

## The Interaction between Insurance Organizations and Health System: The Insurance Mechanism based on Game Theory

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### ABSTRACT

**Introduction:** In order to achieve the highest level of effective interaction between the insurance organizations and the health system, efforts should be made to identify existing communication challenges for policymakers and decision makers. The present study was conducted to identify interactive behaviors aimed at designing an insurance mechanism based on game theory to cover the existing gaps.

**Methods:** This study consisted of two phases of qualitative and quantitative. In the qualitative phase, data were collected and classified by a semi-structured interview with a number of insurance professionals in insurance organizations and the health system. In the quantitative phase of the study, interactive behaviors between the two organizations were studied. Finally, with the help of Gambit software, the insurance mechanism was designed.

**Results:** In the qualitative phase, the data were collected in three main categories: behavioral and communicative, structural and financial and deductibles and 11 sub-categories. In the quantitative phase, 35 optimal interactive behavioral strategies were delineated.

**Conclusion:** The best behavioral strategy for interaction between insurance organizations and health system, to fill gaps in insurance system and to improve the interaction between the two organizations, was introduced in the form of 35 strategies to provide an insurance mechanism.

**Keywords:** Game Theory, Health System, Insurance Organizations, Insurance Mechanism

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## Introduction

Health is one of the most important human concerns and the health system with its new definitions, has an increasing role in maintaining and improving health in the community. The high cost of health services is a kind of health expenditure that exceeds a certain level of household income (often 40%) (1). For many years, national and international health authorities in different countries have been seeking ways to provide appropriate mechanisms to finance these services in support of people, especially the poor, and have proposed different methods (2). The country's basic types of insurance include social insurance, health insurance, the armed forces medical insurance, and Imam Khomeini Relief Committee insurance under the auspices of Welfare and Social Security Ministry, each of which includes different individuals and groups in the community, and the government has also a different contribution to finance each one of them (3). The insurer organizations and hospitals interact under a binding contract. On the basis of the right to terminate, if one party breaks one of the provisions in the contract, the other party can terminate the contract and avoid further losses (4). One of the important factors in the financial affairs of the hospitals is the problem that arises from the lack of financial and accounting management in hospitals which imposes costs on hospitals.

Despite the shortage of hospital funding, what makes matters worse is the reimbursement of the insurer, which is usually delayed and deducted. Because the insurance company is committed to paying part of the health costs of the insured in the hospital. The widespread health insurance coverage leads to an increase in demand for health services. As a result, existence of insurance can lead to inflation in healthcare services price (5). The source of the hospital's income concerning the implementation of the public insurance law and sale of services to the insured people under insurance

coverage is provision. Usually, each month, the insurance company deducts amounts under the name deductibles from the total of the requested amounts after examining the financial records of the hospitals (6). The main source of hospital's funding is insurance, but hospitals in some cases have issues with the insurer, and typically all of their debts are not collected. The magnitude and the cause of deductibles are important in such a way that they raise the awareness of the hospital's staff and management, and also increase hospital's income and create mutual trust between the two parties (7). Lack of technical knowledge and communication with foreign insurance companies, poor awareness of insurance, risk aversion of government officials, weaknesses in insurance laws and regulations, lack of insurance justice, lack of interaction between the insurance industry and the Islamic Consultative Assembly, mismatch of insurance products with the demand of society, the insignificant presence of insurance companies in the global market, disregard of training highly qualified and efficient workforce, and the limited research activities are among the challenges of the insurance industry in Iran (8). According to the latest valid statistics from Central Insurance of Iran, the penetration rate of insurance in Iran was 1.734% in 2013, which compared to the previous year it has decreased by 6.22%. The damage factor in 2011 was 76.6%, which increased up to 90% in 2013 (9). Compared with the global statistics average, these statistics show the lack of development in the insurance industry and the existence of major challenges. The existence of fundamental problems in the country's insurance system has formed a tight and unprecedented cooperation between the basic and to some degree the insurance extension organizations and the health authorities of the country, but it is fragile and temporary (10). With the current situation, despite the efforts and services of the managers and the

caring personnel of the insurance system in the country, the system will fail to achieve the goals of public health coverage in order to reduce patients' costs, resulting in a lack of budget and heavy debt while meeting these needs (11). The existence of an optimal insurance system is an important factor in improving health, economic growth, welfare and community development (12). To explore the existing behavioral challenges and understanding the interdependencies of parties within the health system, game theory can be used. Game theory is the science of studying strategies and the interaction between rational decision-makers. One of the main applications of game theory is to investigate interactions between organizations (15) Therefore, in order to solve this problem, this study decided to investigate the interaction of insurer systems with the health system, identify factors affecting this interaction and design an insurance mechanism to cover the gaps of insurance systems and the health system based on game theory.

### Methods

This study consisted of two phases of qualitative and quantitative. In the qualitative phase of the study, a goal-based sampling method with maximum variability was used to select the participants. The analysis of interview data was considered as a guide for subsequent interviews. Therefore, sampling continued until data saturation. Two groups of participants took part in the study. The first group consisted of 20 experienced experts from the health system in the field of insurance, and the second group included 13 authorities and experts in insurance organizations in Yazd. The main method of data collection in the qualitative phase was a semi-structured interview and through phone contact with the participants, interview time and appropriate location were determined. Interviews were recorded anonymously assuring the confidentiality of the information. If the participants were not willing to answer a question, they had the right not to do so. They were informed that, if necessary, they may be

referred to again for complementary talks. Participants could have the results if they wanted to.

Individual interviews with participants of the widest variety in terms of work background and diverse work experiences were conducted. Given the circumstances and the participants' willingness, the interview time was between 30 to 60 minutes. Interviews were recorded by a recorder, and then immediately written down word-for-word, so the data was prepared. Data analysis began simultaneously with data collection, and the text of each interview was studied several times. Then the words and sentences related to the participants' conversations, which contained important points about factors affecting the interaction between the insurance organizations and the health system were selected as semantic units, after that, the semantic units were labeled as the summary of a semantic unit whose text was encoded. By reviewing, comparing the codes with each other and integrating the same codes, the codes, as well as the text, were reviewed. The classifications and their extension continued based on similarity and proportionality. To ensure codes' strength, class review and recomparison of the data was conducted. For analyzing and encoding text, MAXQDA<sub>10</sub> software was used.

In the quantitative phase of the study, a questionnaire was designed based on the data collected in the previous phase. First, some games were designed based on extracted interactive behaviors After the qualitative one; a questionnaire on games was distributed among participants in insurance organizations and health system in Yazd. Due to the limited population of people involved in insurance organizations and health system, efforts were made to include them all. The data collection tool in the quantitative phase was a questionnaire containing 140 questions. It represented 35 games from among the interactive behaviors between the health system and insurance organizations. Each behavior was presented as a question in the

questionnaire, each question having two answers (agree and disagree).

With regard to the population of insurance managers and experts who carry out insurance affairs in Yazd, and also with regard to the population of authorities and experts at different levels of the organization and concerning the insurance issues in Yazd University of Medical Sciences, they were all considered as samples. The number of participants in this study was 42 from the health system and 40 from insurance organizations. In order to verify the validity of the questionnaire, after the thorough review by the research team, the finalized questionnaire was sent to 10 experts to confirm the content validity and to receive complementary comments. In order to examine the face validity and proportionality of content with the characteristics of the sample, a pilot study was conducted with 20 experts and authorities of insurance organizations and the health system in Yazd. Cronbach's alpha coefficient was 0.78 in the present study, which indicates the high reliability of the designed tool.

After collecting data by questionnaire, the obtained data was analyzed using SPSS24 software and the frequency percentage of responding to each question, which included agree and disagree answers, was obtained separately for each group. After that, using GAMBIT software, the Nash Equilibrium was determined in each game, which represented the optimal behavioral strategies between the insurance organizations and the health system that occurs when each player considers the decisions made by another player. Also, the optimal behavioral strategies containing best outcomes were introduced. Then a health insurance mechanism based on game theory was designed.

## Results

In the qualitative phase of the study, after interviewing two groups of insurance experts in insurance organizations (20 people) and health system (13 people), 620 codes were extracted. The codes were classified into 3 main categories and 11 sub-categories according to Table 1.

**Table 1.** Interactive categories and subcategories between insurance organizations and the health system

| Main category   | Category                     | Subcategory  |
|---|------------------------------|--|
| The interaction between insurance organizations and the health system | Behavioral and communicative | Lack of affective interaction between hospital and insurance organizations |
|   |                              | Insufficient commitment of hospitals' personnel                            |
|   |                              | Insufficient commitment of insurance organizations                         |
|   | Structural                   | Existence of various insurance organizations                               |
|   |                              | Personnel's lack of knowledge about insurance policies                     |
|   |                              | Repeated changes to the insurance rules and circulars                      |
|   |                              | Lack of administrative facilities necessary for insurance agents           |
|   | Financial                    | Lack of different HIS systems in the hospital structure                    |
|   |                              | A random check of the files  |
|   |                              | Delay in payments by insurance organizations                               |
|   |                              | Deductibles  |

In the quantitative phase of this study, 35 games and behavioral strategies in accordance with codes were designed. All of the experts working in both the insurance organizations and the health system who were involved in insurance affairs were studied. The sample included 82 people among whom 36 (43.9%) were men and 46 (56.1%) were

women. 48.8% of the participants were from insurance organizations, and 51.2% were from health system experts. The undergraduate with 59.8% had the highest frequency. The average age of the experts was 36.98 years old, and the average work experience was 12.85 years.

## The Insurance Mechanism Based on Game Theory

After entering the questionnaire data into the SPSS24 software, the frequency percentage of the response to each game from the two groups of insurance organizations and the health system was

inserted into GAMBIT software, and the marginal benefit of the optimal interactive behavioral strategies (Nash equilibrium) for two insurance organizations and health system were extracted.

**Table 2.** Optimal interactive behavioral strategies (Nash equilibrium) between insurance organizations and the health system in the behavioral and communicative category

| Sub-category   | Optimal interactive behavioral strategy (Nash Equilibrium)  | The marginal benefit of the insurance organizations | The marginal benefit of the health system |
|--|---|---|---|
| Lack of affective interaction between hospital and insurance organizations | Hospital administrators hold more joint meetings with insurance managers to reduce interagency problems and challenges.   | 50 percent  | 50 percent                                |
|  | If the hospital personnel commit themselves to respond to the insurance agents, the insurance organizations will provide them with incentives.                  | 50 percent  | 97 percent                                |
|  | More individual and organizational interaction from the insurer leads to a reduction in deductibles for the hospital.   | 100 percent   | 95 percent                                |
| The insufficient commitment of the hospital staff                          | If the hospital personnel commit themselves to responding to the insurance agents, there will be less filing inaccuracies.                                      | 92 percent  | 93 percent                                |
|  | If the hospital personnel treat the insurance agents with respect, insurance administrative processes will face fewer problems.                                 | 95 percent  | 95 percent                                |
|  | If the hospital personnel classify files in order, insurance agents can handle files more quickly.  | 100 percent   | 95 percent                                |
|  | The training given to the hospital personnel by insurance organizations should be passed on to other employees in order to reduce the inconsistencies in bills. | 100 percent   | 95 percent                                |
| The insufficient commitment of insurance personnel                         | If insurance agents do not deal with files based on their personal opinions, hospital personnel would voluntarily correct inaccuracies found in files.          | 50 percent  | 50 percent                                |

**Table 3.** The optimal interactive behavioral strategies (Nash equilibrium) between the insurance organizations and the health system in the structural category

| Sub-category                                     | Optimal interactive behavioral strategy(Nash equilibrium)   | The marginal benefit of the insurance organizations | The marginal benefit of the health system |
|--|---|---|---|
| The existence of different kinds of insurances   | If Insurances define unified rules and obligations, it is easier for the hospital personnel to respond and decide on insurance affairs.             | 50 percent  | 50 percent                                |
|  | Private insurances (non-governmental funding) provide better quality and financial services to the hospital.  | 57/5 percent  | 52 percent                                |
|  | Despite the variety of insurance, if the same franchise fees be set up for all insurance, hospitals would be less confused about insurance affairs. | 97 percent  | 100 percent                               |
|  | If the Hospital staff have more knowledge of insurance policies, the hospital will undergo less deductible from the insurance organizations.        | 100 percent   | 100 percent                               |
| Personnel's lack of knowledge of insurance rules | If hospital personnel be more careful in entering patients information, the bills sent to the insurance will face less deductible.                  | 95 percent  | 95 percent                                |
|  | The higher the average age of the hospital staff be, the sooner the hospital would match with insurance updates.                                    | 65 percent  | 65 percent                                |
|  | If there be fewer changes in insurance laws during a year, hospitals would faster update and match with the new rules.                              | 50 percent  | 50 percent                                |
| The lack of administrative facilities            | If there be less changes in insurance laws during a year, hospital personnel would remember insurance laws to a greater extent.                     | 50 percent  | 50 percent                                |
|  | If the hospital provides the insurance agents with more office facilities, the insurance affairs will run faster.                                   | 95 percent  | 90 percent                                |
|  | If the hospital provides the insurance agents with office supplies, the insurance affairs will run faster.  | 92/5 percent  | 100 percent                               |
| The existence of HIS systems in hospitals        | If all the hospitals have a unified HIS system, insurance laws and circulars in hospital systems would be updated faster.                           | 50 percent  | 50 percent                                |
|  | HIS systems should match the hospital's needs for insurance affairs to run faster.  | 95 percent  | 93 percent                                |

**Table 4.** Optimal interactive behavioral strategies (Nash equilibrium) between insurance organizations and the health system in financial and deductibles category

| Sub-category                                    | Optimal interactive behavioral strategy(Nash Equilibrium)   | The marginal benefit of the insurance organizations | The marginal benefit of the health system |
|---|---|---|---|
| A random check of the files                     | If insurance agents check the files randomly and then generalize them, the hospital would face fewer deductibles.                               | 65 percent  | 83 percent                                |
| Delay in payment by the insurance organizations | If the hospital personnel send the documents earlier to the insurance organizations, there will be less delay in payments by the insurance      | 77/5 percent  | 79 percent                                |
|   | If the Hospital personnel send insurance documents correctly, insurance will impose fewer deductibles on files.                                 | 77/5 percent  | 86 percent                                |
|   | If hospitals do not have payment delays, the hospital will pay for the actual price of the equipment purchased.                                 | 75 percent  | 83/5 percent                              |
|   | If the personnel record documents and the doctor's orders in files, the insurance will not impose deductibles on bills.                         | 97/5 percent  | 93 percent                                |
|   | If the hospital staff record lab results and nurse's reports in files, they would not face deductibles from the insurance organizations.        | 95 percent  | 90 percent                                |
|   | If the personnel record the attachments of the services for the patients in files, insurance will not impose deductibles on bills.              | 85 percent  | 90 percent                                |
|   | If Insurance does not provide doctors with facilities and privileges, they will apply for extra pay in the operating report.                    | 75 percent  | 82 percent                                |
| Deductions                                      | If doctors ask for extra pay in operating report besides deductibles, the insurance organizations should consider fining doctors.               | 67 percent  | 81 percent                                |
|   | If the personnel enter the scheduled time for anesthesia according to the operating report, insurance will not impose deductibles on bills.     | 87/5 percent  | 90/50percent                              |
|   | If doctors and nurses enter extra codes in files, insurance would include deductible upon discovering that.                                     | 80 percent  | 93 percent                                |
|   | If the drug mentioned in the prescription is the same as the drug used, the insurance will not impose deductibles.                              | 85 percent  | 93 percent                                |
|   | If the drug mentioned in prescription is not covered by insurance, it will result in deductibles by insurance.                                  | 50 percent  | 50 percent                                |
|   | For a doctor who is not a 2K doctor and requests special payment for 2k, insurance should impose special tariffs.                               | 75 percent  | 81 percent                                |
|   | If a letter confirming the doctor's 2k is later sent to the insurance organizations, the organizations should pay for the difference in tariff. | 87/5 percent  | 90/5 percent                              |

**Discussion**

This research showed a framework of interactive behavioral strategies between the health system and insurance organizations. In Table 1, 35 games were designed and presented in 3 main categories and 11 sub-categories. Finally, optimal interactive behavioral strategies (Nash equilibrium) were extracted and

introduced for each game separately to insurance organizations and the health system. The subcategories covered a wide range of issues, in such a way that in some cases it was difficult to differentiate them from those presented in other subcategories. In the present study, individual and organizational relationships from both organizations

did not seem very satisfactory. As the results of a study showed, the relationship between insurance organizations and health system is built through a binding contract, and the parties do not have the right to terminate, which is one of the most important components of a contract. The right to terminate is one of the most important legal recourses that requires the parties to comply with terms of the contract, and if the contract is breached by one side, the other side can use this tool to avoid further losses, force them to comply with the contract or terminate the contract, with which they are no longer happy due to the other side's breaching (13). The results showed that if hospital personnel were committed to respond to insurance agents and treated them with more respect, files inaccuracies would be reduced. Also, classifying and regular sending of documents will allow insurer agents to handle files faster. It was stated in a research that the use of staff nurses in medical documentation unit to better examine the patient's files can be a solution to the problems of documentation (14). In a study, the results showed that the cooperation of insurance agents with hospital personnel, especially the income personnel, could reduce the workload of the agents, because in the case of problems in files, processing of documents would be delayed (15). In the present study, the results indicated that in cases where insurance agents handle files based on their personal opinions, the hospital personnel would not be willing to correct inaccuracies. In the event of the integration of different types of insurance, it will be easier for hospital staff to respond and decide on insurance affairs. The results of a study similar to this study showed that non-payment of bills by insurance organizations caused the dissatisfaction of hospitals and their distrust of patients and insurers (16). In the present study, it was stated that delay in payments by insurers would make hospitals pay more than the actual price for buying hospital equipment. Hospital deductibles are the main subcategory of the present study. Factors such as carelessness of personnel in entering information, doctors' request of extra pay, 2K

doctors, misrecording time or duration of patient's anesthesia, failure to file nursing reports, laboratory reports, imaging reports, and non-attachment of actions and services performed on the patient with no documentation included in the file are the main subcategories of the discussion on deductibles. The results of the study indicated that the agents were also dissatisfied with the doctors' repeat of the request for extra pay for anesthesia and surgery every month because this adds to their workload (17). Due to the fact that the tariffs are not actual, doctors sometimes request extra pay in their reports, and hospital deductibles increase. As in a study, the insurance organizations accused the doctors of abusing the pay system by entering additional codes (18). In another study, the underlying factors of deductible were identified to be the educational and governmental feature of the hospital and problems in treatment and income units (4), which is close to the results of the present study. In this study, one of the reasons for the educational hospitals to face deductibles is students' mistakes. The results of a study showed that due to the educational and governmental nature of the hospitals, there are serious inaccuracies in entering information in files because of hospital's overcrowding, lack of responsible students and interns and training (19, 20). In another study, another reason for deductibles is carelessness of income and accounting staff whose accounts of services are incomplete and do not care to complete files (19). Lack of incentive policies have been identified as another cause of deductibles, which is consistent with the results of the study at the University of Missouri, USA (21). The limitations of this study are the lack of studies related to the interaction between insurance organizations and the health system, as well as the application of the game theory to these issues. Also, non-participation of some key beneficiaries in both qualitative and quantitative phases of both the insurance organizations and the health system can affect the generalization of the results.



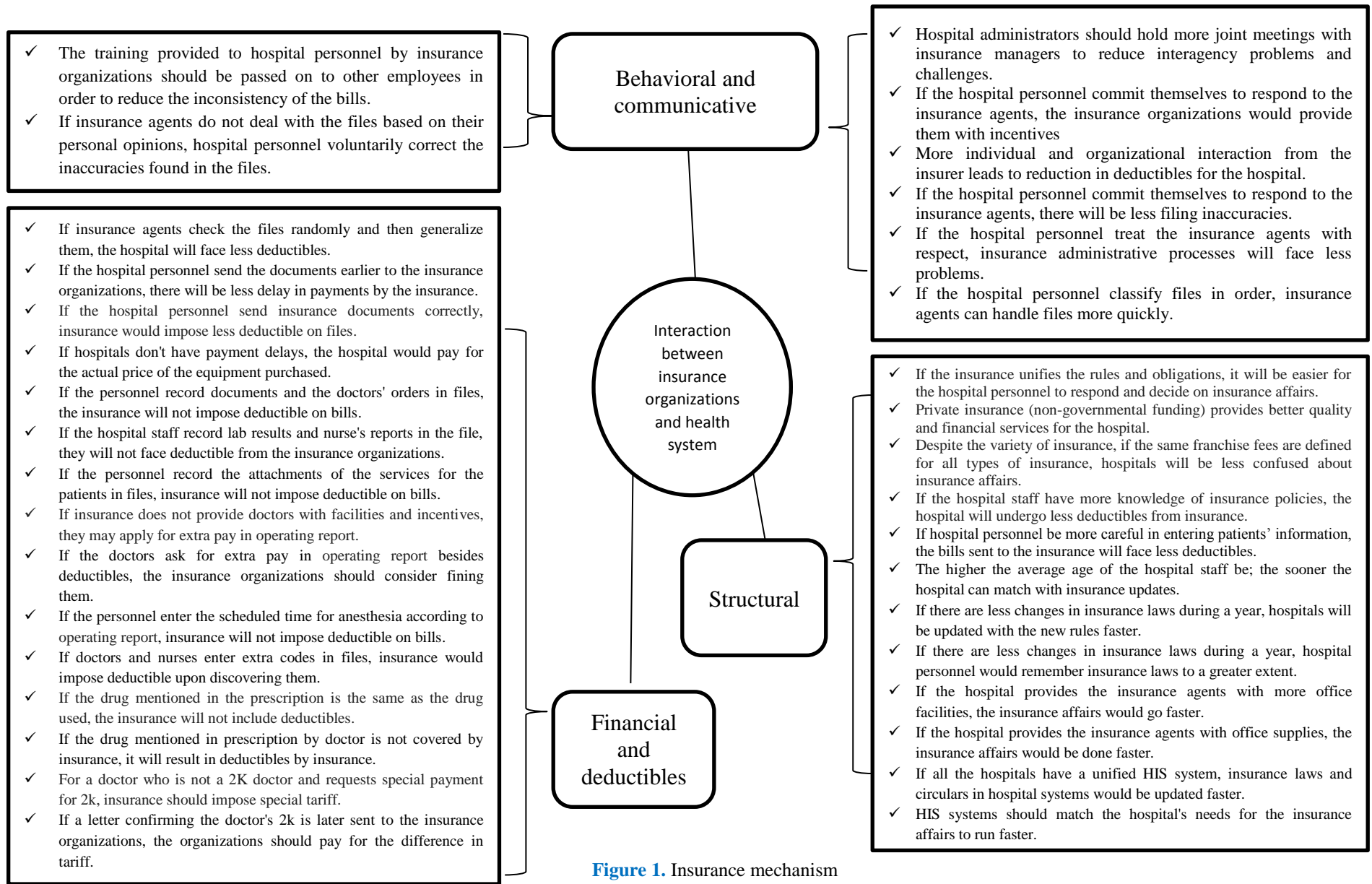


Figure 1. Insurance mechanism

## Conclusion

The results of this study showed that the health system, and in particular hospitals and, on the other hand, insurance organizations in order to eliminate or reduce problems between them, should try to establish effective communication through the insurance mechanism provided. The main difference between the two organizations, which is the cause of later problems, is deductible. Organizations can help reduce these deductibles by providing correct training as well as integrating systems and reducing disparities between various insurances. Best optimal behavioral strategies in the interaction between insurance organizations and the health system to cover the gaps in the insurance system and improve the interaction between the two organizations in the form of optimal interactive Strategies are provided in

Tables 2 to 4 and Figure 1 to provide the insurance mechanism for the two insurance organizations (11 strategies) and the health system (24 strategies) separately.

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## Conflict of Interest

No conflicts of interest have been reported by the authors.

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