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CRITERIA CONSIDERATIONS FOR ESTABLISHMENT OF HEMS OPERATIONS

ABSTRACT

The importance of the "golden hour"; for optimal efficiency of helicopter operations in emergency medical service (HEMS) to meet the "golden hour" requirement the unconditional requirement is to establish a net of operational units to cover the entire area of the Republic of Croatia, capable to operate within wide integrated area (international services). It is additional back-up, not a competition to road and sea EMS vehicles. The required standards; HEMS operation, following complementary traffic policy, i. e. complementary policy in line of traffic system integration within wider region, with reference to standards, must entirely comply with globally accepted standards. Republic of Croatia's obvious objectives are traffic integration into EU (European Union) traffic system. Cost analyses; It is stressed that coherent traffic policy can by certain instruments reduce traffic assigned external cost in national budget. Significant traffic external cost includes cost of traffic accidents, environment impacts and traffic jams, and could be reduced by establishment of multi-purpose helicopter operations. SWOT analyses should be made as for any other strategy or project. Technical-technological criteria and other considerations; Considering technical-technological criteria for relief of critical situations in traffic, it is obvious that one helicopter type cannot comply to all multi-purpose requirements that traffic sets before us – EMS on open roads, sea, mountains and urban traffic congested area, and search and rescue operations. However, common factor for all types is compliance to global standards and regulations. In the paper, some examples of HEMS operations in the EU States are mentioned.

KEY WORDS

Emergency Medical Service (EMS), Helicopter Emergency Medical Service (HEMS), Mobile Medical Team (MMT), Air ambulance, Search and Rescue (SAR)

1. INTRODUCTION

Regardless of internal government structure and organization, every state must establish, organize and

finance a system that assures all citizens Health and Welfare over the entire state area. That includes centres for EMS. Most EMS centres have mobile EMS teams –MMT- to provide first professional help on the site where it is needed. Increasing production, improved living standard, traffic and overall development is unfortunately accompanied by the increasing needs and demands for mobile EMS. To assure efficient EMS over a large area within a given short period of time, the establishment of air mobile EMS teams appeared as an imperative. Furthermore, efficient EMS system, not only within the state area, requires mutually approved standards that have already proved to meet all the requirements and satisfactory level of efficiency. This paper deals with various criteria that have to be considered and/or accepted as standards to which HEMS must comply with within EU EMS systems.

2. THE "GOLDEN HOUR" CRITERION

One of the characteristics of EMS or a trauma centre (the word 'trauma' comes from Greek and means 'wound') is the obligation to be able to send out a specially trained and equipped team 24 hours a day, 7 days a week in the event of serious accidents. Such a team is called a Mobile Medical Team (MMT).

The "Golden hour" is based on the fact that a victim with serious internal bleeding can stay alive for around one hour. If a doctor can take immediate action on site and stabilize the vital functions, the victim has great chance to survive and recover. The victim must get a follow-up treatment at a hospital within the first hour of accident.

Therefore, in trauma care, it's all about speed. This is nothing new, and ordinary mobile ambulances do this as well. Why do we need then to improve efficiency of EMS system with air mobile ambulance or

'trauma helicopters', to help seriously wounded people, and what is the big difference?

Well, the difference when using a helicopter to transport MMT provides following advantages:

Helicopter flies in a straight line with a maximum speed of 240-250 km/hour; therefore, MMT is able to reach any location within a radius of 60 kilometres of the operational base within 15 minutes. By the virtue of its vertical performance characteristics, it can land on any nearest suitable obstacles-free area.

The short response and travelling times mean that the MMT gets to the accident site much quicker, saving time during the period immediately after the accident. As most often serious accidents and acute medical problems occur within a large area, the only possible means to act within the "golden hour" - for all citizens over the entire area - is to back up EMS centres with helicopters (in addition to ordinary road and/or sea vehicles to transport MMT). Such a concept enables EMS system flexibility to respond efficiently over the water and/or land, day and night under all weather conditions. This can save lives.

3. REQUIREMENTS APPLICABLE FOR HEMS OPERATIONS

There is a set of requirements that an HEMS operation must comply with, with reference to vehicle (helicopter) itself, flight crew, MMT, equipment, operation procedures etc.

3.1 Helicopter characteristics criteria:

- *Minimum dimensions*; There must be enough space in the helicopter for two crew members, a doctor, a passenger (trainee) and at least one patient, lying down. In addition, there must also be room for the medical equipment and flexible stretcher to load the victim.
- *Maximum dimensions*; The helicopter must be as small as possible to enable it to land in as many places as possible. This is particularly important for built-up areas, but also applies to landing at hospitals which do not have a helicopter landing pad.
- *Weight*; It is important to keep the weight of the helicopter down to increase the performance and reduce the downwash (air displacement). Downwash may be particularly inconvenient in the immediate vicinity of an accident and in built-up areas where there are often a number of bystanders.
- *Vibrations*; When patients are transported, vibrations must be kept to a minimum as that increases their oxygen consumption, and oxygen is the most

important factor for survival. It has been proven that vibrations increase the patients' stress levels.

- *Noise level inside the helicopter*; Noise also increases the patients' stress levels. The condition of patients is often such that they are not able to wear ear protectors. In most cases, the only solution is to sedate the patients, so that they are less aware of their surroundings (if this has not already been done).
- *Noise level outside the helicopter*; HEMS helicopters often land at sites where lots of people live. The helicopter landing pads are also usually right next to or on the roof of hospitals, as a rule in built-up areas. Because helicopters have to land and take off frequently, a great deal of attention must be paid to reducing the level of noise caused by this.
- *Safety precautions*; Given the nature of accident sites, specific safety measures must be taken. For example, the main rotor must have high mounting, and the exhaust fumes must be dispersed. The tail rotor must also be protected to prevent the bystanders and members of the emergency services from being injured.
- *Start-up and shut-down*; A very short start-up and shut-down time for the engines is essential so that the helicopter team can reach the patient and transport him or her as quickly as possible (that implies turbine engines).

The European minimum requirements and approved legislation for helicopter performances and flight operations are numerous, dealing with operations, equipment, structure, maintenance etc. and are globally and mutually accepted by most EU and non-EU States. For HEMS international cooperation within EU, complying with this standards is a must.

3.2 Helicopter flight crew criteria

Air ambulance is in principle called out for all life-threatening situations and the pilot also often witnesses these situations. A pilot may also assist at the scene of the accident (preparing medicines and/or drips, getting extra materials from the helicopter, etc.). The pilot must therefore also be a team player. The following specific characteristics distinguish HEMS operations from other aviation jobs:

- An EMS helicopter should land anywhere where there is an obstacle-free space of approximately 25 by 25 metres.
- There is usually only one pilot per helicopter (for day operations).
- The average flight time is approximately 8-10 minutes.

- When in service, the aim is to be in the air in just 2-3 minutes after receiving the call (mission assignment).

The above points should be taken into account when drawing up the European minimum requirements for HEMS pilots. These requirements are determined in JAR-OPS 3 (Joint Aviation Authorities Part 3 Commercial Transport with Helicopters). The minimum requirements to work as a pilot in command for Medical Air Assistance are:

- at least 1000 flying hours as pilot in command of aircraft, of which at least 500 flying hours must be as pilot in command of helicopters, or a minimum of 1000 flying hours as co-pilot in HEMS operations, of which 500 flying hours must be as pilot in command under supervision and 100 flying hours as pilot in command of helicopters.
- 500 flying hours of experience in helicopters in an operational environment comparable to the future HEMS operation.
- HEMS pilots who are deployed during night-time operations must have at least twenty night-time flying hours as pilot in command.

The pilot selection procedure also includes a psychological examination at the Aeromedical Institute. During this examination, attention is paid, among other things, to the pilot's ability to cope with stress, his/her team qualities and the possible influence of medical and/or emergency-related factors on the decisions made during flights.

3.3 Additional skills for Helicopter Mobile Medical Team

The *doctor*, a surgeon or anaesthesiologist should pass specific training in emergency medicine at the site of an accident. She/he takes immediate action on site and stabilises the victim's vital functions. The helicopter doctor does not have any tasks relating to the actual helicopter flight but is the one who deals with the communication with the Emergency Room in the hospital. However, they should be familiarized with helicopter flight and technology, as well as communication and medical equipment operation and availability in the helicopter.

The *nurse* or paramedic should have attended a course in aviation communication and navigation. During the flight, she/he can act as the by sight. Because the helicopter nurse must be able to assist the pilot as a member of the crew, he or she must also be familiar with the helicopter technology.

In a multi-purpose helicopter a fourth crew member is required as winch operator and/or pilot's assistant (a nurse/paramedic in that case is winch-flyer).

4. COST ANALYSIS AND FINANCING

HEMS operation within State EMS system requires additional infrastructure (dispersed "bases" in sufficient number to cover the entire State area), sufficient number of highly sophisticated helicopters, EMS equipment, multipurpose communication system and highly educated and trained personnel. All of it implies additional higher costs compared to ordinary EMS. However, most EU states found such concept as the only one that complies with the "golden hour" criterion and thus justifies the cost. Namely, the majority of accidents are caused by automobile traffic (70%) which are accompanied with extremely high "external" costs (heavy traffic jams lasting several hours and kilometres of cars, polluting environment and causing several hundreds thousand hours of delays – up to 14% of gross national income). Many studies proved that reducing external traffic costs and saving lives more than justifies the cost of HEMS.

As the majority of accidents are caused by traffic, most EU States HEMS operations are established as "public-private-partnership" and/or joint with state auto club, supplementary financed by Health and Welfare Department and additionally by the auto club membership fees.

4.1 Cooperation with State Departments

HEMS must be incorporated into the State EMS system to achieve efficiency; therefore, a close cooperation and coordination, not only with Health and Welfare Department, but also with the police and fire brigades is a must. Acknowledging that fact, the EU States have set up "SOS 112" where by calling the unique number the whole system is alarmed, and most appropriate medical, fire and/or police actions are initiated to resolve or relief any incident/accident.

4.2 "Multi-purpose Helicopter Operations System"

Fire and police Departments are also very often in need of air support and a "multi-purpose helicopter operations system" may result with higher utilization and improved cost efficiency. For example, the existing HEMS operation is already equipped for part of "Rescue" services. With additional equipment, as search light, thermo/IR camera, the same helicopter may be efficiently operated for "Search" operations, i. e. to serve as HEMS and Search & Rescue helicopter.

A helicopter equipped with thermo-camera can serve excellently in the wild forest fires prevention, by spotting heat sources (before the fire starts), or can be used for police patrol, borders patrol etc.

In such a case, "multi-purpose helicopter operations system" with additional equipment to meet the requirements, cannot rely only on auto-club member's fees for supplement financing (Police and Fire Departments are financed from the state budget) as auto-club members should not finance "leisure accidents relief" such as hunters, climbers, scuba divers, yacht club members etc. Moreover, the requirements for such operations differ from HEMS road accidents, and one type of helicopter can hardly provide the optimum. A combination of min. 2 types may provide satisfactory optimum with reference to cost and efficiency of the entire "multi-purpose helicopter system". Geographical characteristics (sea, high mountains, area and temperature) will form additional criteria to be met. Extensive study is required to evaluate additional costs and possible savings, by international co-operations with neighbouring States etc. which may result in the proposal of optimal organization and financing for the multi-purpose system. A "pilot project" (HEMS & SAR) is one way to start with.

5. OPERATIONAL AND OTHER CRITERIA

In Croatia, according to HGSS statistics the majority of accidents happens over the weekends and holidays, mostly in January - May, the majority of victims are males - average age of 40, indicating that those are mostly leisure and sport accidents. To this group we can add in spring-through-autumn period an increased number of crashed and/or lost boats accompanied with drowning (due to sudden storms) and accidents with scuba-divers (decompressions). Open road traffic accidents (high speed collisions) and wild forest fires (burns/evacuation) are prevailing during summer period, while urban and open road traffic accidents are present all year round, just as gun and stab wounding. This implies the need for continuous EMS duty time - a 24 hours 365 days operative system.

5.1 System establishment and professionalism criteria

HEMS is in principle called out for all life-threatening situations. With reference to all year-round required EMS implies the need for professional EMS system supported by HEMS to cover open wide areas with well trained personnel for all kinds of operations (at sea, on open roads, high mountains, and forest and in the city). This cannot depend on voluntarism, and the system must be organized, equipped, trained and financed, with established procedures, duties and responsibilities (SOS 112). The division of tasks and supports must be planned and laid down, so that the

victims are assisted as effectively as possible and the safety of personnel at the site of the accident is guaranteed. SAR operations may be supported by local or regional voluntary - non-commercial clubs or organisations (GSS, DVD), and in case of disaster by the army.

5.2 System cooperation criteria

If there has been an accident somewhere, someone calls 112. The operator who answers the 112 call decides whom to alarm. There are special rules for this and the most usual scenario is organized to the following procedure:

EMS centre; Accident is reported to the EMS centre, the operator decides whether or not to deploy the helicopter and passes the call on to the nearest heli-base via a separate reporting system. During the flight, the information is given through in detail;

Ambulance services; Only the ambulance personnel on site can cancel the helicopter, also via the EMS centre. A helicopter team is never sent instead of, but always in addition to the ordinary ambulance. The heli-team does not take over the tasks at the site of the accident, but works together with the ambulance personnel to provide the best possible help to ensure that the patient is in as good condition as possible. The patient is in general transported to the nearest suitable hospital by ambulance car or a helicopter;

Fire Brigade; It is very important that the ambulance and helicopter teams work together with the fire brigade at the site of the accident. If victims are trapped in a damaged car, then the members of the fire brigade will do everything they can to free the victim. The MMT monitors the patient's condition while this is going on. It is also important that the various emergency workers know what and why the others are doing in a specific way. Staff are regularly trained for this cooperation;

Police; The police are responsible for safety around the helicopter and at the site of the incident. The pilot will decide where to land the helicopter, since s/he has the best overview from the air and will land as close to the accident as possible. However, if it is not possible, if necessary, the police will transport the Heli-MMT to the accident. The police usually take over the guarding of the helicopter.

5.3 HEMS deployment criteria

In case of *primary deployment*, the helicopter flies out on the basis of the initial report of an accident. The operator at EMS centre takes the call via 112 and by a set of questions can assess how serious the patient's condition is and decide whether or not it is necessary to send out HEMS. The key criteria for this include:

1. Serious (traffic) accident;
2. High-speed collision;
3. Fall from a height;
4. Several seriously injured victims;
5. Ambulance would take a long time (or too long) to get there;
6. Hypothermia;
7. Gun or stab wounds;
8. Serious injuries or severed limbs;
9. Burns and drowning.

Sometimes the situation at the site of the accident is much more critical than expected. At the request of the ambulance personnel on site, the EMS operator will then call out the HEMS. This is the *secondary deployment*. The key criteria for this include:

1. Obstructed air passage and/or breathing difficulties;
2. Circulatory difficulties;
3. Possible loss of consciousness;
4. Traumatic amputation or need for amputation of a limb.

Secondary deployment includes also another possibility for use of HEMS. If patient in a critical condition was admitted to a hospital, and it becomes clear that this patient cannot be properly treated in that hospital, immediate transfer to a more specialised hospital centre is often the only (life-saving) solution in such a case. In certain cases, HEMS or air ambulance is used for this type of transfer even to another country.

5. CONCLUSION

For optimal efficiency of a EMS to provide medical help on the site, for all citizens over entire state area, the most critical criteria is to meet the requirement of the "golden hour". The only possibility to act over a wide area and within the shortest possible time is by HEMS, established as a net of operational units covering the entire area of the Republic of Croatia, capable also to operate within a wider integrated area (international services).

HEMS operations, following complementary policy of traffic system integration within EU region, with reference to legislation, must entirely comply with the accepted standards and regulations implemented for medical and flight operations. This implies that helicopters and crew teams must comply with such requirements. A unique 112 "alarm" centre must be established, professionally organized, equipped and personnel trained to achieve the required level of system efficiency. Efficiency will depend on a numerous set of different criteria that have to be considered and determined. All of it requires extremely sophisticated

equipment and technology, dedicated and trained professional personnel that is obviously costly, but forms a system that saves lives and more than justifies this higher cost.

It does not take just good will and money to establish such an efficient system (112) but it also takes time. One cannot just "buy" a pilot, doctor, and helicopter and form good HEMS; it takes time (few years) to educate and train each member of the team and to improve coordination of each team member and of the system. HEMS operations have been studied, analyzed and approved all over the world, and experiences have been accumulated. The question is therefore not why we have to do it, how we have to do it or does it pay to do it, but whether we are willing to ensure safe lives and how much more time we have left before we start.

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SAŽETAK

UTJECAJNI ČIMBENICI ZA USPOSTAVU HEMS OPERATIVE

Značaj "zlatnog sata"; Za optimalnu djelotvornost helikopterske operative u zbrinjavanju stradalnika, (Helicopter Emergency Medical Service – HEMS) neizostavno je za udovoljenje zahtjeva za djelovanje unutar "zlatnog sata", uspostaviti decentraliziranu mrežu operativnih jedinica za djelovanje po čitavom teritoriju RH i sposobnošću djelovanja unutar šire integrirane regije (djelovanja međunarodno). To je nadogradnja a ne konkurencija u zbrinjavanju stradalnika cestovnim i pomorskim prijevoznim sredstvima. Zahtijevani normativi; HEMS operativa, slijedeći usvojeno načelo komplementarne prometne politike, odnosno politike usklađenja s temeljnim ciljevima integracije prometnog sustava u širu regiju, s aspekta normative, mora biti u cijelosti komplementarna globalno usvojenim normativima. Očigledno su ciljevi RH, integracija prometnog sustava u EU sustav. Troškovna analiza; Naglašava se da koherentna prometna politika može također pridonijeti smanjenju rashodne veličine državnog proračuna u prometni sektor instrumentima za smanjivanje eksternih troškova. Značajni eksterni troškovi prometa, uključuju troškove stradanja u prometu, štetnog djelovanja na okoliš i prometnih zagađenja, a mogu se umanjiti uspostavljanjem višenamjenske helikopterske operative. Pri tom je, kao i za svaku strategiju ili projekt neizostavno potrebno načiniti SWOT analizu. Tehničko-tehnološki kriteriji i ostali čimbenici; Razmatrajući osnovne tehničko-tehnološke kriterije helikopterske operative za potporu u kriznim situacijama u prometu, očigledno je da samo jedna konstrukcija ne može udovoljiti svim višenamjenskim zahtjevima,

koje promet pred nas postavlja - zbrinjavanje stradalnika na cestama, moru, planinama i u urbanim sredinama s prometnim zagušenjem te djelotvorno izvođenje operacija traganja i spašavanja. Međutim, zajednički nazivnik svim konstrukcijama je udovoljenje i sukladnost globalno usvojenim normativima i standardima. U radu se navode pojedini primjeri i modeli HEMS operative u državama EU.

KLJUČNE RIJEČI

Emergency Medical Service (EMS), Helicopter Emergency Medical Service (HEMS), Mobile Medical Team (MMT), Air ambulance, Search And Rescue (SAR)

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