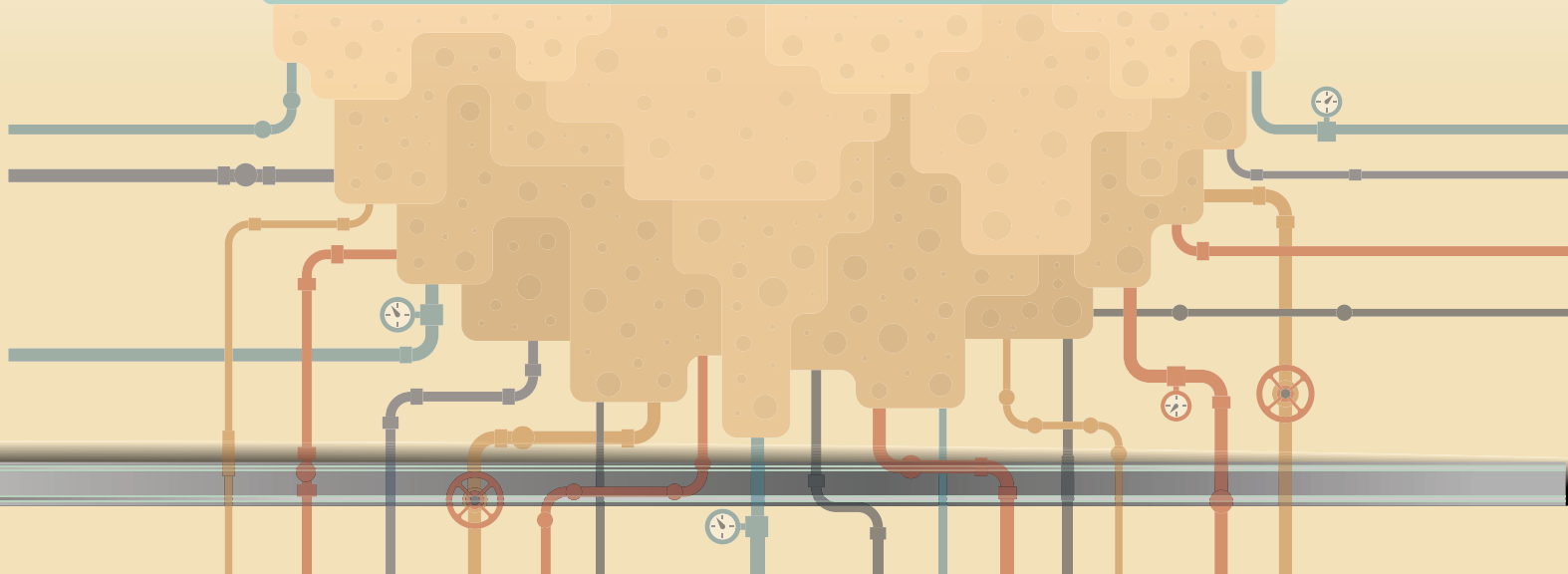


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Sava centar, Beograd  
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# MOGUĆNOST ODGOVORA ZDRAVSTVENIH USTANOVA NA INDUSTRIJSKE AKCIDENTE – PRIMER ZDRAVSTVENE USTANOVE U OPŠTINI OBRENOVAC

## HEALTH CARE FACILITIES PREPAREDENESS FOR RESPONDING TO INDUSTRIAL HAZARDS - CASE STUDY OF HEALTH FACILITY IN OBRENOVAC, SERBIA

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*U skladu sa opštim načelima datim kroz Sendai i Hjogo konvencije u oblasti upravljanja rizici-  
ma u uslovima katastrofa (Hyogo and Sendai Framework for Disaster Risk Management) izazvanim  
prirodnim i antropogenim faktorima, na teritoriji opštine Obrenovac sprovedeno je istraživanje  
spremnosti zdravstvenih ustanova da odgovore na potencijalne industrijske akcidente. Lokalne  
zdravstvene ustanove su javni objekti koji predstavljaju prvi nivo u hijerarhiji pružanja pomoći lo-  
kalnom stanovništvu u slučaju industrijskih hazarda manjih ili većih razmera. S tim u vezi, stepen  
njihove opremljenosti predstavlja imperativ u upravljanju rizicima od katastrofa na nekom području.  
Kroz istraživanje indeksa bezbednosti lokalne zdravstvene ustanove u Obrenovcu (doma zdravlja)  
utvrđene su postojeće mogućnosti za odgovor na industrijske katastrofe i dat predlog mera koje bi  
trebalo sprovesti u cilju unapređenja kvaliteta usluga u slučaju akcidenata. Kroz rad će biti prikazana  
metodologija u oblasti definisanja otpornosti zdravstvenih objekata, kroz utvrđivanje indeksa bezbed-  
nosti bolnica (hospital safety index), propisanog od strane Svetske zdravstvene organizacije,  
mogućnost primene ove metode evaluacije na zdravstvenim ustanovama u Srbiji, prezentovani rezulta-  
ti istraživanja i dat predlog mera za prevazilaženje organizacionih, tehničkih i arhitekonsko-  
građevinskih problema u objektima zdravstvene ustanove u Obrenovcu.*

**Ključne reči:** rezilijentnost, zdravstvene ustanove, indeks bezbednosti bolnica, opština Obreno-  
vac

*Based on the Hyogo and Sendai Framework for Disaster Risk Management caused by natural  
or human factors, a study was conducted on the territory of Obrenovac municipality regarding the  
readiness of health care facilities to respond to potential industrial accidents. Local health care facili-  
ties are public service provider which often represent the primary level in the hierarchy of providing  
health care services to the local population in case of smaller or larger industrial accidents. Through  
our paper we will present the methodology used for calculating the hospital safety index defined by the  
World Health Organization, the possibility to apply this method of evaluation on health care facilities  
in Serbia, the preliminary results of our studies and suggested procedures for overcoming organiza-  
tional, architectural, and construction problems in the primary health care facility of Obrenovac.*

**Key words:** resilience, health care facility, hospital safety index, Municipality of Obrenovac

### 1 Introduction- resilience and social infrastructure

Resilience in terms of cities generally refers to the ability to absorb, adapt and respond to changes in an urban system [1], [2], [3]. The resilience and preservation of infrastructure, also including the social infrastructure within which schools and health care facilities are of special importance, is an integral part of the city resilience [4]. [5], [6]. Hazards can be natural or man-made hazards (anthropogenic hazards) and they carry in themselves a high probability of causing the socioeconomic consequences (possible human losses, damage to property and economy including the destruction of infrastructure), but also the probability of harmful effects on the environment (environmental impacts) [2].

The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted in 2015 [7], which set the long-term goals and in which the effects of the previous Hyogo Framework were assessed [7]. It was concluded that the Hyogo Framework has contributed to raising awareness about the importance of disaster risk management, as well as reduced human losses due to disasters and created common forms of action amongst the member countries (168 signatories, including Serbia). In spite of the realized contribution, primarily contribution to the institutional disaster risk reduction measures, it was concluded that the large-scale disasters have occurred [6]. The Sendai Framework together with the Action Plan sets high targets within the four priority fields: understanding disaster risk; strengthening disaster risk governance to manage disaster risk; investing in disaster risk reduction for resilience; enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction. The activities are divided into activities at global level and activities at national level, while the mechanisms of additional support to the less developed member countries in order to achieve common, global goals are pointed out. The representatives of Serbia also participated in the conference, on which occasion they presented the National Disaster Risk Management Program [8].

It is critical that health care facilities continue to work during emergencies and disasters, which cannot only be natural, but also industrial in nature, since people immediately go to the nearest hospital for medical assistance when emergencies occur, without considering whether the facilities might not be functional. Consequently, it is vital to identify the level of safety and functionality a hospital will have if an emergency or disaster occurs. Hospital evaluations aim to identify elements that need improvement in a specific health care facility or network of health care facilities, and to prioritize interventions in them that are essential for reducing the mortality, morbidity, disability and other social and economic costs associated with emergencies and disasters. [10], [11].

## **2 Hospital Safety Index –evaluation criteria**

Because of importance of safe health care capacities in normal, and particularly in emergency situations, a method for checking their safety has been developed by the World Health Organization [9]. The check is carried out by determining the Hospital Safety Index, which represents a methodology for fast and relatively economical evaluation of functional capacity of a hospital. The Hospital Safety Index (HSI) not only estimates the functional capacity of a hospital during and after an emergency, but it provides ranges that help authorities determine which hospitals most urgently need actions to improve their safety and functionality. The check is carried out for basic group of criteria that are diversified into 2 forms: 1) general information on a hospital, and 2) safe hospital checklist, divided into 4 modules: Module 1: Hazards affecting the safety of the hospital and the role of the hospital in emergency and disaster management; Module 2: Structural safety; Module 3: Nonstructural safety; and Module 4: Emergency and disaster management. Each of the mentioned modules contains a set of questions for evaluation, whereby the risk is quantified based on the magnitude of impact on the safety of capacity of health care facilities and probability of risk occurrence. [12]

## **3 Resiliency of health care facility in Obrenovac**

Health care facilities are highly important for the resilience of cities. Hospital safety index evaluates different aspects of resilience of one building/institution.

First module is about different accidents or hazards. Hazards which risk is evaluated in this paper are Human-made hazards. That category is referred to part of Technological hazards. Specific hazards are divided to 7 main types: Industrial hazards, Fires (e.g. building), Hazardous materials (chemical, biological, radiological), Power outages, Water supply disruption, Transportation incidents (e.g. air, road, rail, water transport), Other technological hazards (e.g. air pollution, structural collapses, food/water contamination, nuclear). [9], [12]

Industrial hazards refer to regional and local hazard maps of industrial facilities or other hazard information and any past incidents involving industrial hazards, and rate the industrial hazard level for the health care facility location and potential contamination of the its systems. The health care facility should be prepared to respond to an emergency or disaster due to industrial hazards (based on exposure of the catchment population or the specialized role of this facility for the treatment of patients exposed to industrial hazards).

Fires refer to local hazard maps or other hazard information on building fires inside and outside the health care facility and any past incidents involving building fires, and rate the fire hazard level for the health care facility. Health care facility should be prepared to respond to an emergency or disaster due to building fires (based on exposure of the catchment population or the specialized role of the health care facility for the treatment of burns patients).

Hazardous materials refer to local hazard maps or other hazard information on hazardous materials (incidents and spills) inside and outside the health care facility and any past incidents involving hazardous material spills or leaks, and rate the hazardous material hazard for the health care facility and the potential contamination of its systems. Health care facility should be prepared to respond to an emergency or disaster due to hazardous materials (based on exposure of the catchment population or the specialized role of the health care facility for the treatment of patients exposed to hazardous materials). They are divided into three different hazards: chemical, biological and radiological.

Power outages refer to any past incidents involving power outages for the health care facility location, and rate the power outage hazard for the health care facility. Water supply disruption refers to any past incidents involving the disruption of the water supply for the health care facility location, and rate the hazard for the health care facility. Health care facility should be prepared to respond to an emergency or disaster due to disruption of the water supply.

Transportation incidents (e.g. air, road, rail, water transport) refer to records of past major transport incidents, and determine whether the hospital should be prepared to respond to an emergency or disaster due to transport incidents (based on exposure of the catchment population).

Other technological hazards (e.g. air pollution, structural collapses, food/water contamination, nuclear) refer to regional and local hazard maps, or other hazard information and past incidents to identify other technological hazards for the health care facility. Hazard needs to be specified and to be rated with the corresponding hazard level for the health care facility's location. Health care facility should be prepared to respond to an emergency or disaster due to other technological hazards (based on exposure of the catchment population or any specialized role of the health care facility for the treatment of patients exposed to other technological hazards).

Evaluation process consisted of giving one of three marks to each of the above named hazards. Marks represent hazard levels: low, average and high, or it can be stated that there are no some specific hazards. Hazards that belong to fires, hazardous materials, transportation incidents and other technological hazards were given the marks labeling no hazard of this type. Secondly, hazards regarding power outages and water disruption were given marks of high hazard level regarding recent floods near health care facility which was in area of massive floods in Obrenovac, in 2014.

Main type of hazards from which can this health care facility can be at risk are industrial hazards. Risk of them is evaluated considering mainly the positions of SEVESO facilities in its near surroundings [13]. For this purpose it was used the document Preliminary list of SEVESO facilities on the territory of Republic of Serbia. In that document there are two main categories of SEVESO facilities: secondary (less hazardous) and primary (highly hazardous).

Secondary SEVESO facilities in nearby location of the health care facility Eko – Dunav DOO Beograd, Skladište ND „Prva Iskra Barič“ (fuel storage), Tent DOO Obrenovac ogranak TE „KOLUBARA“ (thermal power plant), „Prva iskra namenska proizvodnja“ AD Barič (explosives production facility). Primary SEVESO facility in nearby location of health care facility is Tent DOO Obrenovac Tent – A (thermal power plant). [13]

Regarding the position and number of SEVESO facilities near the health care facility and also danger of influences of floods, earthquakes and other natural hazards in their protection zones (1000 m), the evaluation of these specific types of hazards is marked as high level hazard.

The health care facility is first and nearest government health institution which can be in danger from this kind of hazards. On the other hand it is the first that can help in triage, transporting and treatment of the injured patients and can be of great importance in the first minutes of immediate danger.



| Module 1: Hazards affecting the safety of the hospital       |              |     |         |      |  |                                     |
|--|--------------|-----|---------|------|--|-------------------------------------|
| 1.1 Hazards  | Hazard Level |     |         |      | Should the hospital be prepared to respond to this | Observations (evaluator's comments) |
|  | No hazard    | LOW | AVERAGE | HIGH |  |                                     |
| <b>1.1.1 Geological hazards</b>                              |              |     |         |      |  |                                     |
| Earthquakes  |              |     |         |      |  |                                     |
| Dry mass movement – landslides                               |              |     |         |      |  |                                     |
| <b>1.1.2 Hydro-meteorological hazards</b>                    |              |     |         |      |  |                                     |
| <b>1.1.2.1 Meteorological hazards</b>                        |              |     |         |      |  |                                     |
| Local storms   |              |     |         |      |  |                                     |
| <b>1.1.2.2 Hydrological hazards</b>                          |              |     |         |      |  |                                     |
| Wet mass movements – landslides                              |              |     |         |      |  |                                     |
| <b>1.1.2.3 Climatological hazards</b>                        |              |     |         |      |  |                                     |
| Extreme temperature (e.g. heat wave, cold wave, Drought)     |              |     |         |      |  |                                     |
| <b>1.1.3 Biological hazards</b>                              |              |     |         |      |  |                                     |
| Epidemics, pandemics and emerging diseases                   |              |     |         |      |  |                                     |
| Human-made hazards   |              |     |         |      |  |                                     |
| <b>1.1.4 Technological hazards</b>                           |              |     |         |      |  |                                     |
| Industrial hazards (e.g. chemical, radiological)             |              |     |         | X    |  | Seveso facilities                   |
| Fires (e.g. building)  | X            |     |         |      |  |                                     |
| Hazardous materials (chemical, biological, radiological)     | Chemical     | X   |         |      |  |                                     |
|  | Biological   | X   |         |      |  |                                     |
|  | Radiological | X   |         |      |  |                                     |
| Power outages  |              |     |         | X    |  | Floods in 2014.                     |
| Water supply disruption                                      |              |     |         | X    |  | Floods in 2014.                     |
| Transportation incidents (e.g. air, road, rail, water)       | X            |     |         |      |  |                                     |
| Other technological hazards (e.g. air pollution, structural) | X            |     |         |      |  |                                     |
| <b>1.1.5 Societal hazards</b>                                |              |     |         |      |  |                                     |
| Security threat to hospital building and staff               |              |     |         |      |  |                                     |
| Displaced populations  |              |     |         |      |  |                                     |
| <b>1.2 Geotechnical properties of soils</b>                  |              |     |         |      |  |                                     |
| Liquefaction   |              |     |         |      |  |                                     |
| Clay soils   |              |     |         |      |  |                                     |
| Unstable slopes  |              |     |         |      |  |                                     |

Table of hazards regarding technological hazards as relevant to this paper

#### 4 Conclusion

Resilience of the Municipality of Obrenovac has to be evaluated also through the ability of their Primary Health Care Facility to respond to potential disasters. Hospital Safety Index, developed by the World Health Organization, represents a good tool which can be used to evaluate this readiness to respond to disasters. HSI can provide an estimation of the functional capacity of a hospital during and after an emergency, and provides ranks which can help authorities determine which parts of hospital functioning need urgent improvements.

Through research conducted for this paper, four secondary and one primary SEVESO facility in close vicinity to the Primary Health Care Facility in Obrenovac have been identified. Considering the danger of floods, earthquakes and other natural hazards in the zone of 1000 m, these specific hazards have been marked as “high-level” hazards.

Taking into account the fact that the Primary Health Care Facility in Obrenovac is the nearest public health care facility to the victims of potential industrial disaster in Obrenovac, its importance for triage, transport and treatment of injured patients is very high. Detailed results of the evaluation of this hospital using the Health Safety Index should be seriously considered when planning investments into the hospital infrastructure.

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#### 6 References

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