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A Qualitative System Dynamics Approach to Clinical Risk Management

Elaheh Zadfallah[a], Mahdi Bastan[a, b], Alimohamamd Ahamdvand[a]

[a] *Department of Industrial Engineering*
Eyvanekey University, Garmsar, Iran
E-mail: e.zadfallah@eyc.ac.ir, am.ahmadvand@eyc.ac.ir

[b] *Department of Industrial Engineering and Management Systems*
Amirkabir University of Technology, Tehran, Iran
E-mail: bastan@aut.ac.ir

Abstract

Medical errors are considered as one of the major challenges of the health throughout the world system and impose many costs on society every year. The losses that caused by mismanagement of these hazards are not only for the patient, these errors can affect the loss of good physicians and hospitals reputation. Threats of Medical errors in the healthcare system, predispose the movements and efforts to minimize the statistics of these errors, mortality and disability. The aim of this study is to provide a systemic model to analyze the dynamics of the healthcare system risks to eliminate or reduce the damages of services. In this paper, we could address to identify factors influencing the adverse events due to medical errors with using system dynamics (SD) approach and shows their impact on our healthcare system and clinical errors. According to the proposed model, creating a safety culture in the health sector, using indicators of overall perception of safety, non-punitive response to error, organizational learning, responsibility, supervision and team communications play an important role in reducing adverse events is due to medical errors, in addition to increasing knowledge and skills of staff through training on the job can also have a significant impact in reducing these incidents. Using a systemic approach in dealing with the problem of medical errors led to support of physicians and will result encouraging themselves to express the errors. Expressed the errors will lead to the system detection and will help the error analysis and preventive measures.

Keywords:
System Dynamics, Causal loop Diagram, Clinical Risk Management

Introduction

Healthcare system is one of the largest systems in each country and is the constant need people in every society. The main objective of the healthcare system provides services to improve public health. Errors and adverse events can occur even in the best of circumstances but due to the fact that errors in healthcare system have very high costs so can be caused the patient death, reduce the errors and clinical risks have an important consideration. This importance, shown the necessity of a framework and a model of the healthcare system in order to achieve the objectives that protect and promote the health and reduce the risks that involved in the care process. There is no access to these objectives without having a framework for the effective and efficient system and healthcare system. Therefore, this is very important in order to enhance quality and improve communication between hospital staff and patients and decrease the complaints regarding medical and nursing errors, clinical risk reduction in hospitals.

It is important to note that Clinical Risk Management (CRM) practices, such as the introduction of guidelines and protocols, patient involvement, etc., do not take into account expenditures and their influence on the staff' behavior. Indeed, such practices, if not properly managed, can give rise to medics and paramedics' work overload burnout, which would inevitably increase the probability of errors. Indeed, improvements of clinical risk profile often allow hospitals to realize important savings on insurance costs. It can also boost institutions' image and increase their competitive advantage. For this reason, it is essential to adopt a systemic and multidimensional approach that allows healthcare companies to properly evaluate CRM policies effects on organizations' performance, in the short, and medium long term[۱].

Health indicators in different dimensions had tremendous growth over the period 2005 to 2008, According to the Ministry of Health and Medical Education of Iran[2]. In the field of health and prevention, added 461 new health centers and access to rural and urban population to primary

health care increased 2% and 6.2-times harm reduction drop-in centers. That is added 47 active hospitals and 13 thousand inpatient beds in the area of treatment and care, the emergency road centers in urban to be 2.6 times and 1.5 times the country's emergency 115 ambulances. In the field of medicine and food, 260 item added to the number of drugs of locally produced and hospitals that have registration system of adverse drug reaction have been 166 times also the report of medical complication surveyed have been 3.2 times. In the field of medical education, added 1286 program of continuing education and increase the student who is accepted entire sections of medical sciences to 24%, the capacity of professional doctorate to 71% and academic disciplines of Ph.D. to 62.5%. In the field of medical research, electronic library of medical universities was 1.8 times and medical research centers are 1.9 times and 1020 people have been added to the number of faculty members of medical universities also the patent in the field of medical science was 52 times. In the field of development of management and resource, increase the share of healthcare of gross domestic product (GDP) to 0.5% and the amount of automation in the central headquarters to 1.8 times and job management education is 3.4 times. In the field of medical equipment, has increased to medical equipment manufacturers 100 company and to produce of medical equipment to 100 items.

We expect of all this new features and improvements developed in the field of the healthcare that increased the safety of patient and followed by reducing medical errors. While complaints due to annually medical errors have been increase five to 10 percent. The number of cases that handled by the forensic commission in Tehran in 2011 about 2,100 complaints and in 2012 increased by five to 10 percent of the cases and has reached to 2,300 [3].

The country statistics check of complaints that provided to the coroner's about medical malpractice cases resulted in convictions shows this trend has been growing in the period between 2012 and 2015. In other words can say that number of complaints referred to the coroner in 2013 over the previous year increased by 8.25 percent, in 2014 compared to last increased by 24.7% and in 2015 had an increase 7.35% compared to the past.

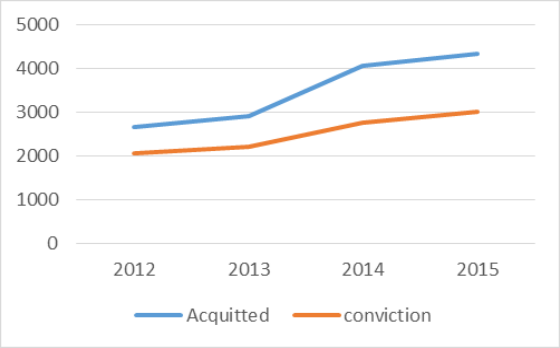

Figure 1-Diagram of malpractice that references to forensic [4].

As can be seen in **Figure 1**, despite the mentioned improvements in the hardware and software resources of the healthcare system, malpractice which is part of the clinical errors are increasing and responding to this ambiguity and analysis of causal structural of this behavior of the main objective of this research. In other words, in this study with utilizes a system approach, will be detected and representation the structure of undesirable behavior in clinical risk management and will be provided the policies improvement with an understanding of the components and relationships within this structure.

Background and literature

The principles which all project risk management schemes have in common are definition, planning, risk identification, risk quantification, action, measurement, outcome assessment, and a post-project review[5]. The risk management process consists of five steps: 1) Identify and analyze 2) Consider alternative risk techniques 3) Select what appears to be the best risk management technique or a combination of techniques 4) Implement the selected techniques. 5)Monitor and improve the risk management program [6]. Patient safety is a discipline in the healthcare sector that applies safety science methods toward the goal of achieving a trustworthy system of healthcare delivery. Patient safety is also an attribute of healthcare systems; it minimizes the incidence and impact of, and maximizes recovery from, adverse events [7]. At the heart of patient safety in healthcare is the avoidance of medical error[8].

CRM can be defined as all structures, processes, instruments, and activities which enable hospital staff to identify, analyze, contain, and manage risks while providing clinical treatments and patient care. CRM is a specific form of Risk Management (RM) focusing on clinical processes directly and indirectly related to the patient [1].

Clinical Risk management is a process of 1)addressing the various clinical and non-clinical activities within a department 2)identifying the associated risks which exist with such activities 3)assessing the probable severity and frequency of those already existing risks 4)identifying solutions towards eliminating those risks and reducing the effect of those risks which cannot be eliminated [9].

Various researchers have conducted in the field of modeling and clinical risk management. Ghadge, Dani [10], have been paid to develop a comprehensive risk assessment process, systematic and quantitative measurement of risk behavior, using systems thinking concepts to modeling supply chain risks. Soheili Nia, Sepehri [11], studied the errors reduction management in the operating room with a developed and revised failure mode and effect analysis method (FMEA). Jalali Far, Sepehri [12], expressed to identify the most important step of causing errors in the hospital medication based on Fuzzy Analytic Hierarchy Process (FAHP). The process of drugs and medication to the patient has an important role in patients cured that is made up from four-step prescription, transcription of prescriptions, distribution, and consumption of drugs or drug injection. According to the results obtained in this study while the copying is done by a nurse from the

physician's orders is identified as the most important step of the causative error, but the ranking of other steps is also very close together. That's why experts and process owners in the Hasheminejad hospital have seen the importance of the entire process up errors. Harris [13], studied the risk assessment about training, incident reporting, the knowledge and consent of acute health care through a postal survey of 62 nursing supervisor or clinical specialists. Brown [14], paid to a review of risk management with a focus on clinical trials and recorded risks were outstanding and developed an action plan. Valentina, Ceresia [7], paid to evaluate the safety culture of the organization, as a means of improving patient safety by using system dynamics and by using the simulation, examined the creation of a safety culture impact in reducing the incidence of adverse events therapy.

Ceresia and Montemaggiore [1], paid to explore multi-dimensional complex operations management system for hospitals, clinical risk management modeling at three hospitals by using system dynamics and compared them together. They examined the clinical effectiveness of different policies on financial indicators and non-financial risk management, to support healthcare companies. Clinical risk management policies were designed to guarantee safety for both patient satisfaction and sustainable growth.

Previous studies indicated that the problem of clinical risk management was a complex system and proper understanding of how it works requires holistic analysis of the causal structure underlying it. Obviously, in such situations using the non-systemic research methods do not mentioned the holistic can't be allowed access to effective solutions. In addition, in the researches that conducted with the SD approach, many factors are ignored such as the state budget to the health care, education, human resources, safety culture, while is not negligible the impact of these variables on the behavior of the system. Therefore the present study tries to provide a comprehensive model for clinical risk management problem in the healthcare system of Iran to take advantage of the holistic system approach in regard to leverage variables influence the behavior of the system.

Methods

We will use the system dynamics methodology for modeling and analysis. This method is one of the Appropriate methods to simulate complex systems is based on causal relationships that enabling the system to provide appropriate learning by providing an environment for testing various scenarios. This method can be also used to analyze the problems with the qualitative approach (causal analysis) and quantitative approach (stock and flow). There are some applications of this methodology in social and economic complex problem modeling such as mobile banking adoption simulation [15], Banking Risk Management [16], Banking paradox [17], Sustainable development [18], Organizational demographics [19], brain drain [20], dust emission [21], waste management [22], Crisis management [23], inflation rate [24], Housing Cost [25], User satisfaction in Healthcare services [26], public health [27].

Modelling

Dynamic Hypothesis

Each healthcare system has some means that using them in pursuing their goals. Health tools are include financing, organizing, payment, regulation, encouragement and its objectives divided into two categories, intermediate objectives and ultimate goals that intermediate goals include access, quality and productivity and the ultimate goals including improving health, protection from financial risks and satisfaction [28]. Medical error problem is a very important impact on health care system goals. Increase the number of patient leads to crowded treatment centers, this crowded causes fatigue and lack of concentration and inconsistencies staff' and increases the error and this increasing error lead to further increase in the number of patients and also the payments and compensations by insurance companies increased due to increase errors and patient and lead to financial bottlenecks that reduce the quality of health care That predispose to increased errors. In addition, some structural weaknesses in the healthcare system have led to very high rates of medical errors. Employing a system approach in dealing with the problem of medical error led to encouraging support practitioners and physician remarked error will result. Expressed the error, will help system to error detection and analysis and preventive measures and facilitate access to goals of health care.

Causal Loop Model

With the increase in population has access to health care needs are reduced as a result, reduced the number of people who can benefit from health conditions and increases the number of patients, so the community health status is compromised and this risk impact on the population.

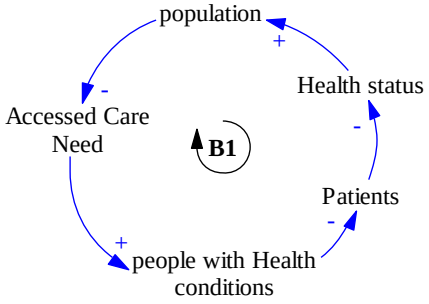

Figure 2-The loop of population effects on health and disease

The number of treatments that done in hospital increases by increasing the number of patients as a result, the treated population decreases

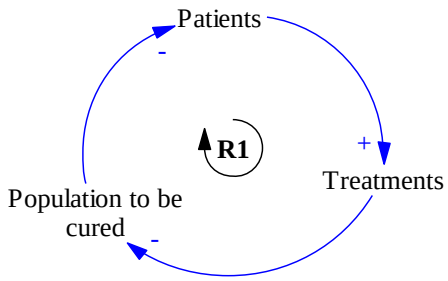

Figure 3-The loop of patient effects on the number of treatments

The hospital faced a shortage of personnel with increase the number of patients so the heavy workload will increase for each staff and this hazard staffing Physical health (fatigue, hungry, or unwell). Lack of health staff will increase medical errors and adverse events and patients who suffer during these events are again visit the hospital for treatment and will increase the number of patients again.

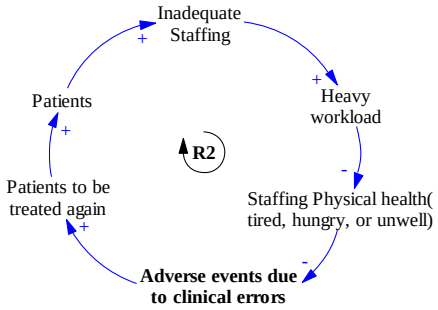

Figure 4-The loop of heavy workload in the hospital

In addition with increasing the number of treatments that are used in hospitals, the treat income increases that drives hospital is improving its financial availability. These financial resources can be used for the development of hospital equipment and clinical risk management investment policy.

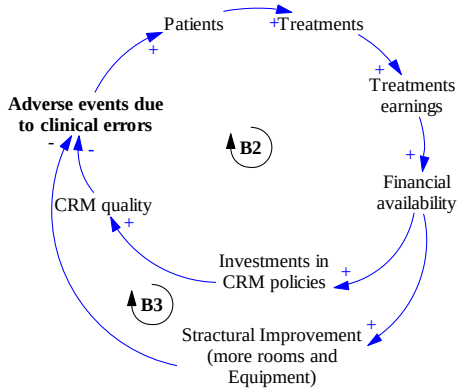

Figure 5-The loop of hospital treatment effect in improving equipment and clinical risk management

The impact of adverse events due to medical error is not limited to patient safety. With increasing the medical error the compensation claims increases as a result of reduced financial resources Hospital and decreases the amount of investments in CRM policies which is leading to increased adverse events due to medical errors. (Loop R3). As well as increased medical errors and adverse events due to Compensation demand destroys the reputation of General Hospital and refer fewer patients to hospital treatment as a result of reduced treatments earnings and due to lack of investment in clinical risk management policies, is increased to the errors.

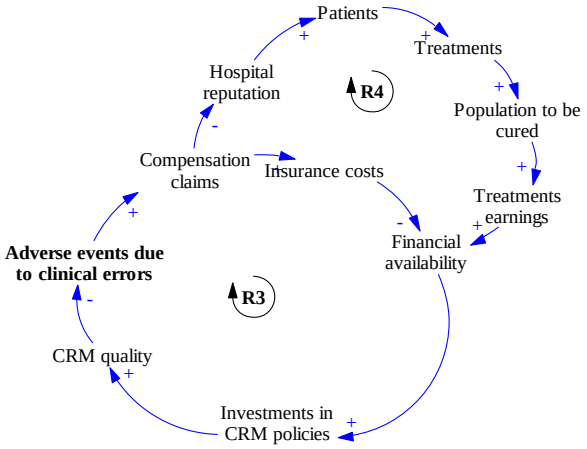

Figure 6-The loop of effects medical errors and adverse events, and a hospital on the compensation claim.

Within the health care system is not always caused by medical errors. Patients' waiting time for health services increases with the increasing number of patients, and this may result in fatigue in patients and patients when receiving healthcare services does not cooperate which in turn enhanced error.

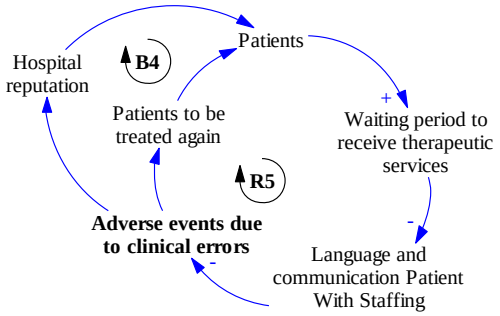

Figure 7-The loop of patient effect in the medical errors and adverse events

The health sector is also supported by the government and the budget allocated to this sector. The expressed budget with impact on the quality of higher education, the education expert human forces, in addition, the budget for providing people access to health care and improve the structure of (room for more) funded the hospital.

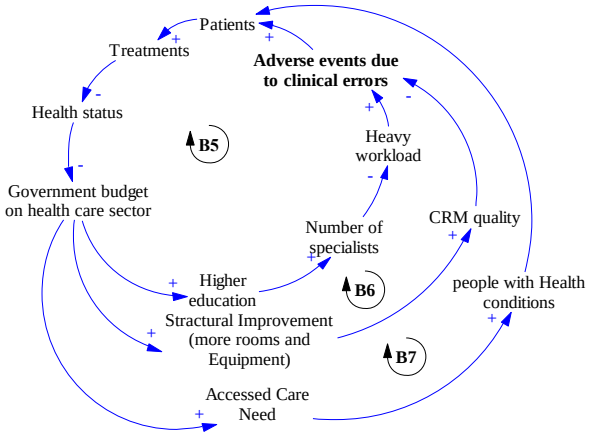

Figure 8-The loop of state budget effects of the in adverse events due to medical error

Different policies effectiveness on clinical risk management of medical errors

This section examines the effects of two clinical risk management policy on adverse events due to clinical errors discussed. Staff training during work is one of the clinical risk management policies. In most cases, staff, tasks mentioned in the protocol to better perform not a routine task. In other words, decision-making in situations when staff which are already no facing or have faced very little is very difficult for them. With staff training and increasing knowledge and skills, they will perform better both tasks described in the protocol and unusual tasks.

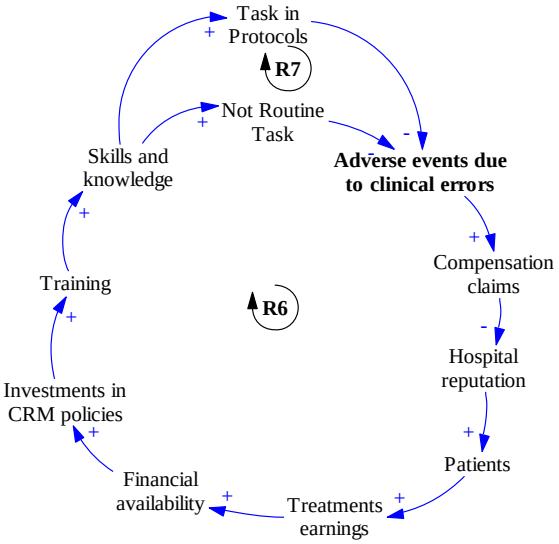

Figure 9-The loop of staff training policy effect on adverse events due to medical error

Patient safety culture policy is increasingly imported in high-income countries currently. Safety culture improves teams communication, supervision, staff better communicate with patients, increasing the responsibility and reduce medical errors. Also, the safety culture at the hospital provides a better understanding of safety for staff and organizational learning and skills development to reduce the rate of adverse events due to medical error and also provides safety culture conditions that staff incident reports to give without fear of punishment, and affect in reducing adverse events due to medical errors.

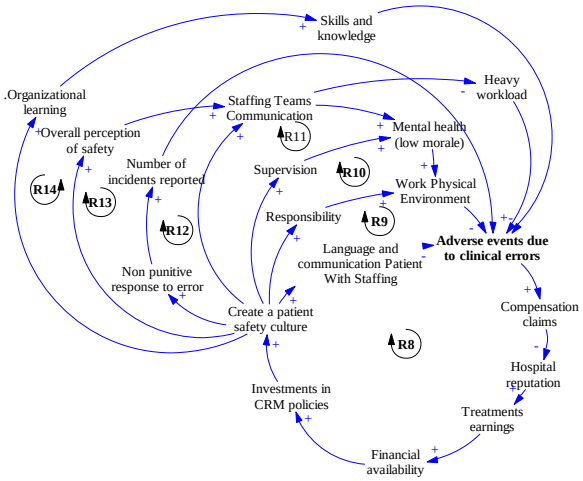

Figure 10-The loop of policy patient safety culture effect on adverse events due to medical error.

Conclusion

Since the reduction of adverse events due to medical errors in healthcare is one of the important goals and due to the negative impact of these events on the patient and the medical staff and the reputation of hospital, in this paper, we try to represent the dynamic behavior of systems to provide adverse events due to medical error and some suggestions given to reduce error and improve the safety. According to the proposed model, creating a safety culture in the health sector, using indicators of overall perception of safety, non-punitive response to error, organizational learning, responsibility, supervision and team communications play an important role in reducing adverse events is due to medical error, in addition to increasing knowledge and skills of staff through training on the job can also have a significant impact in reducing these incidents. It is suggested that investments in order to creation safety culture in health sector planning are a priority. Future research is suggested in order mathematical model simulation system has been developed based on the structure of the stock and flow model in which to view the results and analyze them, provides the ability to test various scenarios can be found more effective solutions to solve the problem.

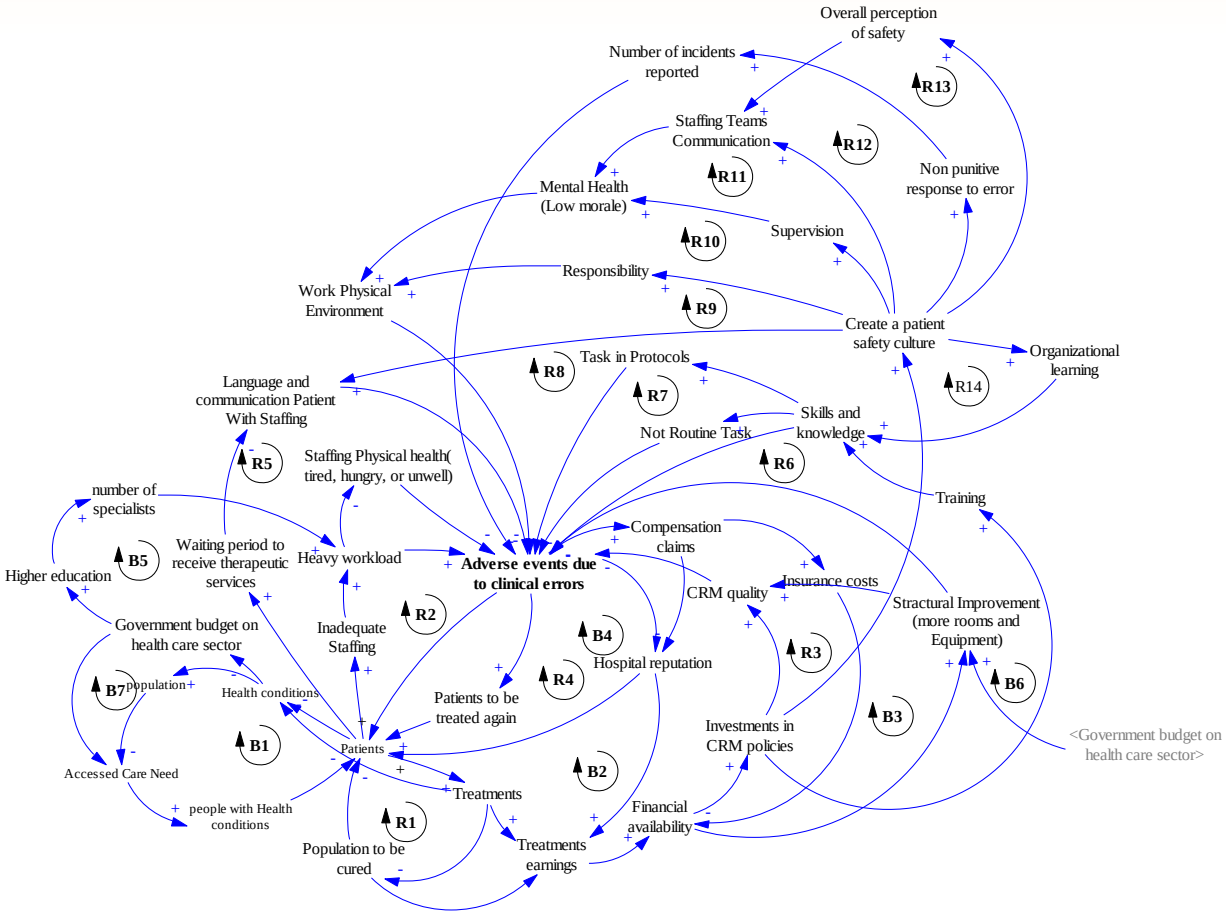

Figure 11-Causal loop Diagram

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