from the case	18
	Calculate the cost of treatment	4
	Deliver up payment receipt	1
Insurance Employee	Deliver up discharge sheet	4
	Get the case for completing	0.3
	Check and complet insurance's documents	6
Cash Desk	Send the case to discharge department	1
	Get the patients treating costs	5
Patient Attendant	Deliver the paying off receipt up	1.5
	Pay the hospital costs off	1.5
	Get the paying off receipt	2.5
	Give discharge sheet to head nurse	4

#### • Evaluation Phase

In this stage, evaluation questionnaires were distributed between team members to present scores from 1 to 10 for each question. The ideas with more than 5 score in average passed to the next stage. A summary of selected ideas include the following:

1. Employing new staff in sectors related to the process
2. Training staff to use HIS system better and coordination with other parts to insert the correct information in the cases
3. Comparison manual and electronic cases exactly, control insurance documents by supervisors because of saving time

4. Getting discharge forms electronically and patient leaving order by a nurse
5. Using more personnel for separating insurance documents from cases
6. Using someone in charge of issuing the discharge form
7. Paying costs in discharge sector when cash desk is crowded
8. Using more than a cash desk for getting costs
9. To deliver up paying off receipt and discharge sheet at the same time in cash desk
10. Sending discharge to ward electronically

We can't use all of these idea, we must pay attention the goals of value engineering that try to omit unnecessary costs

and activities. So with using value analysis process perspective must choose ideas that are more valuable and also with considering the current conditions of hospitals they could be used. In the next step better ideas will be develop.

- *Development Phase*

In this stage with considering hospital conditions and evaluation criteria, ideas that were more practical from the viewpoint of process and can be used in hospital were selected until small changes in them reduce the time in each workstation and errors. These development ideas include the following:

- To devolve completion of patient cases in HIS system, registration and confirmation insurance information in case, controlling the documents of cases and completion them to head nurse

- To calculate the costs after separating financial papers and insurance documents from paper cases
- Not sending the cases to the insurance department for approval documents
- Not delivering up discharge sheet by discharge department
- To deliver up paying receipt and discharge sheet off at the same time in cash desk
- To send discharge sheet to ward electronically by cashier
- Not checking insurance documents by discharge department
- To receive discharge sheet by nurse electronically for discharging patient

**Table 2.** Suggested ideas for function of process component.

Function	Idea's explanations
<i>Doctors</i>	Setting rules by management for doctors to being on time at hospital
	Change the time of doctor's attendance to avoiding delay in discharge process
	Use the forms to inserting patient's information in shorter time
	Employ more nurses because of shortage of staff
	Training personnel to use the HIS system correctly and inserting accurate information in patient's case
	Employ some secretaries for doing discharge works at hospital's wards
	Request insurance's expert for attending in ward and doing works that related to patient's insurance
<i>Staff in hospital's ward</i>	Check daily reports that is inserted in the case to avoiding errors
	Check and match paper and electronic case by head nurse
	Check the type of insurance and its documents by head nurse to saving the time
	Omit paper cases and record all information and documents in HIS system
	Check the case's documents by head nurse to making certain about patient's identity information
	Send discharge's cases for evening and night shifts a day before to discharge department in the early morning hours
	Send the cases to discharge department before noon
	Prepare a schedule for each section to send cases to discharge department while cases arrive at the same time
	Complete case in HIS system by head nurse and send it to discharge department to reducing the process time
	Getting discharge sheet electronically and ordering the patient discharged
<i>Discharge department</i>	Employ new staff for discharge department
	Exact scheduling for checking each sector's cases and examine them for 24 hours
	Informing the patient's attendant about the exact discharge time to avoiding crowd
	Check the electronic case immediately after arriving to discharge department
	Coordinate with hospital wards to send the cases earlier
	Assign more people for separating financial documents that is related to insurance from cases
<i>Cash desk</i>	Use someone for delivering discharge sheet up
	Pay the costs in discharge department when the cash desk in crowded
	Using more than a cash desk for getting the costs
	Deliver up payment receipt and discharge sheet at the same time
	Send discharge sheet electronically to ward

According to the functions of nurses in discharge current process in the hospital and their preoccupation, devolving some of duties to head nurse is necessary because they are more professional in health field and with doing something such as completion of cases cause the reducing errors and

defects that related to preoccupation of nurses. Also check the completeness of paper case, control the type of insurance and its confirmation by head nurse cause they did not need to refer to insurance department and time is saved.

If the cashier after receiving costs, delivering up discharge

sheet and paying receipt off at the same time there is no need to refer the patient to discharge department. Also if the cashier sends discharge sheet to ward electronically, nurse can check them sooner as the result it cause discharge department's functions is reduced.

### 3. Results and Discussion

After development of ideas, the process has been redrawn according to new guidelines. In this process according to the ideas, the change in doctor's functions is not created but the some functions are divided between nurse and head nurse. Also as a result of the process changes in ward, current activities of discharge department change and because of checking insurance documents by head nurse, insurance department has also been removed. Also cashier's activities increase that causes the process improved. After inserting the time information of each function, the total time of the process is calculated with the help of software that is 3 hours 29 minutes and 30 seconds, And after comparing with the time before the process improvement about 3 hours is reduced, Changes in the process as well as reduce the time can be reduced staff's functions and finally reduce errors and

rework.

The results of simulation and improvement can be presented to hospital's manager that he makes effective decisions about changes. Improved process model shown in appendix 2.

Improving discharge process causes reducing the time and creating changes in bottlenecks also functions that were was changed and they are not as a main bottleneck after process improvement and queuing time for every function has decreased. Based on changes in the process because of presented ideas, the number of activities and their names have also changed and some of these activities deleted or merged, For example, some activities that is related to insurance done by head nurse, insurance department is removed in the new model of process and as the result insurance' functions were deleted. Comparing the queuing time graphs before to after improvement realized that the time for doing all functions reduced a lot and expected time is low. Changes and queuing time of functions are shown in Appendices 1 and 2. According to the above mentioned graphs, queuing time of some discharge process functions that were unchanged before and after the improvement are reduced, are shown in Table 3.

*Table 3. Comparison of queue time for some of process functions before and after improvement.*

Function (activity)	Before improvement (minute)	After improvement (minute)
To calculate the costs according to the type of insurance and deliver up payment receipt	27	24
To complete cases in HIS	23	13
To separate financial documents that is related to insurance from the case	18	12
To write nursing reports	10	0
To get paying off receipt	7	5
Calculating the cost of treatment without considering insurance and delivering receipt up	8	5
To get the patients treating costs	6	3
To refer to cash desk for paying the costs off	5	1

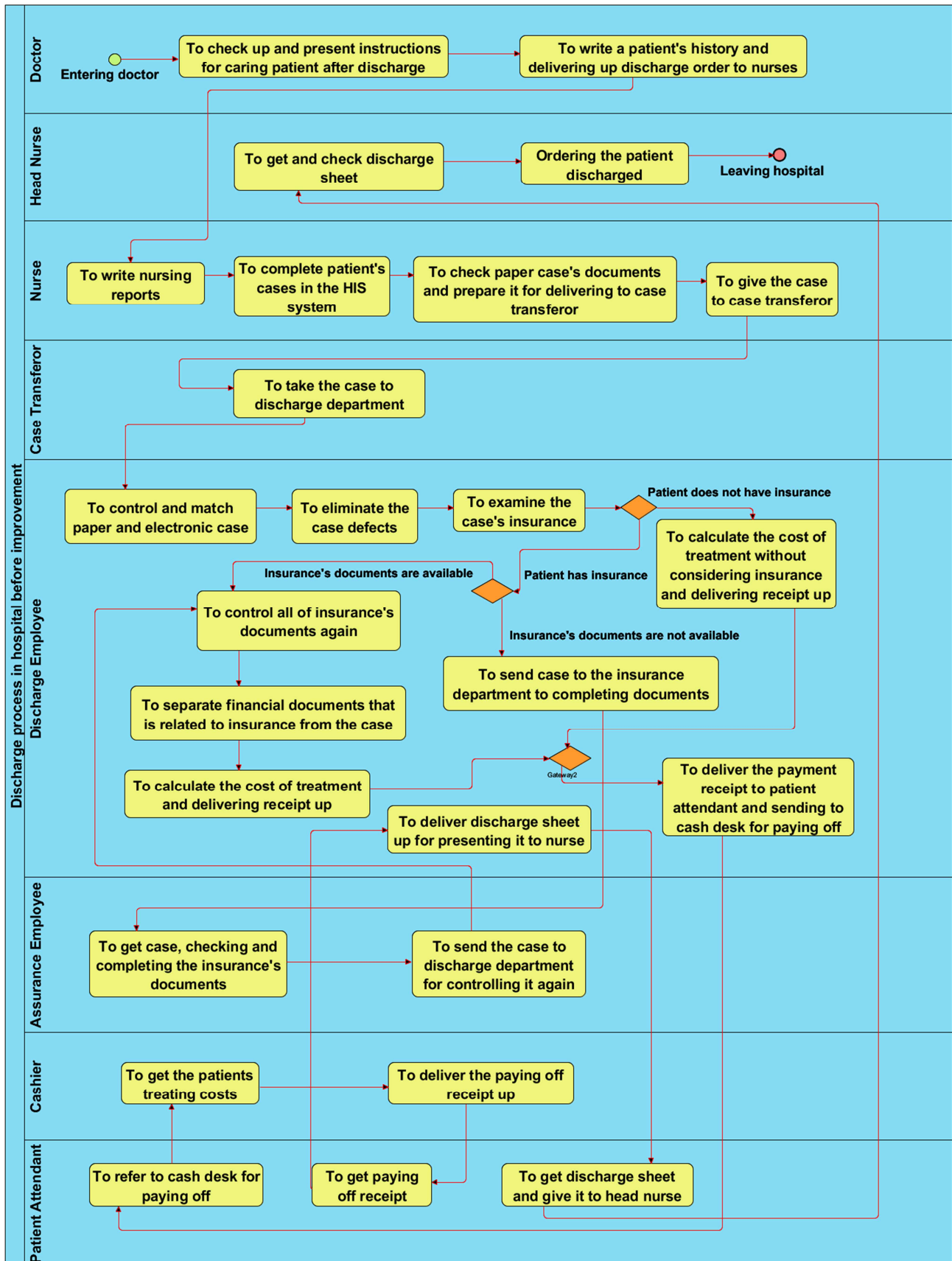
### 4. Conclusion

Service healthcare sectors such as hospitals are public agencies those have complicated business processes. These organizations are involved in something such as decreasing cost time and improving the quality of services. Therefore, they need to utilize new management techniques to improve their processes. Value engineering technique which has a lot of applications in manufacturing organizations has been recently used by a number of institutions to help healthcare organizations on managing costs and provide suitable quality of services to clients. This study presents a model using value engineering's process approach in public service to improve the quality of discharging process. After investigating

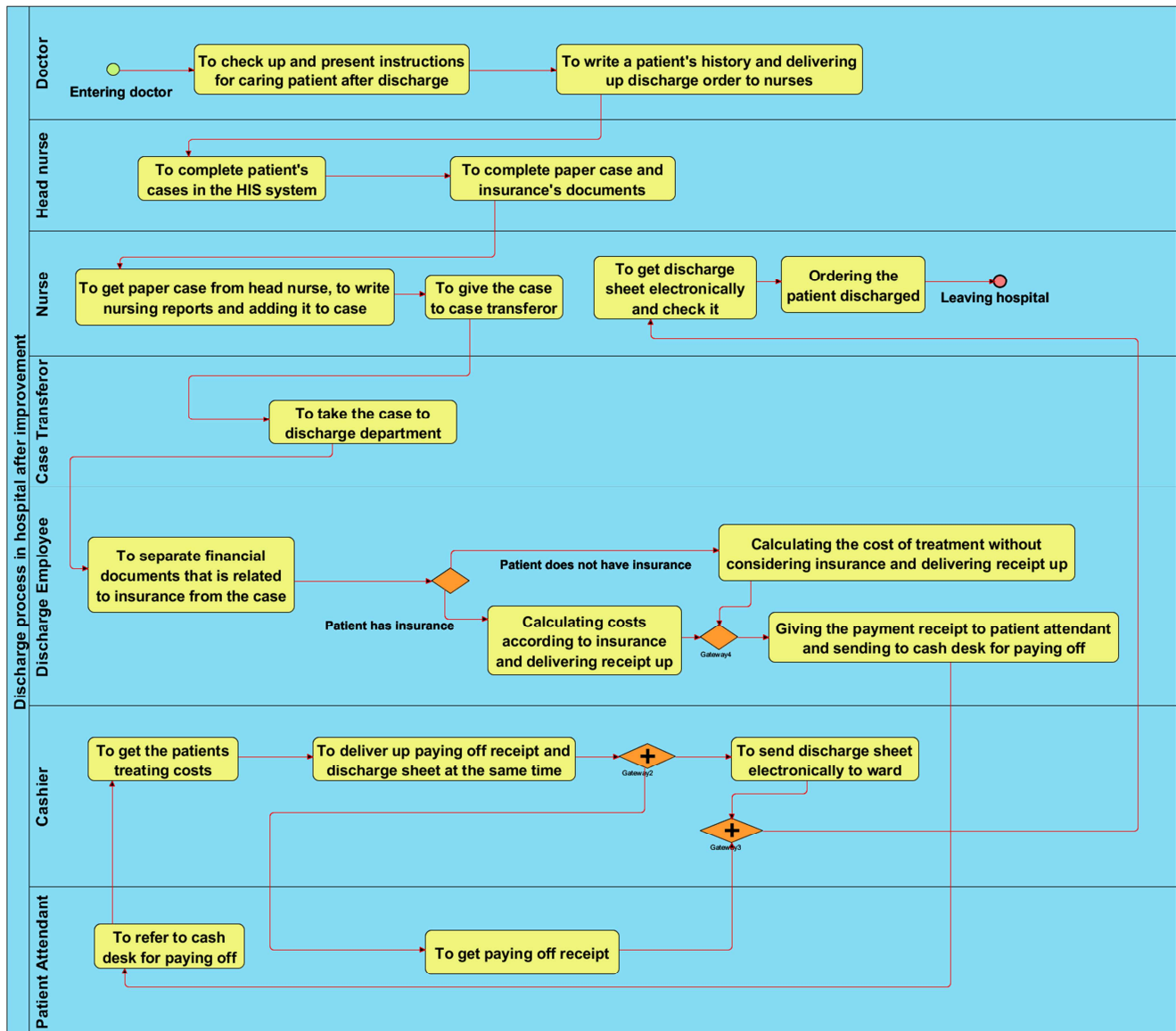
discharging process and its weaknesses and wastes, a work plan for the improvement and change working conditions has been provided using value engineering's followed by simulation of both current and suggested procedures. The performance of improving suggestions before and after implementing have been investigated and results revealed that focusing on reducing process's time and paying attention to process improvement and elimination of wastes on client satisfaction cause time processing reduction and the quality of services would be improved. For future studies, it is recommended to analyze the process utilizing probabilistic techniques in which discharging stages may be different patient to patient according to fitted or estimated probability functions.

## Appendix

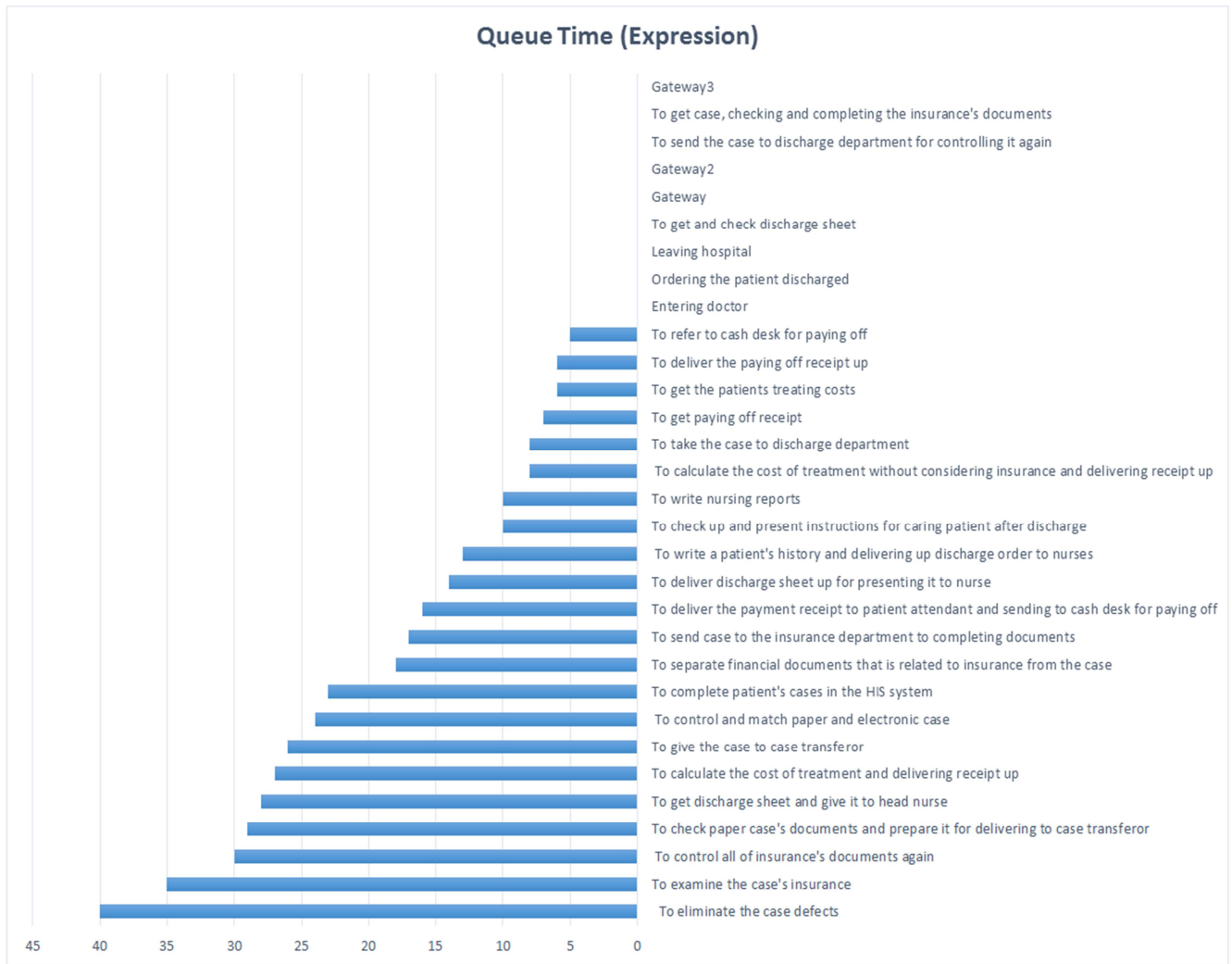
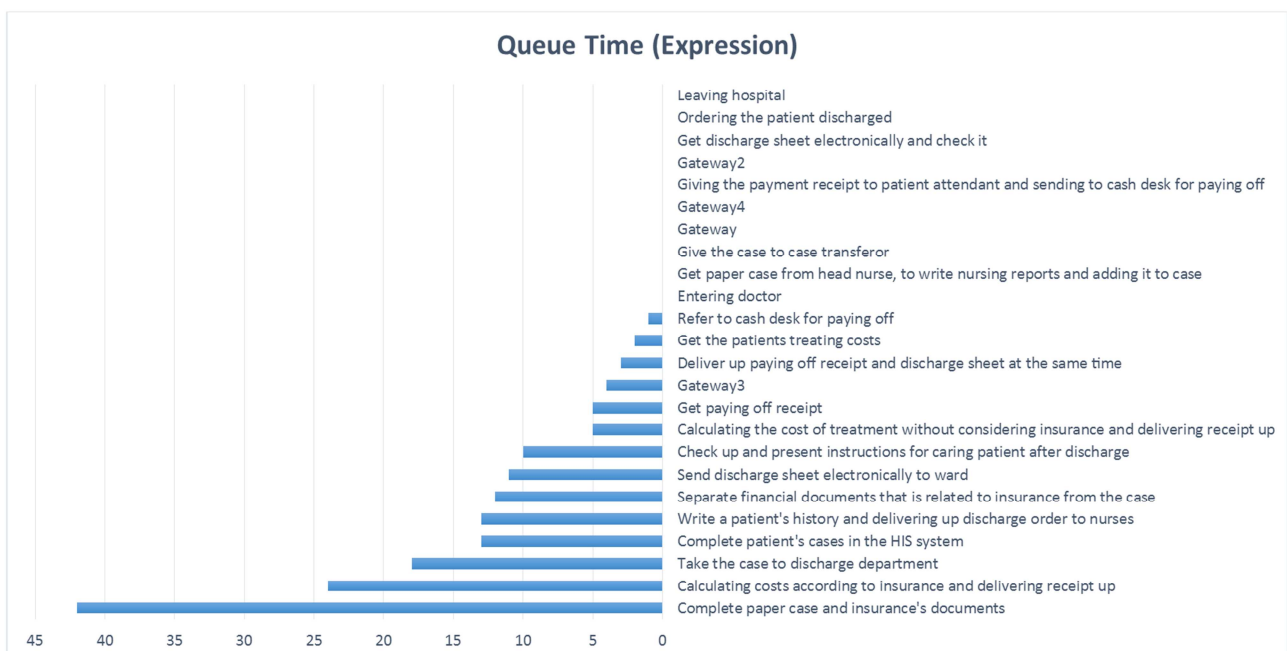
### Appendix 1. Current Discharge Process



## Appendix 2. Discharge Process After Improvement





**Appendix 3. Queue Time Diagram for Current Discharge Process****Appendix 4. Queue Time Diagram for Discharge Process after Improvement**

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## References

- [1] Chougule, A., Gupta, A. K., Patil, S. (2014), Application of value engineering technique to a residential building -case study, International journal of innovative research in advanced engineering ISSN: 2349-2163.
- [2] Orr, Tom P. E. A. (2008), Value Analysis Approach to Healthcare Revenue Improvement, Georgia Institute of Technology, Available at: <http://www.uscost.com>, Accessed February.
- [3] Sharma, A., Belokar, R. M., (2012), Achieving success through value engineering, Proceedings of the world congress on Engineering and computer science, volume II.
- [4] Fong, P. S. W. (1999), Function-Oriented Creative Group Problem Solving. Creativity and Innovation Management.
- [5] Sharma, A., Belokar, R. M. (2012). Implementation of value engineering- A case study, International journal of marketing, financial services and management research Vol.1, No.3, ISSN 2277-3622.
- [6] Vohra, M., Ochabauer, A. (1999), Value Engineering application in environmental process design: A case study. SAVE International conference proceedings.
- [7] Sharma, A., Belokar, R. M., Srivastava, H. (2011), A case study analysis through the implementation of value engineering, International journal of engineering science and technology (IJEST), vol.3 no.3, ISSN: 0975-5462.
- [8] Jakhanwal, S. P., Singh, G. B., (2001), Application of value engineering to rationalize the cost of cataract surgery in eye clinic at Tata Main Hospital. Indmedica - Journal of the Academy of Hospital Administration, Vol.13, No.2.
- [9] Vassilacopoulos, G., Paraskevopoulou, E. (1997). A process model basis for evolving hospital information systems, Journal of Medical Systems, 21(3): 141-53.
- [10] Deraye, S. (2003), Application of systems analysis techniques and methods in the process of admission and discharge of patients, and providing a model, Fourth Iranian Congress of Medical Records, Tehran, Iran, Iranian Society of Medical Records.
- [11] Ketabi, S. (2003), Evaluation and optimization of services in hospitals, University of Esfahan.