

# Fostering Risk Management in Healthcare Units using Grey Systems Theory

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# Road Map

**1**

**Introduction**

**2**

**Hospital's Risk Management Assessment**

**3**

**Grey Incidence Analysis**

**4**

**Case Study**

**5**

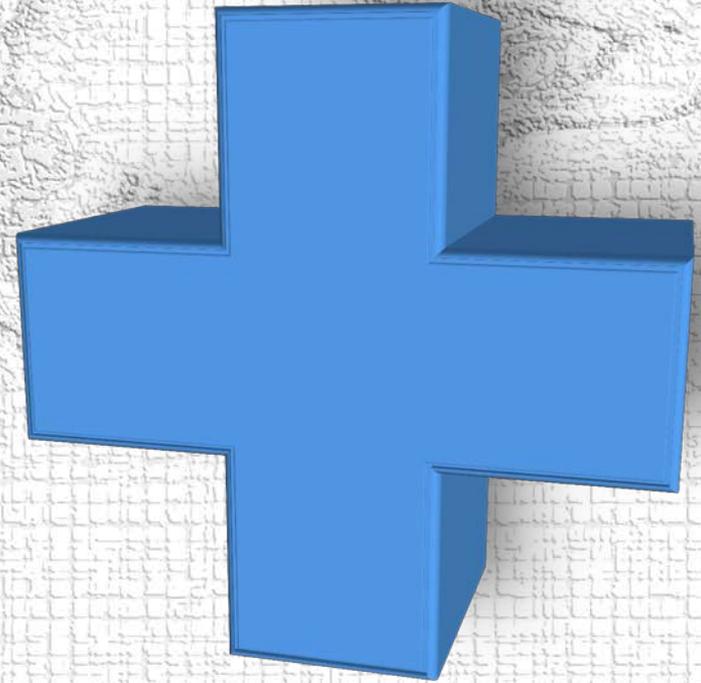
**Concluding Remarks**

# Introduction

- **Healthcare risks** take into account any event or action that may adversely affect the hospital ability to achieve its **strategic objectives** and properly execute its activities.
- Moreover, even the hospitals are facing **financial costs** of these adverse events that take the form of additional treatments and days of hospitalization, therefore, representing one of the main aspects that requires continuous monitoring.
- For this, **healthcare risk management** involves a future-oriented focus on understanding the **links between risks** and how their expression affects the wellbeing of patients.

# Introduction

- The **healthcare units** provides medical services through the followings public and private units:
  - » hospitals,
  - » dispensaries,
  - » clinics,
  - » nursing homes,
  - » diagnostic and treatment centers,
  - » outpatient medical offices,
  - » laboratories,
  - » nursing homes,
  - » pharmacies and pharmaceutical points.
  
- **The hospitals** are medical units with beds, with legal personality which provides medical services, ensuring the population health.



# Introduction

- The **hospital risk management** is essential for the performance and successful of the hospital's, especially through the analysis performed to identify the causes that lead to an adverse risk event.
- It is a process that appeared in England in the early 90s as a consequence of numerous cases of **malpractice** and **represents a solution** to provide: the best quality in healthcare and secure systems design.
- **Risk management in healthcare** means all processes by which it is identified, analyzed, mitigated, or avoided a risk that could affect the financial condition of a hospital or physicians.



# Next

1

Introduction

2

**Hospital's Risk Management Assessment**

3

Grey Incidence Analysis

4

Case Study

5

Concluding Remarks

# Hospital's Risk Management Assessment

- **Risk Management Assessment** in a healthcare unit include:
  - Identification of the **vulnerable aspects** of the healthcare management process;
  - Creation of the **key risk indicators sets** for each of the identified aspect;
  - Periodically **measurement** of the key risk indicators;
  - Observation of the **modifications** that may occur in time;
  - Determination of the hospital's **risk exposure degree**.
  
- **Creating** and applying the necessarily **policies** in order to manage the risk;
- **Continuous monitoring**.

# Main Risk Categories

## Main Risk Categories

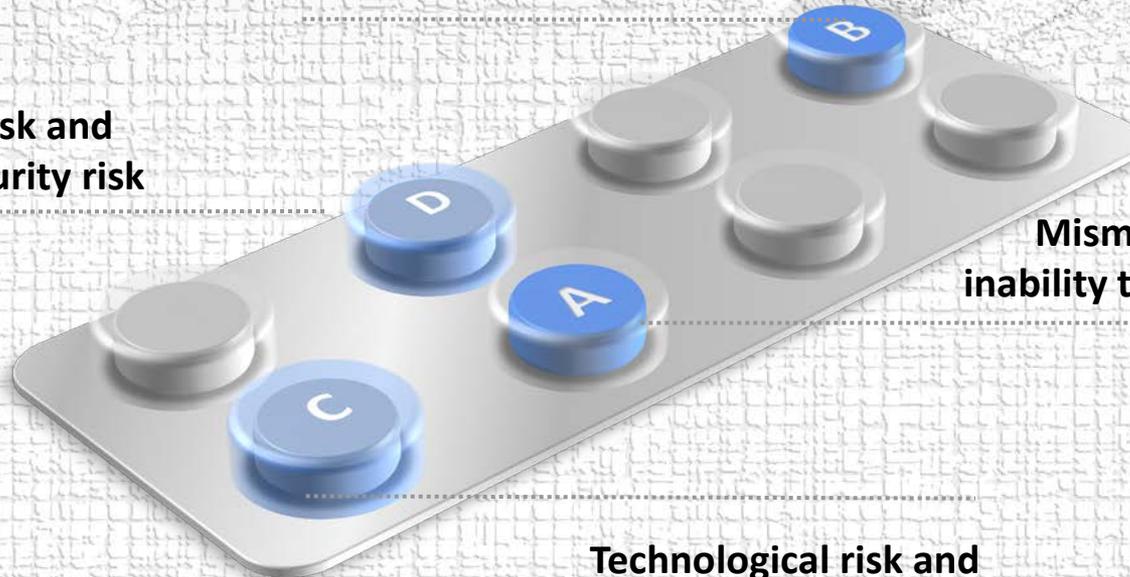
4 main risk categories have been identified and measured

**Human resource risk and the clinical risk**

**Cyber security risk and information security risk**

**Mismanagement risk and inability to threat patient risk**

**Technological risk and hospital conditions risk**



# Main Risk Categories

## ▪ **Mismanagement risk and inability to threat patients risk:**

- » the ability to manage the human and material resources, ensuring the quality and safety of healthcare, encouraging the development and continuous improvement of medical staff,
- » the development of emergency services,
- » the diversification of services provided to patients, improving the laboratory services, creating a risk culture,
- » efficient allocation of tasks,
- » the adoption of EU quality standards,
- » the design of good practices guides,
- » the infrastructure modernization and rehabilitation,
- » employment expenses within approved budget, donations attraction, control of economic and financial compliance,
- » the average waiting time of patients,
- » the number of ambulances and helicopters dedicated to emergencies,
- » the adequacy of medical staff per shift and the number of operating rooms in the hospital.

# Main Risk Categories

- **Key Risk Indicators** for the Mismanagement risk and inability to threat patients risk:
  - » Average length of stay in hospital =  $\text{patient days of hospitalization} / (\text{patients at the beginning} + \text{patients hospitalized during the period})$
  - » The proportion of hospitalized patients from patients treated in emergency room =  $\text{hospitalized patients} / \text{patients treated in emergency room} * 100$
  - » ROA (return on assets) =  $(\text{The net result for the year} / \text{Total assets} * 100)$
  - » The percentage of surgery rooms in total hospital rooms =  $\text{No. surgery rooms} / \text{No. hospital rooms} * 100$
  - » % good practice guides =  $\text{No. good practice guides} / \text{Planned number of the good practice guides}$
  - » No. of physicians in total employees =  $\text{No. physicians} / \text{Total employees} * 100$

# Main Risk Categories

## ▪ Human resource risk and clinical risk:

- » the medical staff participation in training courses, the interest for research,
- » creating of an organizational framework that encourages the cooperation between medical staff,
- » the medical staff satisfaction,
- » the incentives based on key performance indicators, the adequate environment to evolve, unlocking the vacant positions,
- » the correlation between the diagnosis at the admission and the one after 72 hours, assuming responsibilities,
- » the doctor-patient relationship,
- » the ability to distinguish between different physicians productivity,
- » attracting valuable medical personnel with training in complex and rare areas, the procedural compliance,
- » respecting the organizational ethics, the insurance for malpractice, sanctioning the errors and mistakes, quick resolution of patients complaints, avoiding processes through mediation, providing medical information about the patient's health, ensuring the patients safety, the health law knowledge.

# Main Risk Categories

- **Key Risk Indicators** for human resource risk and clinical risk:
  - » The diagnosis concordance index =  $\frac{\text{No. of consistent diagnoses}}{\text{No. treated patients}} * 100$
  - » Frequency of doctoral studies among physicians =  $\frac{\text{No. Physicians with PhD}}{\text{Total no. of physicians}} * 100$
  - » Percentage of physicians interested in research =  $\frac{\text{No. of physicians interested in research}}{\text{Total number physicians}} * 100$

# Main Risk Categories

## ▪ **Technological risk and hospital conditions risk:**

- » the infrastructure modernization and rehabilitation,
- » the thermal rehabilitation,
- » the intensive care development,
- » the supply of drugs, blood, tissues and organs, the medical equipment,
- » the number of elevators adequacy to the average number of patients/day,
- » the evacuation plans for natural disasters and fire,
- » ensuring the adequate number of fire extinguishers and hydrants,
- » the controls of the electric generators.

# Main Risk Categories

- **Key Risk Indicators** for technological risk and hospital conditions risk:
  - » Bed utilization rate =  $(\text{patient hospitalization days} / \text{average number of beds}) / 365$
  - » The supply frequency with drugs, blood, tissues and organs =  $\text{Average stock} / \text{Materials cost} \times 365$
  - » Percentage of functional equipment in the hospital =  $\text{The number of functional medical equipment} / \text{The total number of medical devices} \times 100$
  - » The nosocomial infections rate (or the “hospital-acquired infections”) =  $\text{No. patients with nosocomial} / \text{No. treated patients} \times 100$
  - » The average number of patients per day per number of elevators =  $\text{The average number of patients per day} / \text{Number of elevators}$

# Main Risk Categories

## ▪ **Cyber security risk and the information security risk:**

- » the security of personal data, data on the patient's condition, data of patients examinations, diagnosis, treatment and prognosis, the migration to cloud, the restricting access to the database, the network failure management,
- » the careful recruitment of staff, the software purchasing, the periodic system updates and the controls of data
- » users' unique identification, password on every equipment
- » the possibility of erasing some information from the distance
- » the development of algorithms for detecting cybernetic threats and attacks

## ▪ **Key Risk Indicators** for cyber security risk and the information security risk:

- » The controls frequency in one year =  $\text{No. of controls per year} / \text{The planned no. of controls} * 100$
- » Cyber security risk transfer = the existence of an insurance policy for the confidentiality and security risk

# Next

1

Introduction

2

Hospital's Risk Management Assessment

3

**Grey Incidence Analysis**

4

Case Study

5

Concluding Remarks

# Grey Incidence Analysis

Grey incidence analysis is a central piece of grey system theory and it also can be considered the foundation for grey modeling, decision making and control.

## 1) The Absolute Degree of Grey Incidence

Assume that  $X_0$  and  $X_j, j=1..n$ , are two sequences of data with non-zero initial values and with the same length, with  $t =$  time period and  $n =$  variables:

$$X_0 = (x_{1,0}, x_{2,0}, x_{3,0}, x_{4,0}, \dots, x_{t,0}), \quad (1)$$

$$X_j = (x_{1,j}, x_{2,j}, x_{3,j}, x_{4,j}, \dots, x_{t,j}), \quad (2)$$

The images of zero-start points are:

$$X_j^0 = (x_{1,j} - x_{1,j}, x_{2,j} - x_{1,j}, \dots, x_{t,j} - x_{1,j}) = (x_{1,j}^0, x_{2,j}^0, \dots, x_{t,j}^0) \quad (3)$$

The absolute degree of grey incidence is given by:

$$\varepsilon_{0j} = \frac{1 + |s_0| + |s_j|}{1 + |s_0| + |s_j| + |s_0 - s_j|} \quad (4)$$

where  $|s_0|$  and  $|s_j|$  are computed as follows:

$$|s_0| = \left| \sum_{k=2}^{t-1} x_{k,0}^0 + \frac{1}{2} x_{t,0}^0 \right| \quad (5)$$

$$|s_j| = \left| \sum_{k=2}^{t-1} x_{k,j}^0 + \frac{1}{2} x_{t,j}^0 \right| \quad (6)$$

# Next

**1**

Introduction

**2**

Hospital's Risk Management Assessment

**3**

Grey Incidence Analysis

**4**

**Case Study**

**5**

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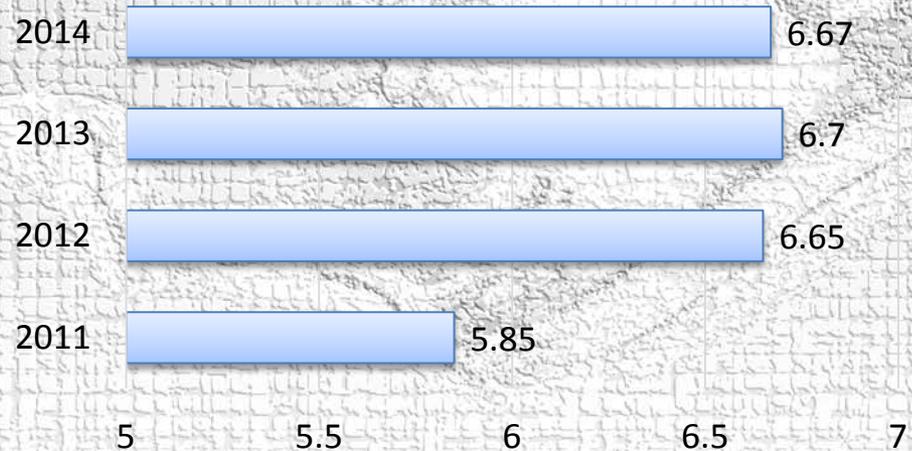
# Case Study

- **Emergency regional hospital, Oradea City, Bihor County, Romania**
  - » Annually – specialized medical assistance for more than 183.000 persons;
  - » 6 buildings;
  - » 885 beds;
  - » Covers 27 medical areas;
  - » 8 laboratories and investigation departments.
- **Data collected: 2011-2014.**
- **Key Risk Indicators:**
  - » **Mismanagement risk and inability to treat patients risk:** The proportion of hospitalized patients from patients treated in emergency room
  - » **Human resource risk and clinical risk:** The diagnosis concordance index
  - » **Technological risk and hospital conditions risk:** a) Percentage of functional equipment in the hospital and b) The nosocomial infections rate
  - » **Cyber security risk and the information security risk:** The controls frequency in one year
- **Hospital Services Quality Indicator:** Hospital's (negligence) compensation claims:
  - » The amount paid for moral and material damage as a result of court judgments in one year / The recorded profit in the year \* 100

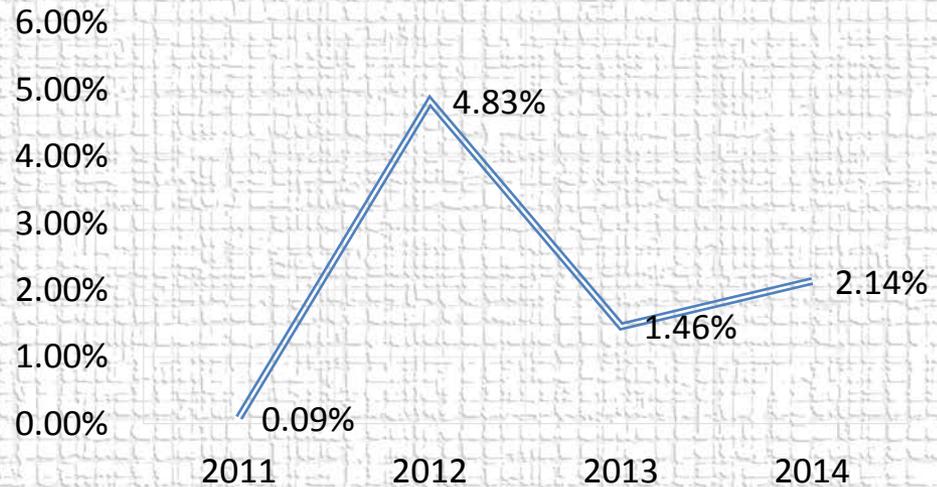
# Case Study

- **Mismanagement risk and inability to threat patients risk**

**Average length of hospitalization**



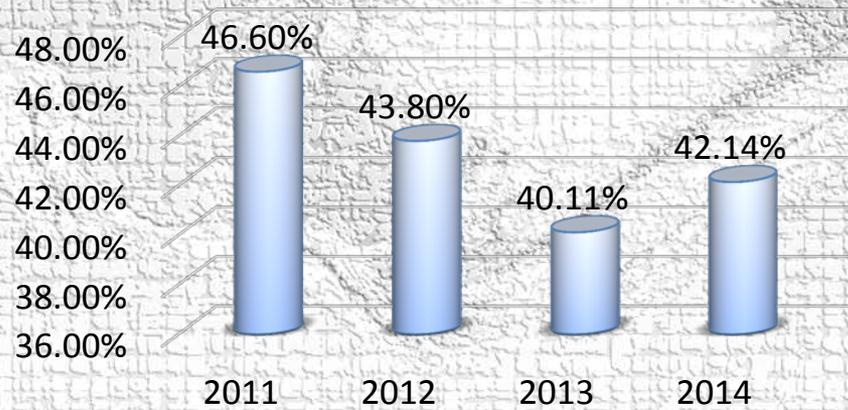
**ROA**



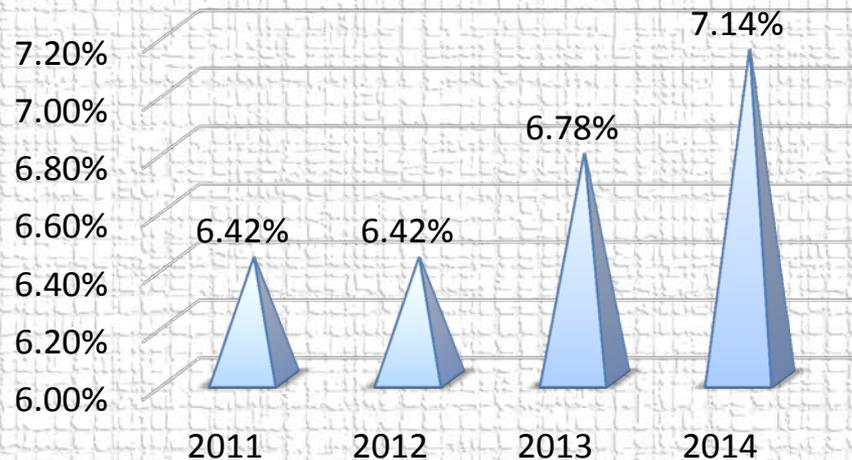
# Case Study

- **Mismanagement risk and inability to threat patients risk**

**The proportion of hospitalized patients**



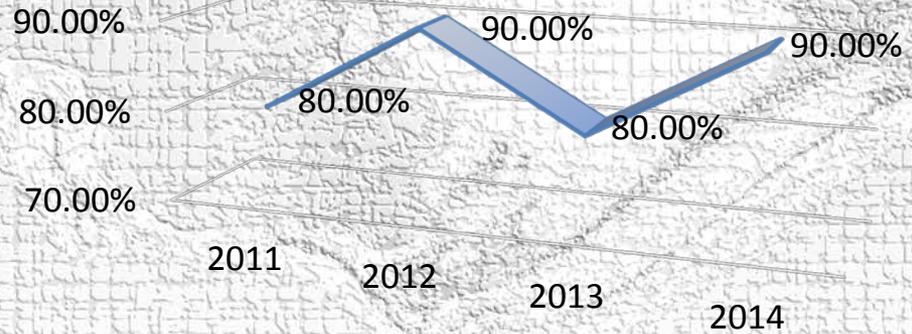
**Surgery rooms**



# Case Study

- **Mismanagement risk and inability to threat patients risk**

### Good Practice Guides

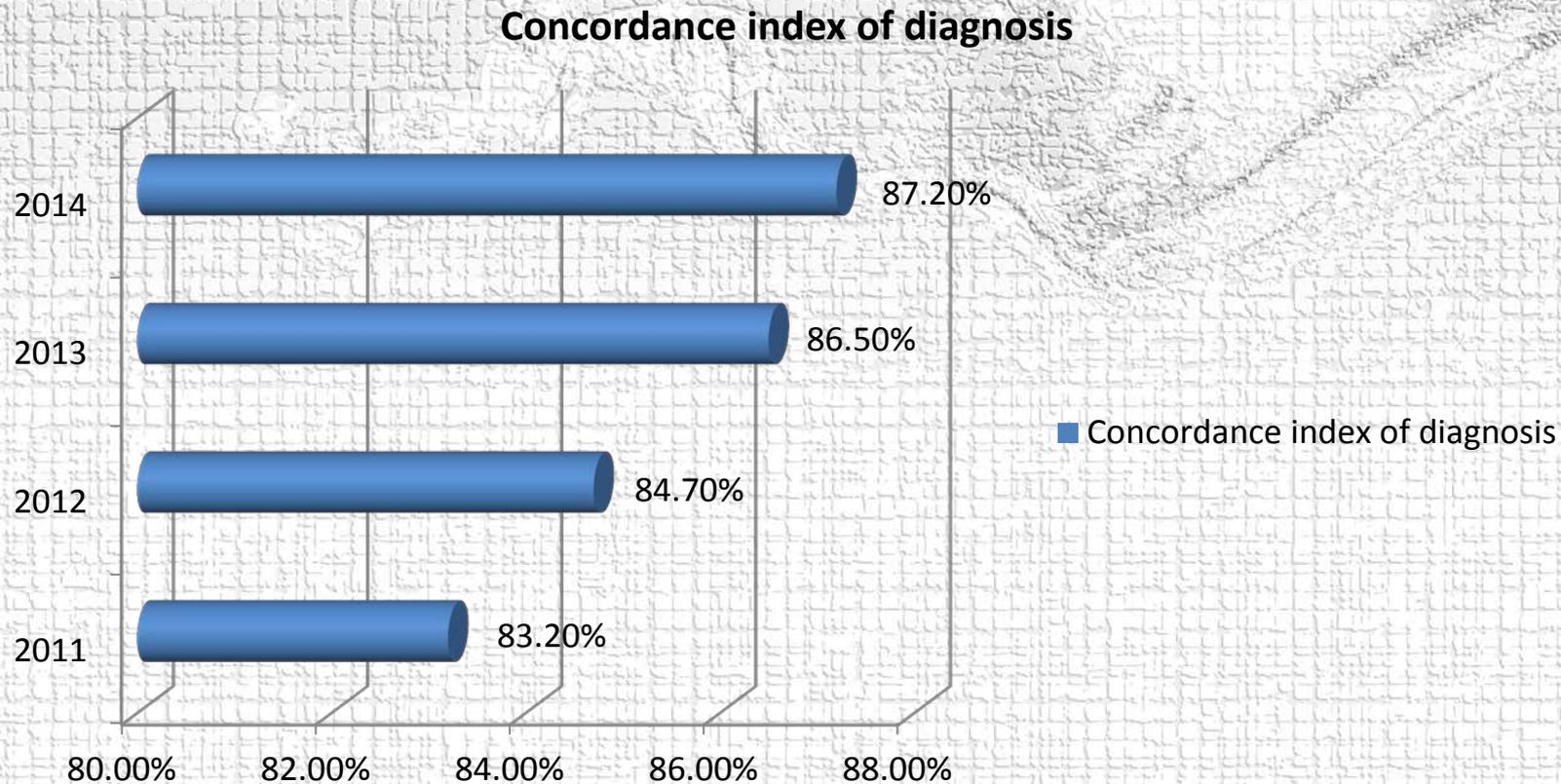


### Physicians



# Case Study

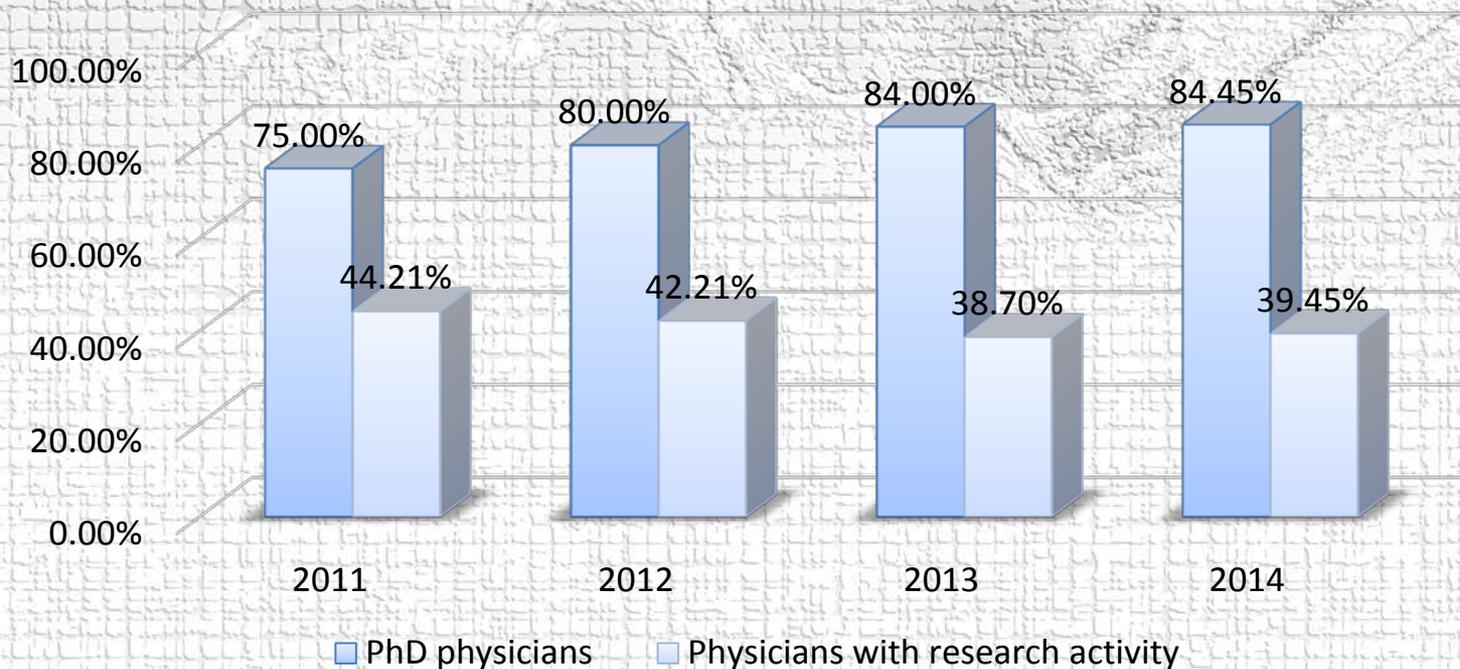
## ▪ Human resource risk and clinical risk



# Case Study

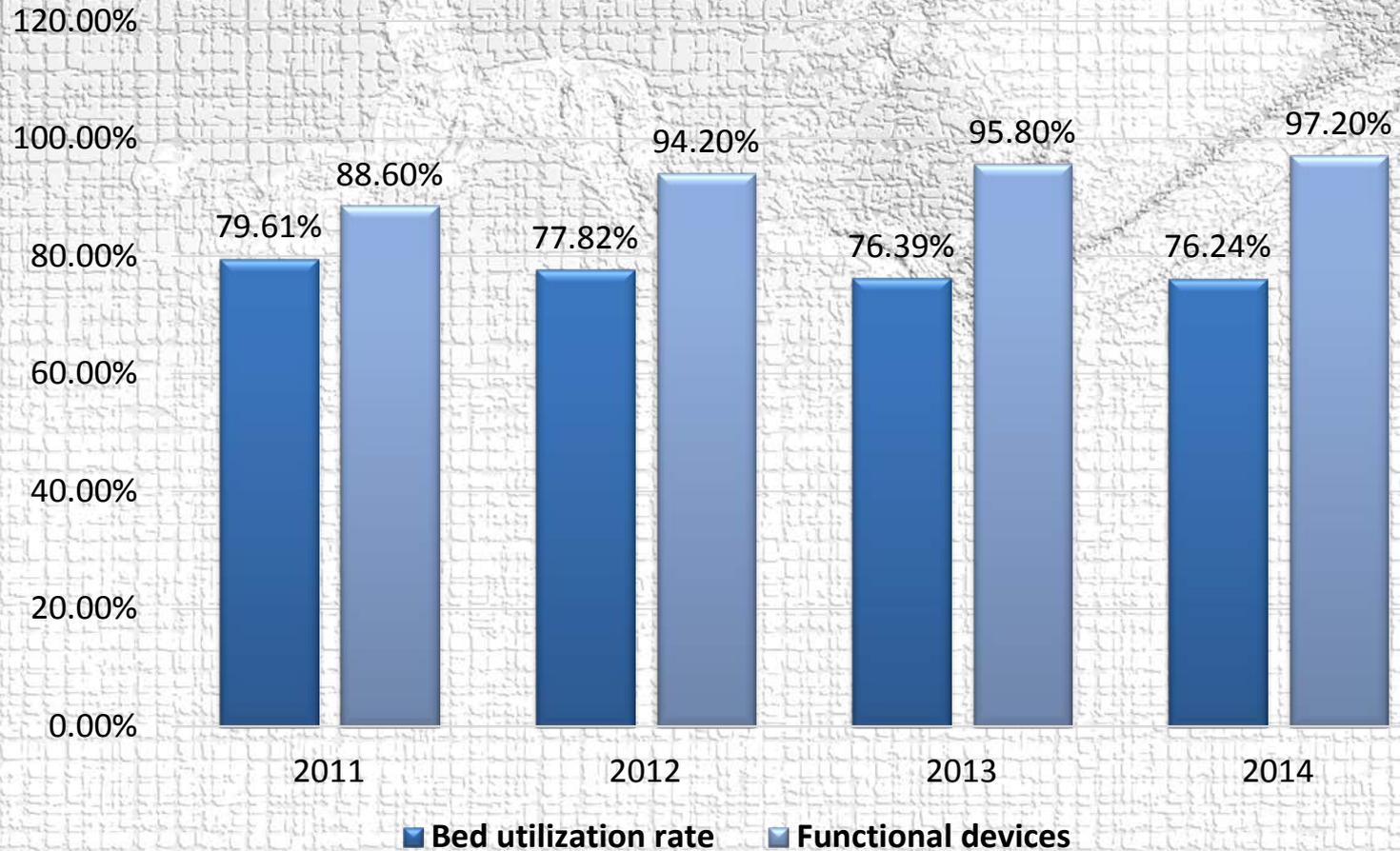
## ▪ Human resource risk and clinical risk

### Physicians in total employees



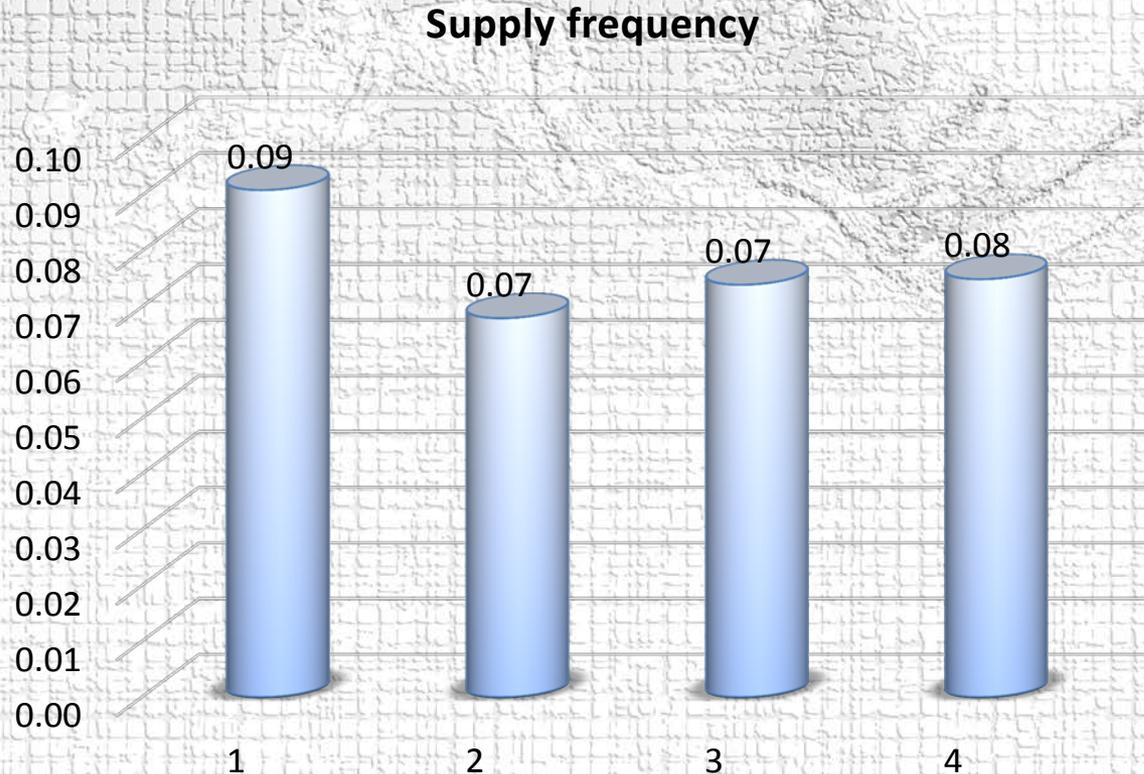
# Case Study

## ▪ Technological risk and hospital conditions risk



# Case Study

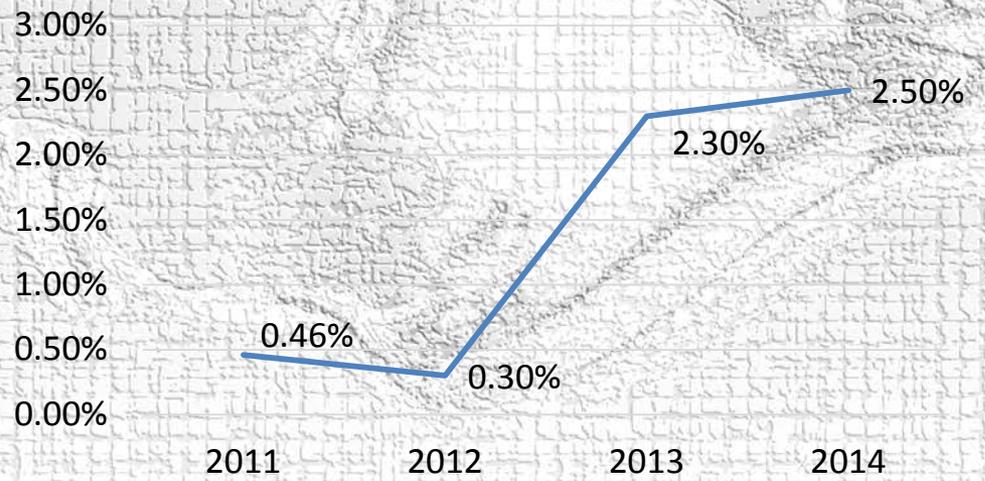
## ▪ Technological risk and hospital conditions risk



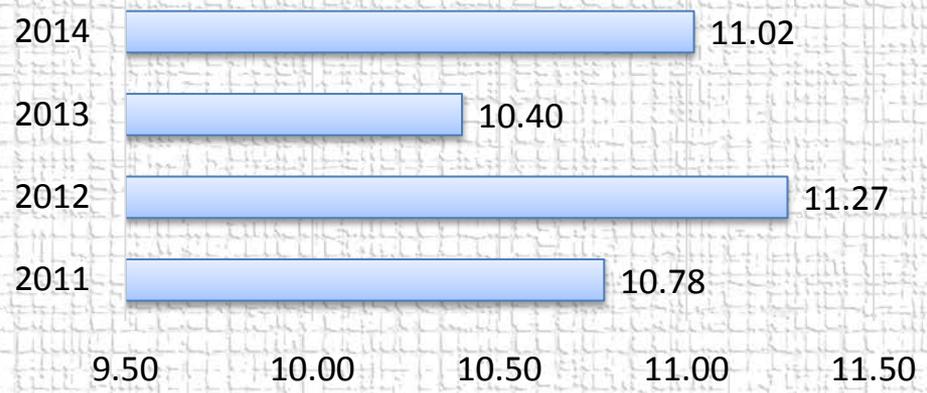
# Case Study

## ▪ Technological risk and hospital conditions risk

### Nosocomial infection rate



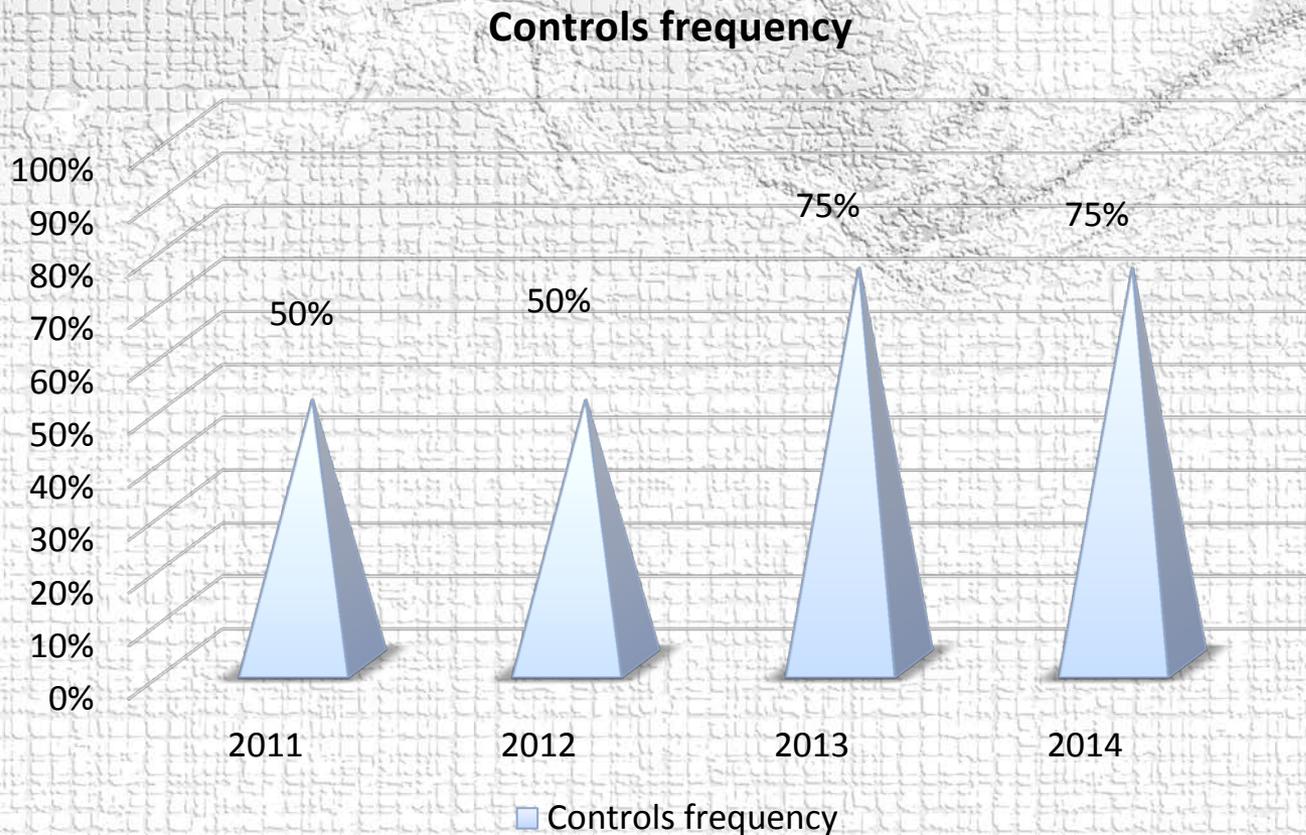
### Patient per elevator



■ Patient per elevator

# Case Study

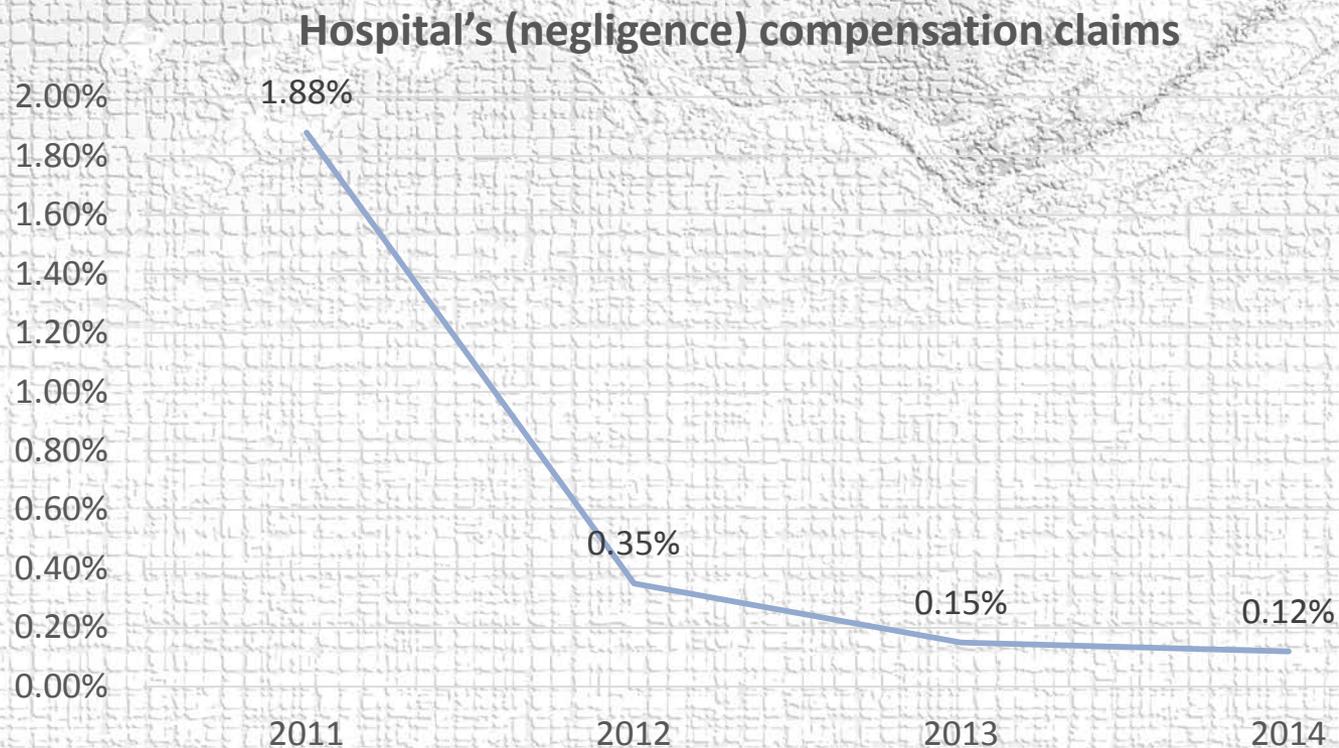
## ▪ Cyber security risk and the information security risk



# Case Study

## ▪ Hospital Services Quality Indicator:

- » The amount paid for moral and material damage as a result of court judgments in one year / The recorded profit in the year \* 100



# Case Study

## ▪ Grey Incidence Analysis

### ▪ Key Risk Indicators:

- » **Mismanagement risk and inability to treat patients risk:** The proportion of hospitalized patients from patients treated in emergency room
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- » **Cyber security risk and the information security risk:** The controls frequency in one year

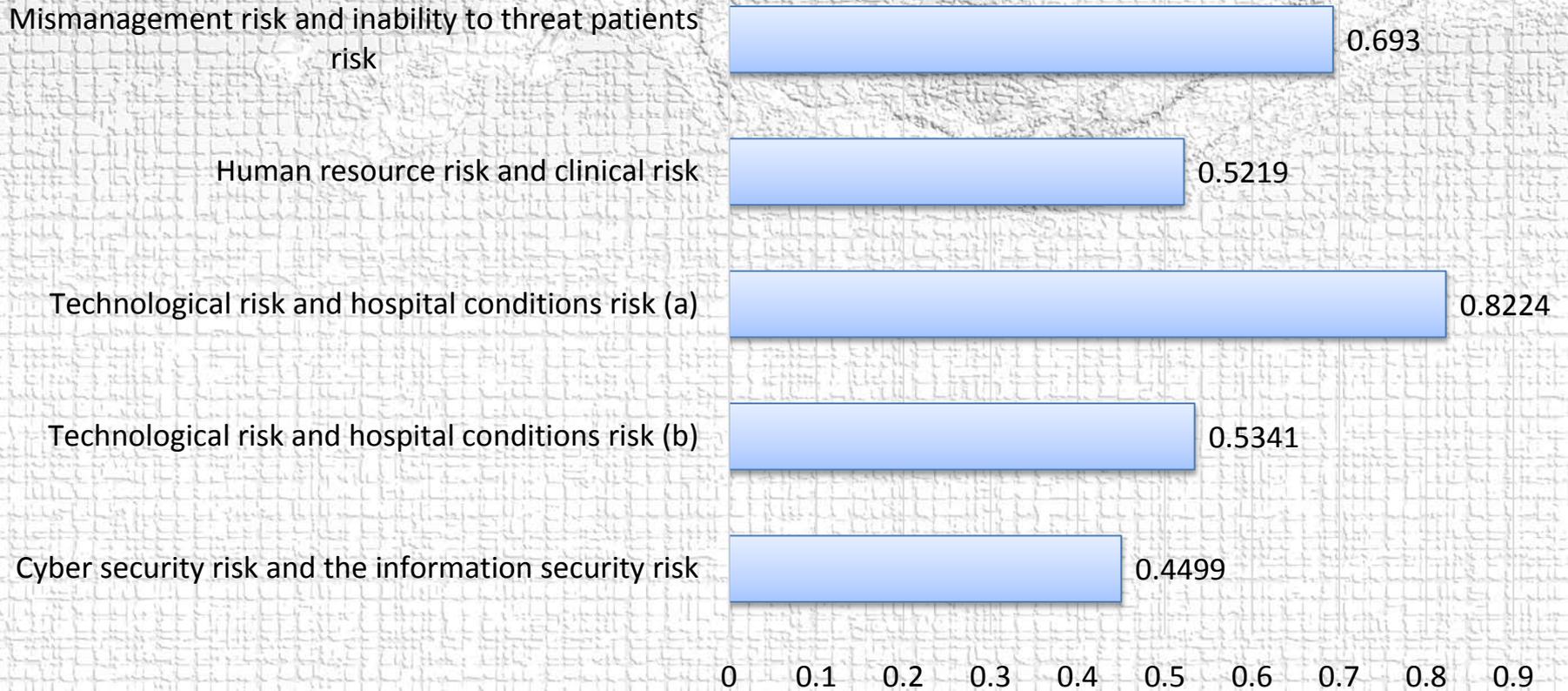
### ▪ Hospital Services Quality Indicator: Hospital's (negligence) compensation claims:

- » The amount paid for moral and material damage as a result of court judgments in one year / The recorded profit in the year \* 100

# Case Study

## ▪ Grey Incidence Analysis

### Hospital Services Quality Indicator



# Next

1

Introduction

2

Hospital's Risk Management Assessment

3

Grey Incidence Analysis

4

Case Study

5

Concluding Remarks

# Concluding Remarks

- It can be seen that the main incidence on the **hospital services quality** indicator considered in this research is given by the **technological risk** and hospital conditions risk, namely the **hospital functional equipment** component (with a value of 0.8224 obtained for the absolute degree of grey incidence).
- The **mismanagement risk** and inability to threat patients risk and the component regarding the presence of the **nosocomial infections** from the technological and **hospital conditions risks** have the second and the third influence on the hospital's service quality, which can make us conclude that the hospital's manager **should focus more on these two risk categories** in order to improve the quality of the provided services.

