# The ability of Lithuanian ambulance services to provide first medical aid in trauma cases

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***Key words:*** *first medical aid; emergency medicine quality; emergency medical procedures; emergency medicine resources.*

***Summary.*** *Objective. To evaluate the ability of country ambulance services to provide first medical aid in trauma cases.*

*Material and methods. A survey of chiefs of emergency medicine service was performed in October–November 2005, in which 34 of the 59 institutions (58%) were participating. The questionnaire presented questions concerning physical and human resources, performance values, and system configuration.*

*The study has shown that emergency medicine service operates in radius of 23 km, each team providing service for about 40 000 inhabitants. Taking into consideration distance and average on-scene time values, emergency medicine service is capable to render the first medical aid within so-called "golden hour" in case the accident is reported immediately. The physical resources are not quite complete. Not all the cars are equipped with essential first aid measures. Among more rarely found resources are vacuum pumps, intubation sets, defibrillators, vacuum splints, back immobilization devices, and hammock immobilization devices. There are less mentioned resources than working teams and even more than two times less than emergency cars at all. Two-thirds of the operating emergency medicine services do not provide advanced life support procedures. The evaluation of theoretical/practical ability to provide some important medical procedures used in emergency medical care showed that medical staff quite often fails to perform defibrillation, intubation, and pleural cavity drainage.*

*Conclusions. Country ambulance service network configuration according to area under service, number of people served, and response frequency comply with the requirement set. The ambulance vehicles lack complete set up as well as some important supplies. Only rarely the staff is skilled enough to perform such advanced life support procedures as intubation, defibrillation, and pleural drainage.*

## Introduction

"Vital functions start to decline immediately after trauma and traumatized patient have a chance to survive only in case if the first medical aid is provided without delay. According to different sources, the most part of traumatized patients will die before first medical aid will be supplied, and most of those who will survive all the rest of their life will suffer from disability." This is what the World Heath Organization (WHO) members say trying to get more attention paid to constantly growing traumatism problem all over the world (1).

Each day about 16 000 persons worldwide die because of traumas (3200 of them because of road traffic accidents), and in addition to every death, we have several thousands of the injured. Most of them remain disabled for all their life (2). Sixteen percent of all diseases and deaths due to traumas are more frequently seen in countries where persons have low and middle incomes. Besides, 90% of traumas occur in these countries (2). In 2004, World Bank assigned Lithuania to middle-income countries.

Therefore, it is not surprising that the level of traumatism in Lithuania is high as compared to other European countries. Detailed data are presented in WHO database. Nevertheless, it is surprising that Lithuania, according to the last available data of the year 2003, takes leading positions for external trauma causes and intoxications not only among European countries but former Republics of the Soviet Union as well (3).

Thus, high demand for emergency medicine service (EMS) remains and, due to population aging,

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keeps growing (4). Evidently, patient health prognosis depends on this service performance (5, 6), and the main aim of the ambulance service is to avoid health status worsening of a patient on the way to the closest hospital.

At the first look, such a simple task is not easily accomplished, and the quality of emergency medicine service is more and more frequently discussed (7–9). The first studies were published in early 1985, and they showed that there is a possibility to diminish considerably mortality due to traumas by applying a quality management system (10). Implementation of systemic approach to emergency medicine service resulted in reduced mortality rates in other countries as well (5, 6, 11).

Present level of medical and technical science permits early diagnosis and treatment of traumatic patients so that in most cases they are given chances to survive and live a regular independent life (12). That is why the primary goal of EMS is its prompt response (12–17). For this reason, emergency medicine network configurations should allow service personnel to reach the injured no later than indicated by the accepted regulations and standards. Following the example of other countries, in 2004 a set time during which ambulance must reach scene place was first defined in Lithuania (18).

Seeking the best quality to meet time criteria is actually not sufficient. WHO describes factors that have impact on the quality of emergency medicine service. They are education, human resources, equipment and medical supplies.

In most developing countries, too little attention was paid to education optimization. Such a situation resulted in deplorable outcomes and lack of knowledge and practice required (19–22). Therefore, teaching and qualification improvement is considered a priority branch of medicine, requesting a proper development (20, 23–26). As proven later, the countries under quality/qualification improvement programs later tend to have better outcomes (19, 23, 27–33).

Speaking about the measures, it is worth mentioning that their physical availability does not necessarily ensure the best results, yet the lack of them may be fatal (34). The first medical aid measures in most cases are not expensive and complicated and, therefore, are affordable. Thus, shortage in them is considered as the problem of organization and planning rather than availability of the measures itself (19, 27).

In 2003, Lithuanian Minister of Health signed an order by which the list of essential measures needed for the first medical aid was set (35). Some of them during transition period until 2007 are not essential; therefore, the system will start to function fully after that period.

Another problem is that in some cases, there might be physical availability of the measures, but their handling, due to certain reasons, may be poor. It is believed that the implementation of quality improvement programs (medical audit) might become one of the measures for the problem solving (21).

**Methods**

In Lithuania during October–November of 2005, a survey of EMS chiefs was performed with an attempt to investigate physical and human resources, services performance and network configuration of emergency medicine service stations. There were 28 questions included in the questionnaire. Questions about covered area, number of inhabitants, ratio of doctors to nurses employed, number of emergency calls were received during the preceding month, percent of the patients brought to the hospitals were presented, and questions about number of emergency medicine teams working during the night and day shifts, amount of available vehicles and measures they had been equipped with as well as life saving procedures a staff was capable to perform (including defibrillation, intubation, pleural drainage, puncture of the vein, intravenous drug administration) and ability to carry out a specialized reanimation procedures.

Questionnaires were sent to the chiefs of all EMS stations, asking them to fill in the questionnaires and to return them back. Information acquired by means of inquiry was analyzed using SPSS v12.0 statistical package.

While interpreting the results, the average number of EMS station teams and amount of equipment and ambulance vehicles were calculated. The list of measures was comprised according to approved order of the Ministry of Health and WHO recommendations. Since the availability of the equipment was interpreted in respect to the average number of teams employed in each EMS station, there we found a need to perform a standardization of the average numbers of the EMS station teams. Among all the results, few of them were rather different from the rest, so it was decided to perform their standardization by calculating z values and to exclude from further calculation data the z values of which were 3 or above.

Standardization was performed by calculating z values according to formula:

$$z = \frac{x_i - \bar{x}}{s} \ ,$$

where: $x_i$ – i member of the sample population; $x$ – mean of given sample population ($x_1, x_2 \ldots x_n$); s – standard deviation.

Having applied standardization, further calculations describing availability for first aid equipment and ambulance vehicles in EMS stations were made. Primarily, means of the available equipment and vehicles for statistical country EMS station was calculated. Later these data were compared with the mean number of teams working in one EMS station. Further it was investigated which essential first medical aid procedures EMS teams are able to perform and whether it is dependent on the time of the day. The data were analyzed as follows: first it was calculated what proportion of teams was able to perform certain procedures on the daytime and night shifts, then the values were compared among themselves in order to find out if the difference between the day and the night shifts was significant.

**Results**

According to the data of Lithuanian Health Information Center, in 2004 there were 16 EMS stations and 43 departments operating in the country.

A total of 34 randomly selected institutions participated in the survey, and this made up 57.6% of all EMS institutions in the country.

*1. EMS activity*

According to the data obtained, each EMS station receives about 972 emergency calls a month. Since there are 30 days in a month, it might be recalculated that each EMS station responds to 24 emergency calls daily or it one call an hour. The average area where EMS station operates is 1644 $m^2$ or it covers the radius of 23 km if the supposed area is circle-shaped. In this area, EMS stations provide service to approximately 40 000 inhabitants (P=0.036).

Most of the interviewed respondents (81.2%) agreed that 21–60% of their patients had been hospitalized for further examination or treatment. In 15.6% of cases, the patients' hospitalization by EMS stations teams was more frequent.

*2. The structure of the EMS stations: teams and staff*

The data obtained show that on the average, statistical EMS station of the country has 4 teams on duty in the daytime and 3–4 at night. The difference in the average number of teams working on the day and nigth shifts is statistically significant, showing that there are fewer teams on duty on the nigth shift (P=0.018). It is also worth mentioning that in 7.1% of cases, EMS station did not operate at nighttime. The distribution of the average number of EMS station teams on the day and night shifts is shown in Figs. 1 and 2.

Each EMS station team employs 3–4 physicians and about 22–23 nurses/assistants in average. However, half of the institutions do not have medical doctors in their teams at all.

*3. Supplies and transport*

Further calculations evaluated the support for the

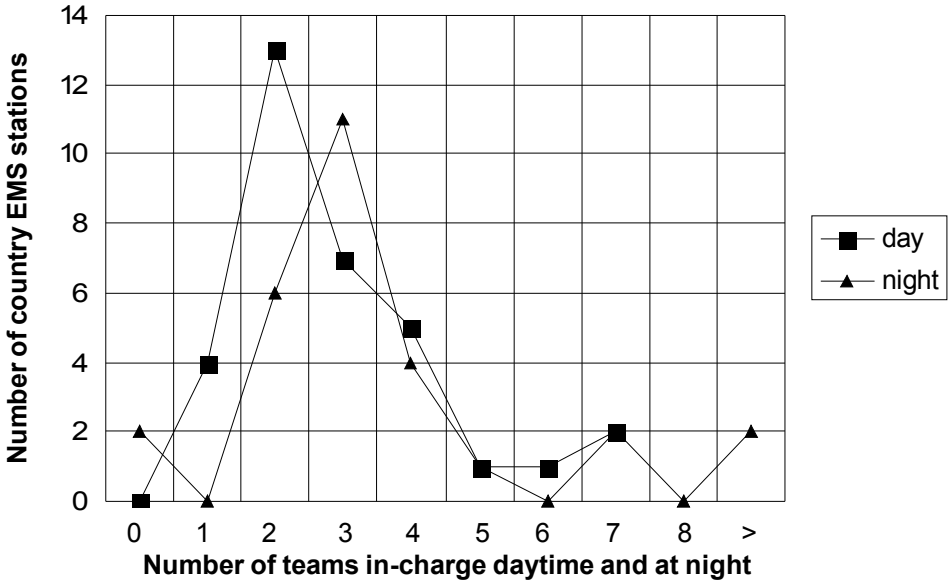


***Fig. 1.*** **The number of emergency medicine service (EMS) stations across the country and their number of teams employed in the day and night shifts**

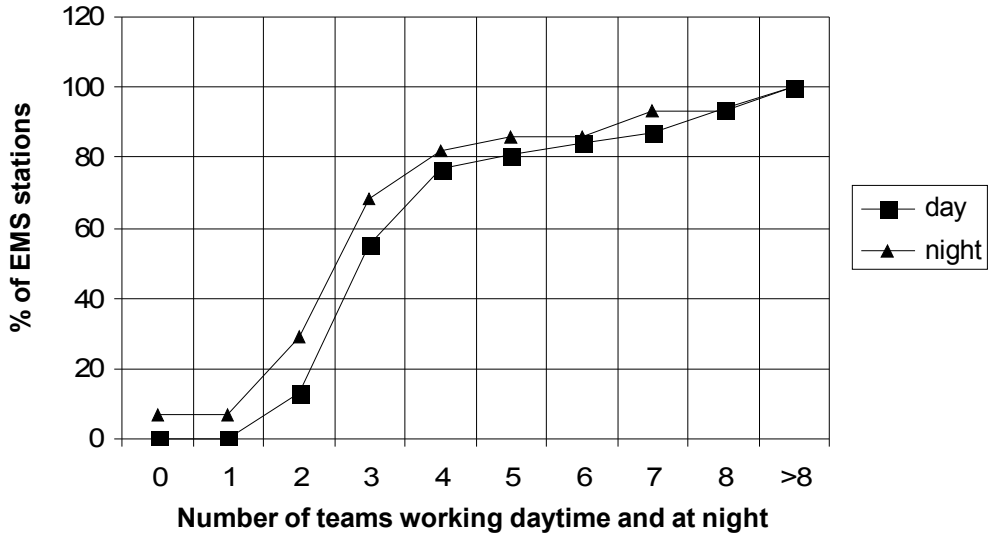


***Fig. 2.*** **Cumulative percentage of emergency medicine service (EMS) stations across the country and number of teams employed in the day and night shifts**

EMS station by certain supplies used for emergency medical aid and emergency medical vehicles. The list of essential equipment was based on the WHO recommendations and the order (No. V-4228) of the National Health Minister issued in 2003. According to respondents, each EMS station has approximately 6–7 ambulance vehicles. The mean numbers of cervical collars, oxygen supply systems, and ventilation bags in each EMS station were 6.28, 5.72, and 5.38, respectively. This leads to a conclusion that the mentioned equipment might be found almost in every ambulance car. They are less equipped with suction pumps and intubation sets (mean numbers of 3.72 and 3.19, respectively). Even worse equipped vehicles have defibrillators, vacuum mattress, and backboards (2.9 (1.67 automatic), 2.78, 2.61). Scoop devices (1.31 units/EMS station), status monitors (0.81 units/EMS station), and artificial lung ventilators (0.81 units/EMS station) were among the most lacking measures. The mean numbers of different supplies that could be found in statistical EMS station are presented in Fig. 3.

Table gives average numbers of the possessed equipment in comparison to the average number (4.26) of employed teams on the day shift within each EMS

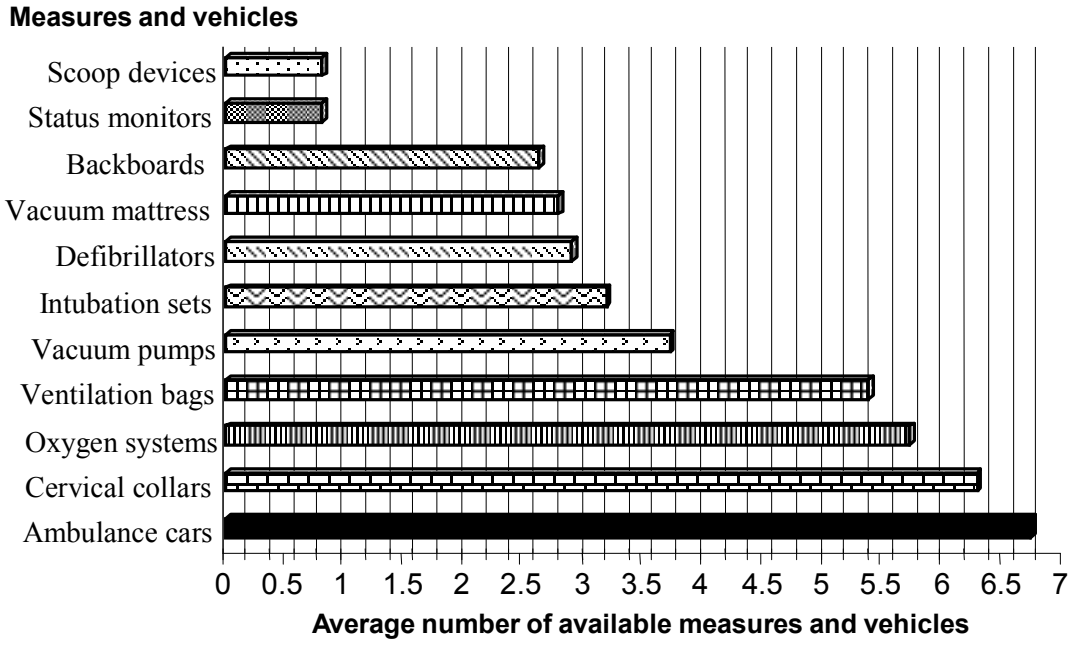


***Fig. 3.*** **Statistical emergency medicine station supply by first aid measures and ambulance cars**

***Table.*** **Amount of measures and vehicles available for one emergency medicine team in statistical emergency medicine service station**

| Measures and vehicles | Units/team |
|---|---|
| 1. Status monitors | **0.19** |
| 2. Scoop devices | **0.19** |
| 3. Backboards | **0.62** |
| 4. Vacuum mattress | **0.66** |
| 5. Defibrillators | **0.69** |
| 6. Intubation sets | **0.75** |
| 7. Vacuum pumps | **0.88** |
| 8. Ventilation bags | 1.27 |
| 9. Oxygen systems | 1.35 |
| 10. Cervical collars | 1.48 |
| 11. Ambulance vehicles | 1.59 |

station. The summary suggests that 7 out of 10 (not taking into account vehicles) important devices are available in lower quantities than there are working teams in EMS station itself.

*4. Clinical procedures and specialized aid*

Almost two-thirds of the respondents answered negatively to the question about their ability to provide advanced life support. In general, there are about one-third of the EMS institutions that have at least one team capable of providing the advanced life support, as it can be seen in Fig. 4.

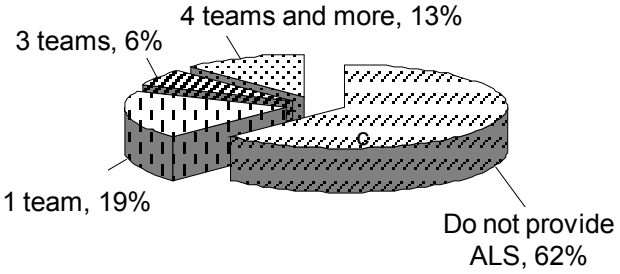


***Fig. 4.*** **Proportion of emergency medicine service stations and number of teams in-charge capable of providing advanced life support (ALS)**

*4.1. Intravenous drug administration*

On the average, four teams in each EMS station are able to administer intravenous drug in the daytime. No difference was observed between number of teams capable to perform procedure and the average numbers of employed teams in EMS station on the day shift in general. This allows concluding that all the staff within EMS station in the daytime is able to administer drug intravenously (Fig. 5). At nighttime, 3–4 teams were capable of drug administration intravenously, and the difference between average number of working teams and the ones capable of performing the procedure was not statistically significant. This suggests that almost

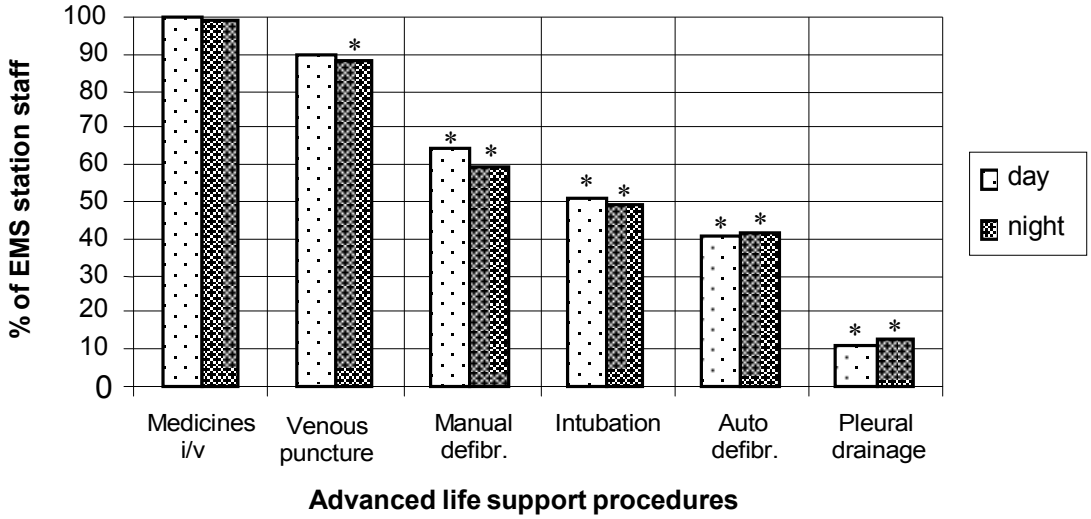


***Fig. 5.*** **Percentage of statistical emergency medicine station staff capable to perform advanced life support procedures on the day and night shifts**

(Day – indicate day shift, Night – night shift. Medicines i/v – capability to administer medicines intravenously. Manual defibr. – capability to perform defibrillation by means of manual device. Auto defibr. – capability to perform defibrillation by means of automatic device. Asterisk marked bars indicate statistical significance, $P<0.05$, when compared percentage of staff capable to perform given advanced life support procedure with the average number of staff working in a given shift).

all the teams working at night are as well good in administering drugs intravenously as their colleagues working in the daytime. It is important to say that the absolute number of the staff who is able to perform intravenous drug administration at night is statistically significantly lower (4.25 – day, 3.64 – night, P=0.012).

*4.2. Puncture of the vein*

Almost all working teams on the day shift are able to perform venous puncture because no statistically significant difference between average numbers of working teams and teams able to perform procedure was found (number of working teams 4.23, able to perform procedure – 3.81, P=0.051). Although statistically significant difference between average number of working teams at night and the ones able to perform venous puncture on this shift (P=0.037) was observed, the difference was not great – 3.67 *vs.* 3.22 (difference by 12.3%). Thus, the numbers implicate that the night shift staff is less potent in performing the venous puncture than the teams working in the daytime (Fig. 5). The absolute numbers of teams able to perform venous puncture at nighttime are also lower (3.79 – day, 3.25 – night, P=0.026), evidently due to less staff employed on the night shift.

*4.3. Pleural drainage*

The proportion of day shift staff capable to perform pleural drainage constituted only some 11.7%. Slightly better result was acquired at nighttime where the proportion of medical stuff able to perform pleural drainage constituted 13.1%. Despite strong tendencies, no significant difference between the proportions of working and able to perform procedure teams on the day and night shifts was observed (P=0.057) (Fig. 5). Thus, results implicate that this kind of medical procedure could be the most rarely used despite its high importance in life saving for the patients with a major respiratory dysfunction thread.

*4.4. Intubation*

A slightly different situation was found when investigating the ability to intubate. Significant difference was found testing the proportions of working teams and able to intubate on particular day shifts. It appeared that only every second team (50.35% in the daytime and 48.5% at night) was able of performing intubation as compared to their average numbers working in a given shift (P<0.01) (Fig. 5). The difference of absolute numbers of teams able to intubate in the daytime (2.0) and nighttime (1.71) was also reliable with error probability P=0.03, showing the less chance to get intubated at night. So again, the emergency medical stuff care in respect of respiratory function preservation might be insufficient as the results do not exceed even half of the desired level.

*4.5. Defibrillation*

Two thirds of the working teams in the daytime (64.8%) are able to perform defibrillation by means of manual device (P<0.01). With the same error probability 58.6% of teams are able perform defibrillation with manual defibrillator at nighttime. Likewise, in preceding situations, probably due to a smaller number of the employed staff at nighttime, there are statistically fewer teams able to defibrillate with the manual device (P=0.026) (Fig. 5).

There were 40.5% of teams able to defibrillate by automatic defibrillator in the daytime (P<0.01) and 41.1% (P<0.01) at nighttime. Contrarily, no statistically significant difference was found between absolute numbers of teams capable to defibrillate by means of automatic device in the daytime and nighttime (P>0.05) (Fig. 5).

**Discussion**

*Structure of EMS system*. Most of EMS institutions operating in Lithuania are comprised of 3–5 teams. The difference between the absolute number of teams working at daytime and nighttime is statistically significant which implies that every second EMS station at nighttime has one working team less than in the daytime. There are considerably more working teams in larger cities stations, but their number, like in rest of the country, is proportional to the number of population served and complies with the regulations issued by national Health Minister Order (36). The ratio of the medical doctors to nurses/doctor assistants employed in country EMS station is close to 1:7.

*EMS performance*. Each EMS station (excluding stations in the largest cities) gets about 24 emergency calls a day or approximately 1 call an hour. Taking into consideration that there are two working shifts, and an average number of teams employed, it may be calculated that one team meanly responds to three calls during a shift. Therefore, frequency of response of emergency medicine teams to emergency calls (0.25 calls/hour) complies with the mentioned regulations (36). National Health Minister Order requires that ambulance car would arrive to the place of the scene not later than in 10 min in urban areas and in 20 min in rural areas. As EMS stations operate in the radius of 23 km, this distance is acceptable for the first medical aid to be supplied timely according to the issued regulations as well.

*Supply*. Country EMS station has 6–7 ambulance vehicles on the average. They are largely equipped with ventilation bags, cervical collars, and oxygen delivery systems. Supplies of suction pumps and intubation sets are worse which might be available in every second vehicle. The supply of defibrillators, vacuum mattresses, and backboards is worse. When comparing their amount with team numbers, it appeared that they were sufficient for a little more than half of the working teams in general (excluding status monitors and scoop devices). The biggest deficit was found in status monitors and scoop devices.

*Skills*. In 62% of cases, EMS station does not have teams able to provide advanced trauma life support; therefore, further development in this field is obviously required.

*Pleural drainage*. This procedure was indicated as the most complicated as only 12% of the teams were skilled to perform it. Failure to adequately manage airway potency and ventilation has been identified as a major preventable death in trauma (37). Therefore, it is of great importance because inability to drain pleural cavity may prevent the adequate ventilation and respiratory function preservation, so as little percent could not be evaluated as sufficient.

*Intubation*. The procedure was found to be complicated for teams as well because about half of the teams were not able to intubate. The Advanced Life Support program emphasizes the importance of rapid evaluation of respiratory function and its proper maintenance and gives it the first priority when resuscitating the traumatized patient. It is so-called ABCD rule where A – airway maintenance, B – breathing and ventilation, C – circulation and hemorrhage control, D – disability: neurological status (2). Other studies showed that respiratory function care was not sufficient even before, and intubation in prehospital sector was performed rarely if at all (8, 38). So it seems there was a little effort made to correct this problem over past years.

*Venous puncture and intravenous drug administration*. Venous puncture is not as frequently performed between of teams working at nighttime as it is in the daytime, despite it is also recommended by ALS. Intravenous drug administration is performed successfully in both, day and night times, but it is worth mentioning that the number of teams working at nighttime is lower.

*Defibrillation*. Very similar situation was observed with insufficient defibrillation skills as well. More than half of the teams were able to perform defibrillation procedure by manual device, and less than half – by automatic device. Capability to defibrillate is essential skill foreseen in national resuscitation standard (39). The ability to provide this procedure is associated with better outcomes and immediate access to defibrillation and advanced life support is described as mandatory (40, 41). In our case, failure to ensure defibrillation in almost half of the cases together with insufficient other circulation support procedures as shown by other authors (8, 38), may lead to a conclusion that C rule (circulation) might not be followed sufficiently as the overall advanced life support recommendations in general.

**Conclusions**

1. The structure and network configuration of the country's EMS system complies with desirable standards and requirements applied by national minister order. It allows rendering medical aid timely if there is no delay reporting about the accident.

2. Ambulance vehicles are not completely set up by the some essential equipment needed for the rendering of medical aid, therefore it would be desirable to seek for the better availability of the mentioned supplies.

3. EMS teams are not always capable of performing all necessary advanced life support procedures, *e.g.* pleural drainage, defibrillation and intubation, therefore additional education and training of the advanced life support skills is desirable.

## Lietuvos greitosios medicinos pagalbos tarnybų galimybės teikti pagalbą traumą patyrusiems pacientams

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**Raktažodžiai:** pirmoji medicinos pagalba, greitosios medicinos pagalbos kokybė, greitosios medicinos pagalbos procedūros, greitosios medicinos pagalbos ištekliai.

**Santrauka.** *Darbo tikslas.* Ištirti Lietuvos greitosios medicinos pagalbos galimybes teikti pagalbą traumą patyrusiems žmonėms.

*Tyrimo medžiaga ir metodai.* 2005 metų spalio–lapkričio mėnesį buvo atlikta Lietuvos greitosios medicinos pagalbos stočių direktorių (vyr. gydytojų) anketinė apklausa, kurioje dalyvavo 34 iš 59 (58 proc.) medicinos pagalbos stotys. Anketoje pateikti klausimai, kuriais bandyta ištirti greitosios medicinos pagalbos stočių fizinius (materialiuosius) ir žmogiškuosius išteklius, kai kuriuos veiklos rodiklius bei tinklo struktūrą.

Tyrimo duomenimis, greitosios medicinos pagalbos stotys dirba 23 km spinduliu, aptarnaudamos vidutiniškai 40 tūkst. pacientų, tenkančių kiekvienai medikų brigadai. Atsižvelgiant į atstumus bei anksčiau atliktų tyrimų duomenimis (1) nustatytą vidutinį medikų darbo laiką įvykio vietoje, galima teigti, jog skubios medicinos pagalbos tarnybos yra pajėgios teikti pagalbą per vadinamąją „auksinę valandą“ po traumos, jeigu apie įvykį pranešama nedelsiant. Deja, materialinė techninė bazė nevisiškai sukomplektuota. Kai kuriuose automobiliuose trūksta svarbių priemonių, naudojamų teikiant skubią medicinos pagalbą traumą patyrusiems žmonėms. Labiausiai trūksta gleivių siurblių, intubacijos rinkinių, defibriliatorių, vakuuminių čiužinių, nugaros ir semtuvinių įtvarų. Šių priemonių yra mažiau nei dirbančių brigadų vidurkis ir netgi perpus mažiau nei turimų automobilių. Du trečdaliai šalies greitosios medicinos pagalbos medikų specializuotos pagalbos neteikia. Analizuojant teorinį praktinį pasirengimą atlikti kai kurias pažangaus gaivinimo procedūras, paaiškėjo, jog greitosios medicinos pagalbos medikai rečiau gali atlikti defibriliaciją, intubaciją bei pleuros punkciją.

*Išvados.* Šalies greitosios medicinos pagalbos tinklo konfigūracija pagal aptarnaujamų pacientų skaičių, teritorijos, iškvietimų skaičių atitinka šioms įstaigoms keliamus reikalavimus. Pirmosios medicinos pagalbos automobiliai sukomplektuoti nevisiškai, juose trūksta kai kurių pirmajai pagalbai būtinų priemonių. Greitosios medicinos pagalbos personalas rečiau gali atlikti tokias pažangaus gaivinimo procedūras, kaip defibriliacija, intubacija, pleuros punkcija.

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