

# The Evaluation Module of the Crisis Preparedness for the Hospitals

Katerina Vichova, Martin Hromada

**Abstract**—This paper is focused on the evaluation module of the crisis preparedness for the hospitals. At the first part of the paper, we describe the situation about security threats and crisis preparedness of the hospital. Based on this introduction we can say, that there is no evaluation system or tool, which evaluate the crisis preparedness of the hospital in times of crisis. In this paper, we assess the selected hospital and their crisis preparedness in the area of the emergency supplies. At the last of the paper, we propose a new evaluation module of the crisis preparedness for the hospitals. This part shows a few diagrams of how the module could evaluate. There is the part with the feedback – hospital, and supplier. At the end of the paper is the discussion about the crisis preparedness.

**Keywords**—crisis preparedness, hospital, evaluation module, information system, emergency management.

## I. INTRODUCTION

THE Czech Republic has a list of the security threats. To this security threats belongs weakening the cooperative security mechanism and political and international legal obligations in the field of security; instability and regional conflicts in the Euro-Atlantic area and its surroundings; terrorism; the proliferation of weapons of mass destruction and their means of delivery; cyber-attacks; negative aspects of international migration; extremism and an increase in Internet and social tensions; organized crime, particularly severe economic and financial crime, corruption, trafficking in human beings and drug crime; threats to the critical infrastructure functionality; interruption of supply of strategic raw materials or energy; disasters of natural and anthropogenic origin and other emergencies [1]. However, nobody knows when another extraordinary event or crisis will strike. This issue deals with security futurology. The security futurology is the science of the future, which deals with the theory, study and creation of variants of possible developments in the security situation [2]. Security futurology includes segments of security - cyber security, data security, network security [3].

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The last threats are likely and threatening the hospitals. Each state has its list of the security threats. Each of us will encounter some emergencies or crisis in his life. Consequences of emergencies and crisis situations lead to direct and indirect threats to lives, health and the environment in which we occur [4]. Natural disasters that originated from extreme weather events have been in an increasing trend in recent years [5]. These incidents also affect medical facilities that have to provide health care to citizens located in this facility. One significant part of crisis management is to search for and mitigate the risks threatening the population dependent on assistance and care in health facilities [4]. Crisis team management focuses on team performance skills during an emergency situation that occurs when a patient has a clinical event that requires immediate intervention. Teamwork during a crisis impacts outcome no matter the setting [6], [7]. In times of emergencies or crisis, supplies may be interrupted. It can be caused by the situations which are described in the next part of the paper. In the Czech Republic, this can happen especially in storms, snow calamities or floods. Abroad, for example in coastal states, it can cause typhoons, hurricanes or snowstorms. Hurricane Sandy, the largest hurricane in the 2012 Atlantic hurricane season and the second-costliest natural disaster in the U.S. history [8]. Numerous governmental and non-governmental agents worked together and responded to the emergency. In addition to physical supports, timely and updated information serves as an intangible help, which can reduce uncertainty and fear, and contribute to timely decisions for more efficient evacuations and reliefs [9].

The central principle that defines a new perspective on the current state of health in its role in ensuring the security of individual citizens and the state is the duty of the country to save life and prevent serious health injuries for all disabled people in various types of emergency, consequences of the terrorist use of chemical, biological, radiological or nuclear means [10].

To meet the expectations of the population of the Czech Republic over health care capacity the fundamental human right to save life and health, even in extraordinary circumstances, is in the security environment defined in the Czech Republic's Security Strategy, the most significant a description of the strategic goal of creating a coherent and mainly functional "health system rescue" [10].

The Charter of Fundamental Rights and Freedoms in the Czech Republic states: "Everyone has the right to health protection. Citizens have the right to free healthcare and healthcare by public insurance under the conditions laid down by the law" [11]. This right of citizens also applies when a

state of crisis is declared, or an extraordinary event occurs too. It is, therefore, necessary for the healthcare facility to be able to provide food, drinking water and energy for people in the healthcare facility.

Safeguarding emergency survival measures is a summary of the activities and practices of the relevant bodies, other stakeholders and the citizens themselves, the aim is conducted to minimize the negative impact of emergencies and crisis on the health and lives of the affected population [12].

The obligation to provide health care depends on the emergency preparedness of the hospital. As has been said, every hospital must be prepared to face extraordinary events and crisis. It is called the concept of crisis preparedness of hospitals. This term is used in the Czech Republic and Europe. Some other states also use different terms for this activity. The term mass casualty incident is mainly used in literature from the United States of America [13].

Under Act No. 239/2000 Coll. about a joint rescue system defines the basic concepts. Protection of the population is the fulfilment of civil protection tasks, especially warnings, evacuations, hiding and emergency survival of the community and other measures to ensure the protection of its life, health, and property. Further, § 10 sets out the tasks of the Region, according to which the Fire Rescue Service performs rescue and liquidation work and also organizes and coordinates evacuation, emergency accommodation, emergency drinking water supplies, food and other necessary means of survival of the population [14].

The following figure shows a summary of measures to protect the population. As mentioned, one of the criteria is emergency survival. It must also be provided to persons present at an emergency in healthcare facilities.

As mentioned, one of the measures is emergency survival. It must also be ensured for persons present at an emergency in healthcare facilities

Crisis management information systems are made up of many modules. These are used to handle emergencies or crisis. No module has yet been put in place to assess healthcare facilities regarding their preparedness to face emergencies or crisis. The purpose of this article is to present the assessment criteria for healthcare facilities for emergency supply.



Fig. 1 The measures to protect the population [15]

One of the problems of the World Health Organization (WHO) is the disaster preparedness of hospitals [16]. Disaster Managers need valid and practical tools to assess the preparedness of hospitals for disaster preparedness. However, for this purpose, there is no standardized and comprehensive tool [17].

The aim of this article is to create the evaluation module of the crisis preparedness for the hospitals.

## II. ANALYSIS OF CRISIS WITH IMPACT ON THE HOSPITALS

The aim of this chapter is to present emergencies that have disrupted supplies of food, food, water for the survival of the population. In such cases, there are measures for the emergency survival of the community. These measures are necessary to overcome an emergency.

In the world, the primary deliveries to the survival of the population are the most often caused by the movement of the air mass - the storm and the hurricane. It has the effect of interrupting energy supplies. It is one of the defined measures of emergency population survival.

### Asia

Earthquakes hit the island Lombok and Bali in Asia in July and August 2018. By this crisis, 98 inhabitants died. The magnitude of the earthquake was at the degree 7. This crisis triggered landslides electrical blackout [18]. The main hospital in the town of Tanjung in the north was severely damaged. And this hospital was evacuated. Staff set up about 30 beds in the shade of trees and in a tent on a field to tend to the injured. There was the power outage. Emergency units in other hospitals were overflowing, and some patients were being treated in parking lots [19].

### The United States of America

Hurricane Sandy struck off the US coast in October 2012. It was a post-tropical cyclone. Hurricane began as a tropical wave in the Caribbean and quickly changed into a tropical storm in just 6 hours. It was transformed into a hurricane on October 24. The total deaths reached 285, including 125 deaths in the United States. Hurricane caused 62 billion dollars of damage and 315 million dollars in the Caribbean. New York was the most affected due to injury to subways and road tunnels. More than 7.5 million people were without electricity [20].

Hurricane Sandy in New York will cause floods in hospitals. That caused power outages. Five hospitals were forced to evacuate. The evacuation was also due to aggregate outages. Other hospitals were evacuated due to flooding of cellars. Aggregates that stopped working here were placed here. The army helped the evacuation.

Other include Hurricane Irma. It was the most powerful hurricane of the Atlantic in recorded history. The storm arrived on the coast of Barbuda in September 2017. Its wind was 185 miles per hour for 37 hours. More than 10 million of the population remained in Florida without electricity. More than 5 million Florida residents were evacuated [21].

Hospital was affected by the hurricane Irma too. They chose to dismiss patients who were able to be in home care. Other patients had to be evacuated to other hospitals. In some hospitals, urgent income was also interrupted.

Hurricane Michael hit USA in October 2018. This hurricane went from Florida north-eastward through Virginia and lasted seven days. More than 400,000 inhabitants are without power in Georgia. Next about 250,000 inhabitants was without power in Cuba. Bay Medical Center in Panama City, a 300-bed hospital in the center of town, was a tumultuous mess. Staff members were frantically working on Thursday to evacuate patients just as new ones showed up at the door. The governor had announced that all of the patients in the hospital were to be evacuated, which was expected to take 48 hours.

Hurricane Michael had strafed the place, blowing out windows and stripping some of the buildings in the sprawling complex down to their metal girders. Signage was strewn in the streets [22].



Fig. 2 Debris outside Bay Medical Center in Panama City [22]

The United States suffers from hurricanes of varying degrees. Other significant storms include Bob (1991), Dennis

(2005), Katrina (2005), Gustav (2008), Issac (2012), Arthur (2014), Mathew (2016), Nate (2017).

### Europe and the Czech Republic

In 2007, the orc Kyrill drove over Europe. In three days, he demanded 48 victims. This orc was overflowing across Britain, Germany, the Netherlands, Poland, the Czech Republic.

In the Czech Republic, power outages occur most often due to storms. It is possible to remember the orc Kyrill, who in 2007 hit the whole of the Czech Republic. This gauntlet resulted in four human sacrifices and caused billions of damages [23].

The same storm struck Herward 10 years later (2017).

In December 2011, the hurricane Dagmar hit the coast of Norway. It was called "thousand-year storm" that reached far into the country and caused extensive tree falls over the power lines. 1.3 million citizens lost their electricity supply, 14,000 for more than 48 hours [24].

In December 2013, the hurricane Ivar caused a blackout for 60,000 citizens in the north of Sweden due to extensive tree falls. While the majority of the affected household got their electricity back within 24 hours, over 1,000 households were without power for more than 5 days.

Similar to Dagmar in both strength and extent of damage, Ivar took out critical infrastructure including roads, trains, electricity, and telecommunication [24].

The tropic storm Leslie hit Europe in 2018. This storm hit mainly South of Europe. The most affected were Portugal, France, Spain and the island state of Mallorca. This storm causes flash flood in these states. Roads washed away, hospitals were flooded and thousands were evacuated in France. A similar situation was also in Portugal, which was hit by flash floods. At least 300,000 homes were reported to be left without power [25].

### III. EMERGENCIES HOLDING OF HEALTHCARE FACILITIES

The Ministry of Health of the Czech Republic is responsible for the crisis management in the healthcare sector. The Ministry of Health states that its role in crisis management is to ensure framework conditions for the provision of health care in the event of emergencies and crisis situations through the creation and enforcement of state health policy [26]. Crisis preparedness in healthcare in the Czech Republic is defined as the ability of providers of health services and healthcare facilities to provide the necessary health care to the population of the local administrative unit in crisis situations and in extraordinary events in the continuity of medical principles for the provision of healthcare by professionally qualified workers [26].

In the times of an emergency or a crisis and a disruption of supply, there are measures for the emergency survival of the population. The illustration below shows the necessary supplies for emergency survival.

Figure 2 presents the necessary measures that are required for the emergency use of the population. In particular, it is an emergency supply of water, food, and energy. These supplies are crucial in emergencies or crisis that may affect healthcare facilities [12].

There may also be emergency accommodation, necessary emergency services and the organization of humanitarian aid. It should be noted. However, that evacuation of the entire hospital, such as the county hospital, cannot be carried out. If there was a crisis - a flood and the buildings of a health care facility were at risk, it would be sufficient to evacuate only within the building. It is, therefore, necessary for patients to leave from the ground floor of the building to the upper floors, along with the staff and the appropriate devices.



Fig. 3 Emergency survival of the population [15]

However, it is necessary to take into account the situation where, in the event of a crisis - the floods will flood part of the building, it is assumed that there may be power outages. For these situations, hospitals are equipped with power generators that can provide energy for a specified period.

#### IV. METHODOLOGY

Four methods of scientific work were used in this article. The method of analysis is used because it uses the principles of logic to achieve the set goal and provide the framework to explore the principles of crisis management and crisis preparedness of the healthcare facilities. The induction method was used, where this method serves to examine the fact of creating a hypothesis from the points obtained. Comparison method allows to evaluate and analyse processes and approaches in healthcare facilities in the Czech Republic. Finally, heuristic analysis of preparedness was used.

A heuristic analysis of preparedness was developed for the evaluation of healthcare facilities. This method is based on a quantitative assessment of the availability of emergency medical facilities. Based on this assessment, we will get an accurate idea of the weaknesses and strengths of the assessed healthcare facilities.

The evaluation of the system used a set of evaluation questions, which was divided into five categories. As mentioned above, we propose a system for assessing

healthcare facilities from an emergency supply point of view, focusing on three measures - emergency water supplies, emergency food supplies and emergency supplies.

**Emergency Water Supply** - this category aims to evaluate whether the hospital is prepared for water loss - drinking or utility. It is assessed how long the hospital can withstand its water supplies. It is also evaluated whether the hospital has a contract with the supplier of drinking water - packaged, in a tanker. It is also necessary to assess the area of service water that is necessary for the operation of the medical facility. In the last part, the dry toilets are evaluated at the time of the loss of utility water.

**Emergency Food Supply** - this category evaluates whether a cookery shop is being built in a health facility. In the event of a food supply failure, it is assessed whether the hospital has a supply of food. It is also evaluated whether the hospitals are contractually contracted by hot food suppliers, food supplies or finished meals.

**Emergency Power Supply** - this category evaluates the preparedness of the healthcare facility for emergency energy supplies - the ownership of energy supply replacement units. However, these aggregates are fuel-dependent, and it is, therefore, necessary to assess fuel supply to the hospital. It deals with the area of contractual fuelling, its gas station, etc.

**Other Emergency Supply** - this category only marginally identifies the supply of medical equipment from the supply of drugs, blood and blood plasma and their contractual provision.

**Hospital Capacity** - this category addresses the current capacity of the health facility. The availability of free beds, medical staff, hospitalized is evaluated. Also, it is essential to deal with their distribution (children/adults, diets, acute).

Based on the above analysis, an evaluation was performed using the following formula:

$$HFP = ((R + H) / 2 \times R) \times 100\% \quad (1)$$

Where, HFP = healthcare facility preparedness, R = sum of results (obtained points), H = number of assessed heuristics.

The evaluation methodology consisted in assigning a response to each question answered in the form of valuation from a predefined set of values (0 = does not meet; 1 = meets; blank field if the problem is not relevant).

#### V. RESULTS

In the article of the work, three medical facilities of the Regional Hospital and the Faculty Hospital were evaluated.

The proposed method was used to assess the medical facility. Firstly, there was evaluated healthcare facilities, type hospital of the municipality.

TABLE I. EVALUATION OF THE HOSPITAL 1

Category	Quesstins	Answers	Points	Total
Water	9	9	6	83.33%
Food	11	11	8	86.36%
Energy	9	9	6	83.33%
Others	6	6	5	91.67%
Capacity	8	8	0	50%
Total	43	43	25	78.94%

Table 1 shows the results of the heuristic analysis of hospital preparedness – hospital of the municipality. As can be seen, the best-assessed category is preparedness others types of supply (accommodation, blood, medical supplies). The overall preparedness of the hospital is 78.94%.

Secondly, there was evaluated healthcare facilities, type regional hospital.

TABLE II. EVALUATION OF THE HOSPITAL 2

Category	Questins	Answers	Points	Total
Water	9	6	-2	33.34%
Food	11	9	-2	38.89%
Energy	9	8	1	56.25%
Others	7	7	3	71.43%
Capacity	8	8	8	100%
Total	44	38	8	59.98%

Table 2 shows the results of the heuristic analysis of hospital preparedness – regional hospital. As can be seen, the best-assessed category is the capacity of the hospital. The overall preparedness of the hospital is 59.98%.

TABLE III. EVALUATION OF THE HOSPITAL 3

Category	Questions	Answers	Points	Total
Water	9	9	7	88.89%
Food	11	11	7	81.81%
Energy	9	9	8	94.45%
Others	6	6	5	91.67%
Capacity	8	8	6	87.5%
Total	43	43	33	88.87%

Table 3 shows the results of the heuristic analysis of hospital preparedness – faculty hospital. As can be seen, the best-assessed category is preparedness others types of supply (accommodation, blood, medical supplies). The overall preparedness of the hospital is 88.87%.

The heuristic analysis of preparedness was used by the three hospitals (different types). The best-assessed was faculty hospital. Secondly, it was hospital of the municipality. Finally, the worst assessed was regional hospital.

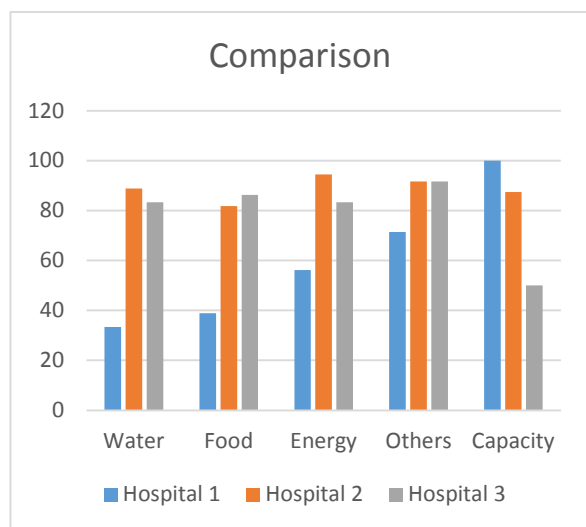


Fig. 4 Comparison of the evaluated hospital

Figure 3 shows the comparison of the hospital preparedness. The best-assessed was faculty hospital. Secondly, it was the hospital of the municipality. Finally, the worst assessed was the regional hospital.

TABLE IV. COMPARISON OF THE EVALUATED HOSPITAL

Strengths	Weaknesses
<b>Hospital 1 – hospital of municipality</b>	
Stocks of bottled drinking water. Contractual supply of drinking water. Contractual supply of food. Contractual supply of medication and blood. Contractual supply of fuel. Contractual supply of dry toilets. Own kitchen.	There is no online number of hospitalized patients. There is no online number of medical staff available.
<b>Hospital 2 – regional hospital</b>	
The quality of drinking water is controlled. Own grocery store with food stock. Stocks of raw materials for nutrition for two days. The preparedness for power failure - aggregate. Stocks of fuel to the aggregate in 12 hours. The stocks of medicines, blood, blood plasma and medical supplies. Online capacity for the number of patients and staff.	There are no supplies of bottled drinking water for patients. There is no contract of supplies of bottled drinking water. There is no contract to deliver dry toilets. There is no contract of supplies of utility water. There is no contract of supplies hot-food / ready-to-cook food. There is no contract of fuel deliveries. There is no contract of additional accommodation. There is no responsible person for the emergency supply of the hospital.
<b>Hospital 3 – faculty hospital</b>	
Stocks of bottled drinking water for three days. Stocks of raw materials for three days. Contractual supply of drinking water. Contractual supply of food. Contractual supply of medication and blood. Contractual supply of fuel. Contractual supply of dry toilets. Own kitchen. Own gas station. Transfusion station itself. Online capacities on the number of patients.	There is no contractual supply of drinking water in the tank from the Fire Rescue Service.

The table shows strengths and weakness of the tested hospitals.

VI. EVALUATION MODULE OF THE CRISIS PREPAREDNESS FOR THE HOSPITALS

This paper discussed emergency population survival and crisis preparedness of the hospitals. There was mentioned the problem of the WHO, which the hospitals must be prepared for the disasters and crisis. The authors of the other paper said that there is no standardized tool for this purpose. For this purpose, we propose a new evaluation module for the crisis preparedness of the hospital.

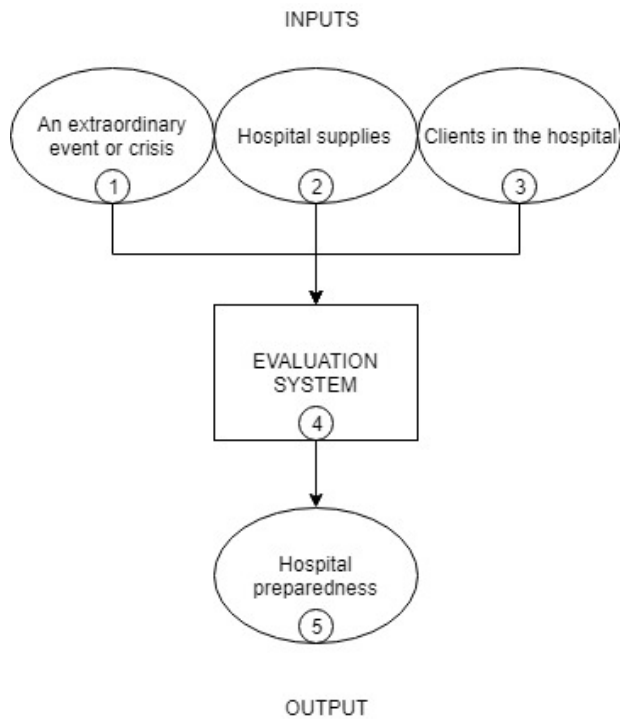


Fig. 5 The basis for algorithm design

Figure 5 shows the evaluation module of the hospital preparedness. As can be seen, the figure shows three inputs of the module and one output.

Inputs one represents the time interval of the extraordinary event or crisis. This input will show in hours.

The second input represents hospital supplies. That means how much of drinking water, food, fuel, and generator have the hospital.

And last input represents clients in the hospital. This input is divided next.

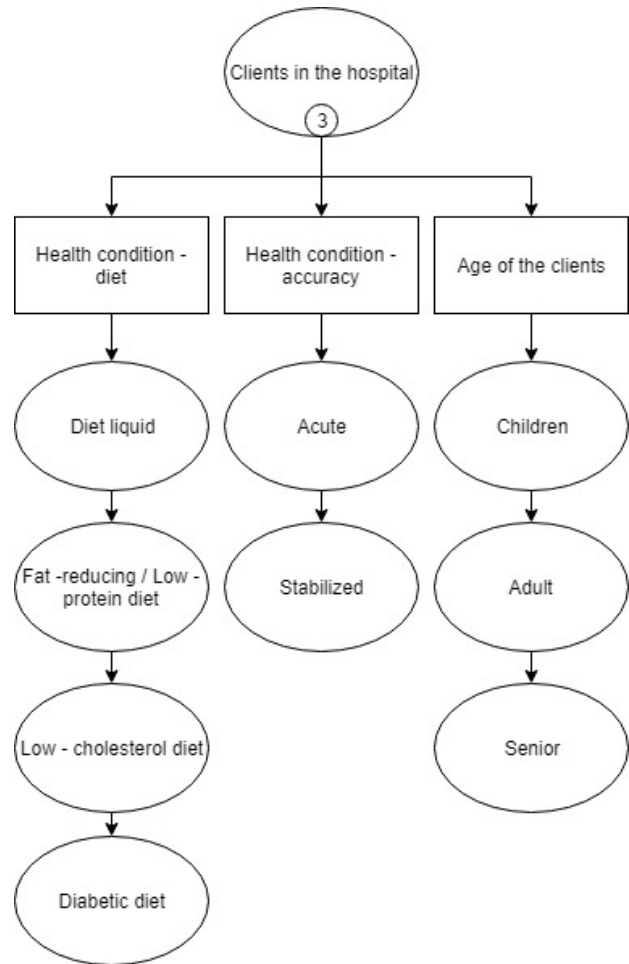


Fig. 6 Input 3 – clients in the hospital

All of these inputs go to the evaluation system. The output of this evaluation system is hospital preparedness.

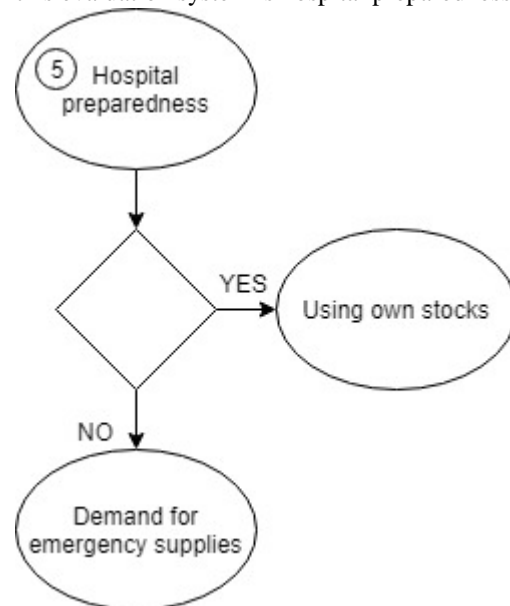


Fig. 7 Output – hospital preparedness

If the hospital is not preparedness, demand the emergency supplies. Each hospital itself provides contractual emergency

supplies. There must be feedback about sending emergency supplies to the hospital. It can be solved using a mobile application that will monitor inventory movement.

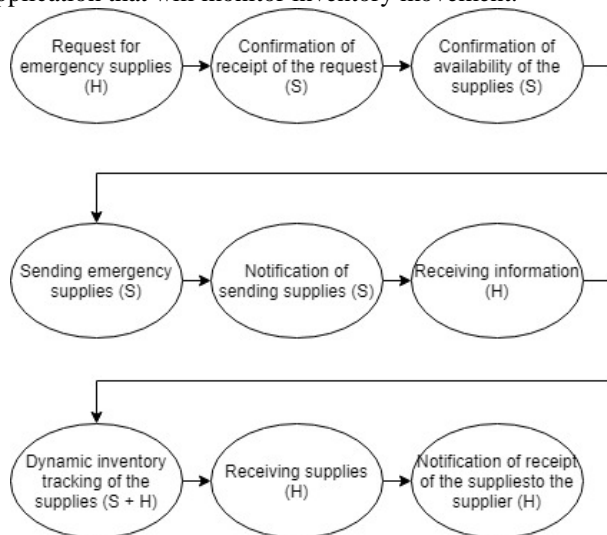


Fig. 8 Way of communication

## VII. DISCUSSION AND CONCLUSION

This paper dealt with the evaluation module of the crisis preparedness of the hospital. The aim of healthcare facilities is to provide medical care to hospitalized persons. It is also the same at the time of an emergency. Such an extraordinary event may be a power outage. There may also be the crisis, such as floods. These may prevent food, water or energy supplies.

Each healthcare facility provides emergency supplies of energy, food, and water alone. It is clear, therefore, that each healthcare facility has this supply ensured according to its requirements.

A self-assessment method was developed for the evaluation of healthcare facilities. This method is divided into five categories. The aim of this analysis is to determine the availability of emergency medical facilities. The heuristic analysis was used at three hospitals. By the study, one can point to a high diversity regarding their emergency preparedness.

Information systems address emergency or crisis. They are used both at the county level and at the health facility level.

We propose to introduce a new module for these information systems.

This module would be able to assess whether the hospital has enough stock, based on the expected development of an emergency or crisis, to overcome these events. If hospitals are found to need emergency supplies, they are usually required by the contractors. It is also necessary to have feedback here. She would provide the hospital with information on whether and how many supplies are ready and when they are supposed to be delivered. Currently, this situation is solved only by telephone, and very rarely the hospital has feedback.

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## REFERENCES

- [1] "Security Strategy of the Czech Republic", Prague, Ministry of Foreign Affairs of the Czech Republic, 2015.
- [2] J. VVALOUCH, H. URBANCOKOVA. "Methodology of Future Security Studies". In *SECURWARE 2016: The Tenth International Conference on Emerging Security Information, Systems and Technologies*, 2016, pp. 69 - 71.
- [3] J. EICHLER, International security in the early 21st century. Prague: DoD CR, AVIS, 2006, p. 304.
- [4] L. BREHOVSKA. Approach to assessing the preparedness of hospital to power outages, In *Transactions of the VSB*, Vol. 12, 2017, pp. 30 - 40.
- [5] A. SENA, C. CORVALAN, K. EBI. Climate Change, Extreme Weather and Climate Events, and Health Impacts. In *Freedman B. (eds) Global Environmental Change. Handbook of Global Environmental Pollution*, vol 1. Springer, Dordrecht, 2014, pp. 605 - 613.
- [6] V. O. BAKER, et al., Teamwork education improves trauma team performance in undergraduate health professional students, In *Journal Education Evaluation, Health Prof*, 2015
- [7] W. RILEY, et al., Didactic and simulation nontechnical skills team training to improve perinatal patient outcomes in a community hospital, In *Joint Commission Journal on Quality and Patient Safety*, 2011, pp. 357 - 364.
- [8] E. S. BLAKE, et al., Tropical cyclone report: Hurricane Sandy, Technical report, 2012, p. 157.
- [9] J. F. McCARTHY, D. M. BOYD, Digital backchannels in shared physical spaces: experiences at an academic conference, In *Proceedings of CHI'05*, 2005, p. 4.
- [10] V. FISER, H. VRASPIROVA, Crisis preparation in education health, *SKPZ*, 2012.
- [11] Czech Republic. Law No. 2 from the year 1993 Charter of Fundamental Rights and Freedoms
- [12] Measures for Emergency Survival [online] Available: <http://www.hzscr.cz/clanek/opatreni-pro-nouzove-preziti-558778.aspx>
- [13] E. DAVOLI, Crisis preparedness plan, A practical tool for the preparation of a hospital crisis preparedness plan, with special focus on pandemic influenza, *World Health Organization*, 2007, p. 38
- [14] Czech Republic. Law No. 239 from the year 2000 about Joint Rescue Service.
- [15] D. REHAK, L. FOLWARCZNY. The Bases of Technical and Organizational Protection of the Population, Ostrava, 2012, p. 89
- [16] A. ARADAM, et al. Hospitals safety from disasters in I.R.iran: the results from assessment of 224 hospitals. In *PLoS Currents Disaster*, Vol. 28, No. 6, 2014, p. 18.
- [17] E. HEIDARANLU, et al. Hospital Disaster Preparedness Tools: a Systematic Review. In *PLoS Current*, Vol. 14, No. 7, 2015.
- [18] H. NIANIAS, CH. GRAHAM. Indonesia earthquake: At least 98 dead as tourists evacuated after 'massive' damage, 2018 [online]. Available: <https://www.telegraph.co.uk/news/2018/08/05/earthquake-kills-19-tremors-hit-lombok-bali/>
- [19] T. EMBURY-DENIS. Lombok earthquake: Tourists 'forced to pay to board rescue ships', 2018 [online]. Available: <https://www.independent.co.uk/news/world/asia/lombok-earthquake-latest-indonesia-tremor-quake-dead-victims-tourists-a8480356.html>
- [20] Facts about Hurricane Sandy, 2018 [online]. Available: <https://www.dosomething.org/us/facts/11-facts-for-hurricane-sandy>
- [21] I. UMAIR. Superstorm Sandy May Have Long-Term Public Health Impact, 2012 [online]. Available: <https://www.scientificamerican.com/article/superstorm-sandy-may-have-long-term-public-health-impacts/>
- [22] R. FAUSSET. Hospitals Pummelled by Hurricane Michael Scramble to Evacuate Patients, 2018 [online]. Available: <https://www.nytimes.com/2018/10/11/us/hurricane-michael-hospitals-damage-florida.html>
- [23] Extreme Wind Storm Catalogue - Kyrill, 2007 [online]. Available: <http://www.europeanwindstorms.org/cgi-bin/storms/storms.cgi?storm1=Kyrill>
- [24] Extreme Winf Storm Catalogue – Dagmar, 2011 [online]. Available: [http://www.europeanwindstorms.org/cgi-bin/storms/storms.cgi?storm1=Dagmar\\_Patrick](http://www.europeanwindstorms.org/cgi-bin/storms/storms.cgi?storm1=Dagmar_Patrick)
- [25] T. TAHIR. France flash floods, 2018 [online]. Available: <https://www.thesun.co.uk/news/7494537/france-flash-floods-devastation-hospitals-roads-evacuations/>

- [26] V. FISER. Crisis management in the health sector, Prague, Fire Rescue Service, 2006, p. 53.

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