



Emergency management and internal audit of emergency preparedness of pre-hospital emergency care

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Abstract

One of the negative components of international travel is the higher likelihood of emergencies that affect a large number of people (mass negative impact on health), for example the transmission of infectious diseases, as e.g. SARS CoV-2 pandemic. The frequency and sources of mass-casualty incidents are currently changing dynamically, especially with the onset of terrorist attacks and large-scale natural disasters. Health services and emergency medical service (EMS) take part in addressing these emergencies. For this reason, this paper deals with the EMS emergency preparedness in the Czech Republic for an emergency events with a large number of affected people. EMS in the Czech Republic are not provided by the state but by individual regions. EMS in the Czech Republic do not have central management, nor do they use uniform data documentation. The investigation of the current situation has shown that the attitudes of EMS in individual regions of the Czech Republic to the tasks of emergency preparedness for mass casualty incidents are not identical. The current method of evaluating improvements in the quality of EMS emergency preparedness lacks consistency and is not comprehensively supervised. To tackle this, the paper presents an internal audit methodology for assessing the level of emergency preparedness of the emergency medical services. The authors therefore defined the decisive criteria and indicators assessing the quality level of EMS emergency preparedness at major disaster with multiple victim incident. When developing the methodological procedure of the preparedness evaluation, an algorithm was chosen, based on the gradual verification of the evaluation criteria and indicators by an expert group. Some findings and recommendations based on a research carried out in EMS in individual regions of the Czech Republic are presented.

Keywords Emergency management · Emergency preparedness · Evaluating · Multiple victim incident · Major disaster · Emergency medical services

1 Introduction

International tourism is an integral part of the development of contemporary society, which also contributes to the growth of the national economy. Transport, accommodation, catering and other services that support the mass travel of people are key factors for its development and functioning.

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A negative aspect of international travel is the higher probability of emergencies. In countries that attract the most tourists, the number and stay of foreign nationals is increased at a certain time. These foreigners bring with them respect for a different culture, religion, respect for different legal norms, and a different state of health. Their different behaviour and visit in a foreign country can be a potential factor in the emergence of an emergency, such as the transmission of infectious diseases, a higher number of mass traffic accidents, or even the possibility of a terrorist attack. Examples of the above-mentioned serious incidents of the “widespread type” may be the shootings in Mumbai in 2008 or the Paris attacks of 2015 (Roy et al. 2011; Hirsch et al. 2015). Health services and emergency medical service (EMS) take part in addressing these emergencies. For this reason, this paper deals with the EMS emergency preparedness in the Czech Republic for an emergency event with a large number of affected people.

The standard of the emergency preparedness (EP) of individual rescue teams units (Fire Rescue Service, Fire Rescue Service units, Emergency Medical Service, Police of the Czech Republic, non-governmental non-profit organizations, etc.), which form the integrated rescue system (IRS) of the Czech Republic, significantly affects the success with which emergency events are handled. The IRS in the Czech Republic is not an institution, it is a system. In fact, it is a coordinated procedure of its rescue teams in the preparation and solution of emergencies, in the implementation of rescue work and elimination of the consequences of an emergency situation.

An emergency event (EE) is, in accordance with Czech Law Act no. 239/2000 Sb. on the Integrated Rescue System and on the amendment of certain laws, defined as “detrimental action of forces and phenomena caused by the action of man, natural effects and accidents that pose a threat to life, health, property or the environment and that demand the performance of rescue and clearance work”.

A mass-casualty incident is defined by Czech Regulation 240/2012, which implements the law on the Emergency Medical Service, as an event to which it is generally necessary, in view of the nature or extent of the incident, to send five and more deployment groups of a provider of emergency medical services at the same time to provide urgent pre-hospital care or a place at which more than 15 injured persons are found.

A typical mass-casualty incident (MCI) is characterised by a single action and a single site of incidence (Šín et al. 2017). A specific type of mass-casualty incident is an event of the “widespread type”, which does not involve a single defined event, but rather a larger number of events with a single cause, though occurring at different times in different places.

The resolution of mass-casualty incidents demands of medical personnel not merely a change of attitudes, approaches and thinking and targeted lifelong education in the area of catastrophe medicine, but also the need to increase the standard of emergency preparedness in individual segments (Šín et al. 2017).

2 Used methods

2.1 Overview of methods of evaluation of emergency preparedness of EMS in the Czech Republic

The emergency medical service is organised differently in individual regions in individual areas stipulated by the law. Differences can be seen both in the organisational

structure, communication systems, economic aspects, and technical and material equipment for resolving emergency events, and in the sphere of education, training and the performance of training.

The actual state of preparedness of workplaces is influenced by a number of factors. It is dependent not only on real experience, but also on the number and focus of tactical and verification exercises performed. Tactical and verification exercises are such exercises in the Czech Republic that focus on a specific type of emergency. This verifies the skills and knowledge of rescue teams and their cooperation in the field. The number of training exercises implemented is one of the factors that influences the state of preparedness of the emergency medical service, though the qualification, competence and level of engagement of all persons contributing to the handling of mass-casualty incidents and the quality of crisis planning documentation is a no less important factor (Šín et al. 2017).

Attention is devoted around the world to the assessment of the EP of organisations for emergency events. Assessment programmes are applied that focus on the documentation of crisis and emergency planning from the viewpoint of a given state or region. Methods of assessment are generally drawn up by international accreditation organisations. A dominant position among them is held by the independent company emergency management accreditation program (EMAP), which assesses plans focusing on emergency management.

EP is assessed on the basis of answers to a set of 64 standards (criteria) in the area of administration and the operational and logistical preparedness of rescue teams operating in the given region. The given standards for the assessment of emergency management are a tool for continual improvement to local and state programmes within the scope of the management of emergency events (EMAP Standards 2010).

The standardisation of processes and planning in the area of EP is demanded from the viewpoint of medical facilities. These standards and services are provided by various international professional organisations such as, for example, the International Society for Quality in Health Care (ISQua 2018). The principal aim of this global organisation is to manage improvements to quality and safety in healthcare by means of education, knowledge sharing and external assessment of safety systems in healthcare. The international accreditation programme (IAP) is used for external assessment of healthcare organisations and their standards. It is comprised of criteria focusing on the main structure, processes and outputs of healthcare facilities, and not merely in the area of safety management. In practice, the IAP realises an investigation in the form of qualitative research. The stipulated indicators take the form of questions with possible yes/no answers. These questions focus on, for example, organisational planning or the management of risk and preventative measures for its minimisation (ISQua 2018).

The World Health Organization (WHO), which has drawn up the manual “Toolkit for Assessing Health-System Capacity for Emergency Management” (WHO 2012) is a key partner to the ISQua. This manual contains indicators associated with the assessment of emergency management plans in healthcare, again in the form of questions with the required answer yes/no. Attention is devoted to individual aspects that can be used *ex ante* for the assessment of EP.

In practice the assessment of emergency preparedness is generally performed in two directions. In the first direction the preparedness of the emergency medical service is assessed in individual segments of its activity following mass-casualty incidents (Tušer and Navrátil 2020; Svarcova et al. 2016). Shortcomings are subsequently identified and proposals for increasing the quality of the preparedness of the emergency medical service implemented.

In the second direction, a number of papers focusing on the preparation of solutions to a specific emergency event are published, and the overall preparedness of the emergency medical service system assessed, possibly in connection with urgent hospital care. The study of Jama and Kuisma (2016), which maps out the level of preparedness of the EMS for chemical incidents associated with mass impacts on health or persons, can be stated as an example. This study assesses co-operation between the EMS and hospitals during the transport of exposed patients and the provision of means of decontamination. Also studies of Bekesiene and Hoskova-Mayerova maps accidents and Emergency Events in Railway Transport While Transporting Dangerous Items (Bekesiene et al. 2016, 2017; Navrátil et al. 2019).

Similarly, Sanders (2014) considers the issue of deployment interoperability between the police, firefighters and paramedics. It states that the quality of co-operation between deployed units is positively influenced by the unified information technology introduced.

Solutions for increasing the EP of the system in two stages are presented at Assessing community and region emergency-services capabilities by Shoemaker et al. (2011). The first stage is intended to lead to an improvement to the soft skills of paramedics, including teamwork, co-operation, team leading, self-reflection, flexibility, interpersonal relations, conflict resolution, communication, planning, etc. The second stage takes in hard skills, including the measurable capabilities of the individual such as knowledge of technological, operational or financial procedures, capacity, stamina and recovery.

2.2 Current situation in evaluation process of emergency preparedness in the Czech Republic

The United Accreditation Commission, which focuses, first and foremost, on medical facilities, has been one of the certified evaluators of quality and safety in healthcare in the Czech Republic (CZ) since 2012. It implements its stipulated goal by means of activities such as, for example, the “issuing of accreditation standards for medical facilities, including a detailed methodology or assistance for medical facilities preparing for accreditation, specification of a methodology according to types of medical facilities, consultation on the drawing up of internal standards for a given facility, etc.” (UAC CR 2016). Accreditation standards for the emergency medical service, including rules of assessment, are set, first and foremost, for the areas of urgent pre-hospital care in daily operations, though they give less consideration to requirements for the preparedness of the emergency medical service for mass-casualty incidents.

From the viewpoint of the United Accreditation Commission, shortcomings in the preparedness of medical facilities frequently occur in areas of processes and regulations. For example, persons responsible are not stipulated in regulations—definitions of risks may be given, though without specific measures, while a connection to actual conditions and risks is lacking, and knowledge and updating of regulations remain unchecked. Procedural acts are often uncompleted, contracts with suppliers are not always properly updated, the resolution of specific risks is unclear (who, where, how?) and tests of substitute sources are often performed without load (Tušer and Navrátil 2020).

Analysis of the issue of evaluation of emergency preparedness has revealed that the evaluation tools used abroad and in this country do not always give due consideration to all the specifics of EP activities in urgent pre-hospital care. Neither non-governmental organisations nor international accreditation programmes interpret this issue in a comprehensive manner (Tušer and Navrátil 2020).

2.3 Main aims and research question formulation

Unfortunately, the aforementioned methods and procedures in the CZ are not used in the field of emergency events with multiple victim incidents.

A key role in the preparation of the emergency medical service of the CZ for emergency events is played by emergency preparedness units. Basic criteria for an objective assessment of the standard of the emergency preparedness of an organisation for emergency events have not, however, yet been stipulated. One of the reasons for this is the fact that the structure and work of these units is not entirely identical in the individual regions of the CZ.

Therefore, the aim of the research and also this paper is to propose evaluation criteria and indicators that will be capable of providing relevant information on the state of preparedness of emergency preparedness units and the entire organisation for emergency events.

The main goal is to stipulate obligatory necessary minima to which regional specifics can be linked.

To verify the proposed method of evaluation of the prehospital emergency care, the authors identified the following research question:

Does the EMS in individual regions of the Czech Republic meet the specified level of emergency preparedness for a major disaster with multiple victim incidents?

3 Methodology

The EP of the emergency medical service is influenced by a number of factors and the selection of criteria and indicators is not rigid.

The basis for the proposal for evaluating EP was the definition of decisive criteria and indicators assessing the standard of the quality of the EP of an organisation for mass-casualty incidents. During the creation of this methodology for assessing preparedness, the authors of the paper selected, with a view to procedures used in this country and abroad, an algorithm based on the progressive verification of assessment criteria and indicators by an expert group (a group of evaluators) (Talhofer et al. 2019). The members of this expert group were selected on the basis of their institutional employment, erudition and reputation. The expert group included representatives of selected EP units of the emergency medical service, the pertinent departments of regional authorities, departments of defence of the population and emergency management of the Fire Rescue Service, the Faculty of Military Health Sciences, the United Accreditation Commission and the Society of Emergency Preparedness in Healthcare. The group of experts consisted of a total of 32 members (Tušer and Navrátil 2020).

Starting point for the determination of evaluation metrics were legislative regulations (Czech Law Act no. 239/2000 and Czech Act 374/2011 Coll., On Emergency Medical Services) that stipulate the obligations of the emergency medical service for EP and other areas. The authors studied the legislation of the Czech Republic concerning the EP EMS and based on it identified 8 basic criteria determining the level of emergency preparedness of the emergency medical service. These eight criteria were presented to each member of the above-mentioned group of experts individually, at a personal meeting, to assess their relevance.

Experts evaluated the significance of the order of individual criteria by the scoring method. From the submitted 8 criteria, the expert team determined the three most important criteria (A, B, C). Using the method of brainstorming with an expert group, indicators determining

the fulfillment of these criteria were assigned to these criteria. All members of the expert group had the same opportunity to express themselves (Tušer and Navrátil 2020).

The evaluation procedure is based on determination of the level of fulfillment of the individual indicators that are stipulated for basic areas characterising EP in the form of assessment criteria A, B and C:

- A—Collaborative preparedness with other units of the Integrated Rescue System;
- B—The preparedness of emergency medical service forces for emergency events;
- C—Means of communication during an emergency event (Švarcová and Navrátil 2017).

The relevance of the individual indicators was obtained with the use of invention methods (brainstorming, brain-pool-writing). The expert group determined the value of the weightings of individual indicators for the selected criteria “Appendix 1” (Tušer and Navrátil 2020). Assessment scales for the given criteria and rules of evaluation for the overall evaluation of the current state of EP at selected emergency medical services were subsequently created.

The basic scheme of the methodology for the assessment of the EP of the emergency medical service for mass-casualty incidents is depicted in Fig. 1, which is divided into three parts:

1. The actual wording of the evaluation criteria;
2. Description of the evaluation criteria;
3. Evaluation criteria, indicators and questions, as qualitatively assessed viewpoints whose fulfillment weighting is assessed during the survey Tušer and Navrátil (2020).

During assessment of the EP of an entity in practice, the evaluation committee determines the fulfillment of indicators in the form of stipulated questions with possible yes/no answers. Each indicator is assessed, its real value calculated according to the relationship (1) and the level of fulfillment of the criterion characterising the given area of EP determined as the overall sum of the values of the indicators.

3.1 Proposal of a methodology for evaluating emergency preparedness

The assessment of fulfillment of criteria and determination of the resultant level of emergency preparedness proceed in accordance with the “Rules for the Evaluation of Criteria and Their Indicators” is given in the Fig. 1.

*Calculation of actual values of weightings of individual indicators is performed according to the relationship:

$$W_{ki} = \frac{N_p \cdot w_{ki}}{N_p + N_n} \quad (1)$$

where W_{ki} the actual weighting of the indicator, w_{ki} the weighting allocated to the i th indicator within the k th criterion, N_p the number of positive answers, N_n the number of negative answers (Weathington et al. 2012).

The resultant evaluation of each criterion and the overall evaluation of fulfillment of the level of EP is defined by the evaluation range in individual intervals. The range of intervals was set by the expert group and in collaboration with the United Accreditation Commission (UAC CR 2016).

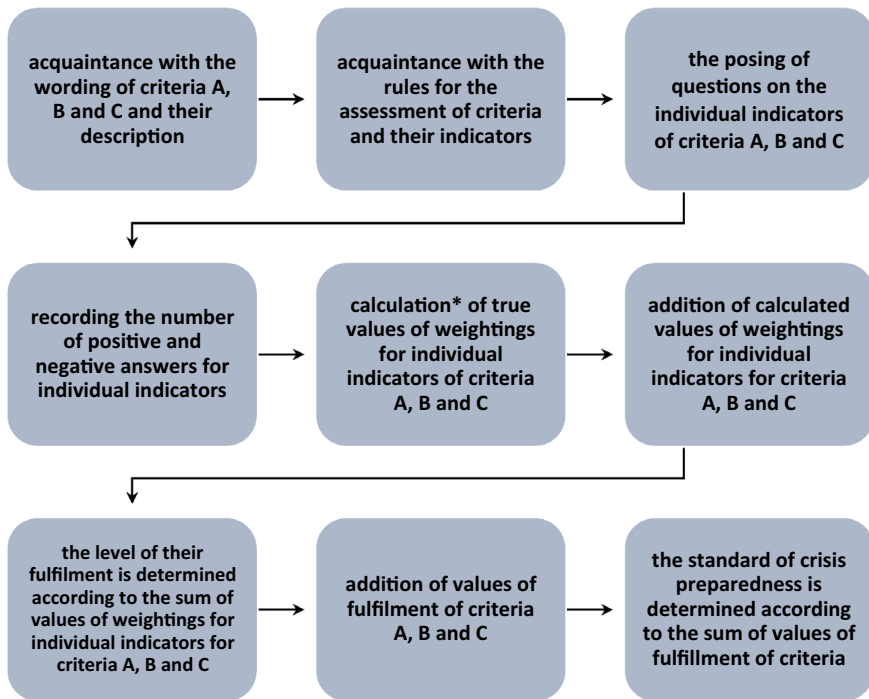


Fig. 1 General scheme of the emergency preparedness evaluation process. *Source:* The authors

The methodology was also transformed into a computer utility for immediate acquisition of the results of evaluation of the level of EP at an assessed unit. During implementation of the procedure in practice, the evaluation commission enters into the computer utility merely the number of positive answers to partial questions for individual indicators of the given criterion. The sum of the values of individual indicators of the given criterion expresses the level of fulfilment of the criterion. An assessment scale is given for the resultant assessment of each criterion:

1. The criterion is met if the total values w_k lie within the closed interval $\langle 0.9; 1.0 \rangle$;
2. The criterion is met in part if the total values w_k lie with the interval $\langle 0.6; 0.9 \rangle$;
3. The criterion is not met if the total values w_k lie within the interval $\langle 0.0; 0.6 \rangle$.

Two conditions have to be met for the overall evaluation of the fulfilment of the desired level of EP of the emergency medical service for mass-casualty incidents:

1. Each criterion is met at least within the interval of values $w_k \langle 0.6; 0.9 \rangle$;
2. The sum of values for criteria w_k is met at least within the interval $\langle 2.6; 3.0 \rangle$.

The relevance of the assessment scale may be further considered and verified during discussion with the trade community at the conferences Urgent Medicine and Catastrophe Medicine (Oulehlová et al. 2017).

4 Research investigation results

The proposed methodology was applied to selected emergency medical services in all regions (14 regions) of the CZ. An evaluation of the level of EP of emergency medical services in all regions of the CZ, according to the methodology put forward, is given in Table 1. The answer to the research question is that 8 regions in CZ did not meet the stipulated level of criteria.

Further verification, e.g. supplementation of the methodology, is possible in the resolution of mass-casualty incidents arising or during exercises focusing on similar issues. The application of the methodical assessment procedure in practice from the viewpoint of an emergency manager can also be understood as a tool of self-assessment (internal audit) for determination of the standard of EP of a given funded organisation without the intervention of an external entity.

5 Findings and recommendations

The respective survey research conducted in 2017 and 2019 has demonstrated:

- The need to introduce unification of documents in all EMS of individual regions of the CZ, and possibly consider establishing centrally managed EMS in the CZ;
- The need for unification of communication technologies of all bodies cooperating in the IRS;
- Staff of healthcare facilities (hospitals) do not know the point of contact where they are obliged to call if their lives or lives of their patients are at risk;

Table 1 Evaluation of the standard of emergency preparedness of emergency medical services in fourteen regions of the CZ

Region	Fulfilment of criteria			Sum of values of criteria	Verbal assessment of emergency preparedness
	A	B	C		
I	0.9157	0.8567	0.8728	2.6452	Stipulated level met
II	1	0.7591	0.7676	2.5267	Stipulated level not met
sIII	1	0.7302	1	2.7302	Stipulated level met
IV	0.8083	0.6489	0.8948	2.3520	Stipulated level not met
V	1	0.6625	0.7261	2.3886	Stipulated level not met
VI	0.7951	0.7986	0.9364	2.5301	Stipulated level not met
VII	0.6876	0.6232	0.8948	2.2056	Stipulated level not met
VIII	0.8793	0.9609	0.9364	2.7766	Stipulated level met
IX	0.8793	0.9284	0.8948	2.7025	Stipulated level met
X	0.8793	0.6625	0.7261	2.2679	Stipulated level not met
XI	0.6749	0.9317	0.8947	2.5013	Stipulated level not met
XII	0.8185	0.9317	0.8748	2.625	Stipulated level met
XIII	0.8733	0.8637	0.8947	2.6317	Stipulated level met
XIV	0.8793	0.7983	0.8947	2.5723	Stipulated level not met

Source: The authors

- Still prevailing no uniformity (differences) in the formats of sorting and identification cards used for triage in mass casualty incidents. (Recommended procedure of the Committee of the Czech Medical Association of J. E. Purkyně, 2009). Some regions do not follow the recommended procedure for card unification. The cooperation of physicians, rescuers from more regions in dealing with a major emergency can thus be negatively affected.

The above findings shortcomings persist even today as reconfirmed at the International Conference of Disaster Medicine 2019 in Hradec Králové, CZ, by the Deputy Minister of Health of the CZ (Prymula 2019).

For the above reasons, the following recommendations and measures to improve emergency preparedness of EMS in the case of mass casualty incidents are proposed.

Harmonization of competences and activities of all EMSs operating in individual regions of the CZ can be achieved by:

- Amendments to legal regulations;
- Implementation of accreditation standards;
- A larger number of staff involved in the preparation and solution of emergencies and/or emergency situations (Svarcova et al. 2015);
- Harmonization of resources needed for emergencies and/or emergency situations, including compatibility and reliability of the means of communication with core and external organizations in the IRS and with other healthcare facilities;
- Systematic and continuous (lifelong) education of emergency management staff (emergency management) (Tušer 2020; Hoskova-Mayerova (2016); ;
- The willingness and ability of inter-ministerial effective communication and interoperability (Ministry of Health vs Ministry of the Interior), but also between partly state-funded organizations and other IRS agencies.

The application of the above measures is fundamentally affected by financial resources and the degree of professionalism of the stakeholders (Kudlák et al. 2020).

6 Conclusion

The basic principles leading to an increase in the quality of the emergency preparedness of the emergency medical service consist of the elimination of shortcomings determined following analysis of interventions at mass-casualty incidents, evaluation of tactical and verification exercises and the implementation of the relevant knowledge and experience from published analyses of previous mass-casualty incidents in this country and abroad. Processes of evaluation of the quality of the emergency preparedness of the emergency medical service for possible emergency events must also proceed continually alongside this process. At the present time, however, the assessment tools used do not give the necessary consideration to all the specifics in the activities of emergency preparedness in urgent pre-hospital care, and the accreditation standards do not provide comprehensive assessment of the emergency preparedness of the emergency medical service for the handling of mass-casualty incidents.

The current method for increasing quality and assessing the emergency preparedness of the emergency medical service is also disparate and is not subject to comprehensive control. Expert discussion focusing on consideration of the suitability of the application of a uniform methodical procedure, system harmonisation, deployment of units and means, and progressive introduction of evaluation criteria, which would allow comprehensive assessment and comparison of funded emergency medical service organisations, is highly necessary.

The article presented here, focusing on a methodology for the evaluation of EP, accepts these facts and is one contribution to the discussion as to how to proceed in the assessment of the EP of the emergency medical service.

The methodological procedure described here can also be used in internal audits performed by emergency managers, who can thus assess for themselves the fulfilment of preparedness criteria for mass casualty incidents.

Benefits of the application for practice:

- Makes it possible to assess and compare the level of EP of the EMS in individual regions of the CZ for coping with mass casualty incidents with a higher degree of objectivity;
- Will allow for a systematic introduction and management of changes in the organization of EMS and in the coordination of activities with IRS units;
- Strengthens the cooperation between EMS from different regions during their joint interventions at mass casualty incidents;
- Proposes a set of measures that will contribute to increasing the crises preparedness of the EMS already at the pre-intervention stage (ex ante);
- Conversion of the Methodology for Evaluating Emergency Preparedness of EMS to the electronic format—mobile application enabling evaluations being made in institutions concerned;
- Helps to make a realistic assessment of the current state of EMS Preparedness of EP units in all regions for coping with emergencies;
- Application of the methodical procedure in the organization allows for the assessment of the level of preparedness of EMS for coping with emergencies and critical situations involving mass casualty incidents with a higher degree of objectivity.

The stipulated set of criteria and indicators and the proposed procedure for the assessment of the EP of the emergency medical service need not be definitive. They can be exactified or modified with a view to the type of emergency event, and may be expanded to take in additional areas associated with the required standard of intervention or otherwise adapted in connection with regional specifics.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix 1

See Table 2.

Table 2 Criteria, indicators and their weights

Defined criteria	Indicators of fulfilment of criteria	Weight Indicators w_{ki}
Collaborative preparedness with other units of the integrated rescue system	Coordination with the IRS components (various technical and tactical possibilities limited by space and time, i.e. potential emergency events and their management, procedure)	0.2859
	Joint negotiations, cooperation in developing emergency documentation and preparing exercises	0.2171
	Realization of joint exercises	0.2437
The preparedness of emergency medical service forces for emergency events	Communication—liaison, command, procedures	0.2531
	EMS staff in sufficient numbers (quantity, available forces, territorial deployment)	0.2781
	Systematic and coordinated education of personnel (quality of human resources)	0.2734
	Exercise, held in connection with potential emergencies	0.1718
	Comprehensive exercise records/participation, joint training	0.1196
Means of communication during emergency events/emergencies	Evaluation of exercises and the implementation in the planning documentation	0.1568
	Knowledge of the use of means of communication	0.2781
	Methods of communication among the IRS components (practising during exercises)	0.2484
	Information and communication technologies (reliability, modernization, compatibility)	0.256
	Method of communication failure or electrical power technology	0.2093

Source: Tušer and Navrátil 2020

Appendix 2

See Fig. 2.

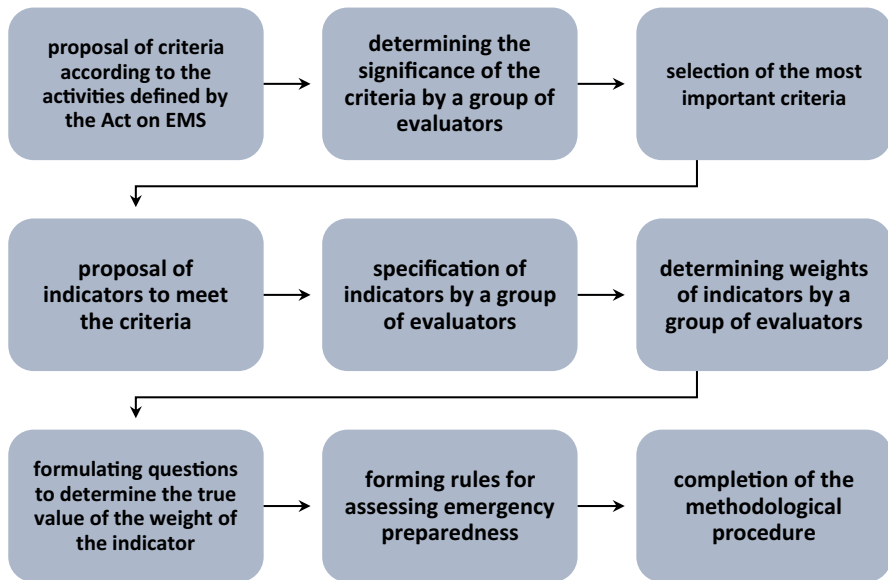


Fig. 2 Algorithm for creating a proposal for a methodological procedure for evaluating emergency preparedness *Source:* Švarcová and Navrátil 2017

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