Medical Ultrasonography
2011, Vol. 13, no. 4, 283-291

Medical education for emergency physician focused on basic competence (Focused Assessment with Sonography in Trauma). Evaluation of the Romanian national program: "Regional Emergency Medical Services Systems"

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Abstract

Focused Assessment with Sonography in Trauma (FAST), a type of training for unique ultrasonography competence, represents a necessity in the emergency assistance of the trauma patient.

The principal **objective** of this prospective study was to evaluate the teaching performance and to identify the training necessities related to the curriculum of the unique ultrasonography competence – FAST – used in the frame of the national program of rehabilitation of the emergency system in Romania.

Material and Method: The study was performed on a number of 164 emergency medicine physicians, trained following a unique theoretical and practical curriculum, between April and December 2006 in 4 Romanian university centers.

Results: The assessment of the theoretical knowledge acquired during the training program revealed a significant ($p<0.0001$) improvement. The comparative analysis of the theoretical evaluation results between the center in Cluj and the other three training centers did not show statistically significant differences. The differences were noticed at the level of the practical evaluation ($p<0.005$). The attendees observed the need for *supplementing the practical activities in trauma emergency situations* (57.38% -72.08%).

Conclusions: The implementation of a national training program, with a unitary curriculum, creates premises for a standardized training process. The first national training program in FAST, a unique competence in emergency ultrasonography, identified the necessity for curricular remodeling.

Keywords: ultrasonography, emergency, medical education, evaluation

Abbreviations: FAST = Focused Assessment with Sonography in Trauma; ED = Emergency Department; US = ultrasonography; ACEP = American College of Emergency Physicians; WINFOCUS = World Interactive Network Focused on Critical Ultrasound; EFSUMB = European Federation of Societies for Ultrasound in Medicine and Biology; REMSSy IV = Regional Emergency Medical Services Systems phase IV.

Received 10.09.2011 Accepted 27.09.2011
Med Ultrason
2011, Vol. 13, No 4, 283-291
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Introduction

The technological development and miniaturizing of the ultrasound machines designed for the evaluation of the critical patient represents a premise for establishing exploration protocols as tools for the clinician to use for emergency diagnosis and therapy management. Several

studies performed in Europe and USA showed that routine ultrasonography (US) used in the Emergency Department (ED) reduces the number of CT scan exams and facilitates a quick diagnosis in cases of post-traumatic critical states, thus shortening the time until surgery is performed [1-3].

Recently the subcommittee of the American College of Surgeons proposed the increase of the FAST examinations in "advanced trauma life support" [4-6]. The diagnosing algorithms proposed for the primary examination in trauma demand a high level of accuracy. Since invasive explorations and radiation exposure must be maintained to a minimum, US is regarded as a quick method that meets these purposes. The American College of Emergency Physicians – ACEP – proposed in 2001 guides for using US in emergency situations according to the clinical scenario: with the purpose of defining the clinical signs and symptoms, assist resuscitation, conduct interventional procedures or monitor emergency therapy results [7].

It is therefore mandatory to develop training programs for emergency medicine residents and specialists and for trauma surgeons. Research in order to define clearly the crediting criteria, the structure of continuing medical education programs and the new applications in emergency ultrasonography, according to the identified demands, it is also necessary [7,8].

In Europe, the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) formulated the first recommendations for training based on competence levels, while World Interactive Network Focused on Critical Ultrasound (WINFOCUS) proposed and promoted unique competence levels targeted towards critical care and suitable for application in resuscitation protocols, "advance life support" (ALS) and "advance trauma life support" (ATLS), with the purpose of making emergency assistance more efficient [9,10].

In the context of equipping the Emergency Departments in Romania according to the European standards through the "Regional Emergency Medical Services Systems" program, the need to elaborate a "unique competence in emergency ultrasonography" national training program, based on FAST, became evident. The target group of the educational program was represented by the emergency physicians from the county hospitals. The Center for Education and Research in Ultrasonography from the University of Medicine and Pharmacy, Cluj-Napoca in cooperation with The Romanian Society for Emergency and Catastrophe Medicine and with the support of the Department for Health Services and Politics as an implementation agency of emergency medicine medical assistance development support program in Romania, with finances covered by the Swiss government, worked together to develop the training program according to the identified demands.

Objective

The principal **objective** of the study was to evaluate the performance of the instructive educational teaching developed in the Regional Emergency Medical Services Systems phase IV (REMSSy IV), a project of rehabilitation and development of the emergency systems sustained by the Swiss government, centered on obtaining the unique competence in FAST emergency ultrasound by emergency medicine physicians in the County Hospitals in Romania. The **secondary objectives** consisted of a two-stage analysis of the formation program: a) on the trainer's level (theoretical and practical knowledge acquired by the student, as well as their applicability); b) on the student's level (identification of additional needs of training in relationship with the initial curriculum).

Material and Method

This was a prospective study performed on a number of 164 doctors who work in the ED of the Romanian County Hospitals and who were trained between April and December 2006. The first stage of this project included a "trainers training" program during a 5 days course. The purpose of the course was to standardize the teaching methods, the questions data base for the exam and the evaluation forms. The curriculum of FAST, unique competence in ultrasonography, program, as part of REMSy IV, was structured in theoretical and practical 10 days training modules, with 7 hours of training/day (a total of 70 hours) and 3 shifts of 12 hours each. The teaching activity took place in ED affiliated to the traditional university centers of Romania, whose experience in ultrasonography training is recognized by the Health Ministry: Bucharest (3 locations), Cluj-Napoca, Iasi, Timisoara (one location each). The students were divided in groups of maximum 6 people, and there were 2 teachers assigned for each group. The 70 hours of educational activity were structured as follows: theoretical lectures = 12 hours; hands-on and practice = 27 hours; clinical applications = 24 hours; theoretical and practical evaluation = 7 hours. The activities were assisted and supervised by trainers who were part of the "trainers training" program, having at least 10 years of practical experience in emergency ultrasound. The direct assistance of each student was around 4-5 hours. The practical training consisted of at least 20 FAST examinations/student and 24 hours clinical applications in the ED with focus on FAST and

on the interpretation of the ultrasonographic result (3-4 hours/day).

For their theoretical training the students were provided with the manual that was written as part of this project [11]. The ultrasonographic FAST protocol of the trauma patient used in this program was according to the standard protocol and included the evaluation of the 4 quadrants and of the pericardial, pleural and peritoneal cavities (fig 1-5).

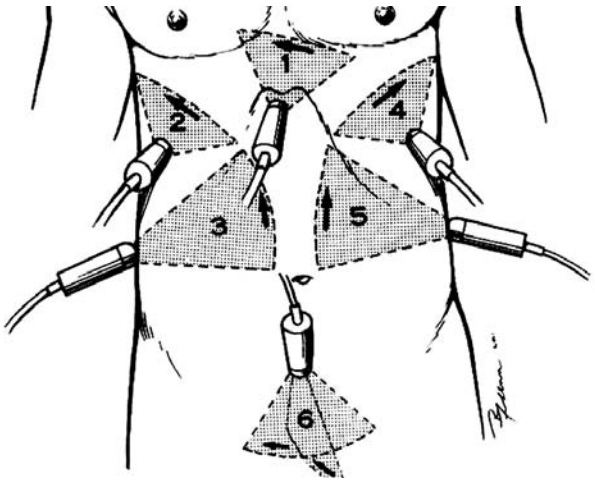

Fig 1. FAST technique - ultrasonographic examination protocol used for students training. Transducer positionig during FAST examination (after: Ma OJ, et al. J Trauma 1995). 1: subxiphoid - pericardium; 2: right intercostal – right pleural space; 3: right upper quadrant – Morison pouch; 4: left intercostal – left pleural space; left upper quadrant – lienorenal space; 6: pelvis sagittal



Fig 2. The 4 chambers view of the heart: visualization of the pericardial space – free pericardial collection with an aspect of incipient heart tamponade.



Fig 3. Oblique right intercostal view: visualization of the right pleural space – large quantity free pleural collection that determines the adjacent lung to colapse.



Fig 4. Oblique right upper quadrant intercostal view: visualization of the peritoneal space – large quantity free subhepatic fluid (Morison pouch), fused towards the right pararenal space.



Fig 5. Hypogastric sagital view: large quantity free fluid collection in the Douglas pouch , with echoic elements

The evaluation of the students included: 1) theoretical evaluation through a pretest and post-test, each consisting of the same 10 multiple choice questions, with a unique answer, chosen from a question data base formulated for the program; 2) a standardized practical evaluation that assessed the following: the students ability to execute the basic views of the FAST examination; the student's ability to obtain an accurate and readable ultrasound image; description of the examined area and of the organs identified there (for example liver, left or right kidney, spleen, diaphragm, stomach, heart, etc); identify and describe fluid collections (transonic fluid, fluid with sediment, floating membranes inside the fluid, floating echoic elements inside the fluid); identify the type of collection (free or secluded fluid within the peritoneal cavity); give a clinical interpretation to the ultrasound findings (physiological, pathological or bloody fluid); give a differential diagnosis by integrating the ultrasound aspect with the clinical scenario (for example hemoperitoneum – old ascites – peritonitis); elaborate a strategy for conservative therapy or surgery.

Evaluation of the program

The training program was evaluated by determining the student's degree of satisfaction with the information that they were provided (quantity, quality, practicality, meeting objectives). The assessment was performed using a qualitative questionnaire, where on a scale from 1 to 5, 5 represented the best qualification. The following items were included in the questionnaire: 1) the activities that were perceived as most useful during the training program; 2) elements included in the program that students believe should receive more attention in the future; 3) instructive aspects of professional training acquired after participating in the program.

The results were introduced in an Excel database. A descriptive and inferential statistical analysis was performed using the software attached to Excel 2007 and MedCalcV.9.3.0.0. The Student Test (T-test) was used to compare 2 normally distributed variables and the F test ("Test for Equality of Two Standard Deviations") to appreciate the variability reduction of a process through a current test. The statistical significance was expressed related to the strength of the study, $p<0.05$ was considered statistically significant and $p<0.0005$ was highly statistically significant. The study was approved by the local Ethics Committee, the ultrasonographic examination of the patients during the clinical training being performed after receiving their consent and under assistance and supervision from the trainers.

Results

Form the physicians included in the study 76.7% were of emergency medicine specialists, 41.4% of these were attending emergency medicine physicians, employees of the county hospitals and 22.05% of them had previous theoretical and practical knowledge of basic ultrasonography, acquired through the national program of formation in general ultrasonography. The distribution of the students among the three University Centers for Training in Ultrasonography was balanced, according to the training requests and territorial spread of the hospitals (table I).

In the university center that initiated the training program (The University Center for Training in Ultrasonography, UMF "Iuliu Hatieganu", Cluj-Napoca), where were enrolled 25.6% of the students (table I), the theoretical evaluation revealed a mean value of the pretest grades of 5.16 ± 1.94 (95% CI: 4.55 - 5.76) and of the post-test grades of 9.12 ± 0.75 (95% CI: 8.88 - 9.35). The inferential statistical analysis of the evaluation of the theoretical knowledge acquired during the training program, using the T-test (assuming equal variances), showed a highly statistically significant improvement ($p<0.0001$). The assessment of the practical knowledge revealed that the students learned the FAST examination technique – the mean value of the grades was 9.25 ± 0.73 (95% CI: 9.03 - 9.48). As far as the interpretation of dynamic ultrasonographic images in given clinical contexts is concerned the mean value of the grades was lower 8.89 ± 0.93 (95% CI: 8.602 - 9.182), the result being weak statistically significant (T-test, $p<0.049$) inferior to that found for learning the examination technique.

A comparative analysis of the theoretical evaluation between the University Center for Training in Ultrasonography (UCTUS) Cluj, and the other three centers did not reveal statistically significant differences. There were statistically significant differences as far as the final practical evaluation of the student was concerned as follows: in the University Center for Training Iasi ($p<0.0006$), the mean value of the grades (8.76 ± 0.56) was lower compared with the organizing center (9.25 ± 0.72), with no statistically significant variance regarding the evaluation process (F test, $p<0.097$); in the University Center for Training Timisoara ($p<0.0011$), the mean value of the grades (9.75 ± 0.43) was higher than that of the organizing center (9.25 ± 0.72), with a statistically significant variance regarding the evaluation process (F test, $p<0.005$) (table II).

The descriptive statistical analysis of the educational methods and instruments used in the program, as they were rated by the students, showed that the most ap-

Table I. The distribution of physicians trained in the REMSSy IV program – FAST ultrasonography technique – in the University Centers for Training according to their specialty

Specialty of physicians trained in the ED	UCTUS Cluj	UCTUS Bucureşti Cantacuzino	UCTUS Bucureşti UCHB	UCTUS Bucureşti UEHB	UCTUS Iasi	UCTUS Timişoara	Total Nr.(%)
Emergency Medicine specialist	14	10	0	8	14	12	58 (35.3%)
AIC specialist/attending physician	2	0	0	0	0	0	2 (1.2%)
General Medicine physician	2	0	0	3	1	0	6 (3.6%)
Pediatric specialist/ attending physician	1	0	0	0	7	4	12 (7.3%)
Family doctors specialist	5	0	0	0	2	1	8 (4.8%)
Emergency Medicine resident	0	0	0	0	2	0	2 (1.2%)
Family doctors specialist with Emergency Medicine competence	3	2	0	1	0	1	7 (4.2%)
Emergency Medicine attending	15	7	6	7	20	13	68 (41.4%)
Cardiology specialist	0	0	0	0	0	1	1 (0.6%)
Total number of trained physicians	42 (25.6%)	19 (11.5%)	6 (3.6%)	19 (11.5%)	46 (28%)	32 (19.5%)	164 (100%)

UCTUS: University Center for Training in Ultrasonography; AIC: Anesthesiology and Intensive Care, UCHB: University Clinical Hospital Bucharest; UEHB: University Emergency Hospital Bucharest

Table II. The results of the final evaluation in the training centers compared with the program's initiation center, Cluj

UCTUS	No. of students	FTE				T-test (p value)	F-test (p value)	FPE				T-test (p value)	F-test (p value)
		MV	SD	95%CI	SE			MV	SD	95%CI	SE		
Cluj	42	***9.11***	0.75	8.88 to 9.35	0.11			***9.25***	0.72	9.02 to 9.48	0.11		
Bucureşti	44	***9.37***	0.69	9.16 to 9.58	0.10	0.638	0.104	***9.36***	0.74	9.13 to 9.58	0.11	0.4974	0.908
Iasi	46	***9.20***	0.92	8.92 to 9.47	0.13	0.645	0.188	***8.76***	0.56	8.59 to 8.92	0.08	***0.0006***	0.097
Timişoara	32	***9.18***	0.89	8.86 to 9.51	0.15	0.7077	0.303	***9.75***	0.43	9.59 to 9.90	0.07	***0.0011***	***0.005***

CTUS: University Center for Training in Ultrasonography; MV: MEAN VALUE; FTE: final theoretical evaluation; FPE: final practical evaluation; SD: standard deviation; SE: Standard error

preciated activity was the *hands-on practice* (between 52.5% in UCTUS Iaşi and 87.77% in UCTUS Bucharest EUHB), followed by the *static and dynamic case study images* (between 33.33% UCTUS Bucharest UCHB an 58.42% UCTUS Timişoara) and *the clinical practice* (between 18.88% UCTUS Bucharest-EUHB and 83.33% UCTUS Bucharest-UCHB). UCTUS Bucharest was the only training center where the theoretical lecture was considered the most useful teaching instrument (table III).

The students from all four centers observed the necessity to supplement the practical activities of emergency ultrasound examinations on real trauma cases (between 57.38% (UCTUS Timişoara) and 72.08% (UCTUS Iaşi). The students also suggested the increase of hours allocated for hands-on practice and for discussions on static

Table III. Descriptive statistical analysis of the educational methods and instruments used in the program according to the appreciation of the students

Training program course activities that were evaluated as most useful (percentage)	**UCTUS Cluj**	**UCTUS Bucureşti Cantacuzino**	**UCTUS Bucureşti UCHB**	**UCTUS Iaşi**	**UCTUS Timişoara**	**UCTUS Bucureşti UEHB**
Theoretical lectures	18.58	31.25	50.00	47.5	20.85	***76.66***
Hands on	***88.26***	***66.66***	***83.33***	***52.5***	***68.42***	***87.77***
Clinical probations (stages)	33.38	41.66	***83.33***	33.33	29.28	18.88
Static and dynamic images based on case study	45.76	50.00	33.33	41.66	58.42	42.22

UCTUS: University Center for Training in Ultrasonography, UCHB: University Clinical Hospital Bucharest; UEHB: University Emergency Hospital Bucharest

Table IV. Descriptive statistical analysis of the educational methods and instruments that were identified by students as needing to be allocated centers more time at the level of the training

Educational methods included in the formation program that students considered should be allocated more hours (percentage)	**UCTUS Cluj**	**UCTUS Bucureşti Cantacuzino**	**UCTUS Bucureşti UCHB**	**UCTUS Iaşi**	**UCTUS Timişoara**	**UCTUS Bucureşti UEHB**
Theoretical lectures	10.96	0.00	0.00	22.5	9.52	39.04
Hands on	35.30	47.91	49.99	43.75	***50.95***	***63.96***
Group discussion based on static and dynamic images	31.68	***50.00***	16.66	34.16	31.90	***56.19***
Practical exercises in ED – examination of trauma patients	***65.61***	45.82	***66.66***	***72.08***	***57.38***	34.28
Others	2.85	0.00	0.00	2.08	0.00	0.00

CTUS: University Center for Training in Ultrasonography, UCHB: University Clinical Hospital Bucharest; UEHB: University Emergency Hospital Bucharest

Table V. Descriptive statistical analysis of the competences acquired during the program as they were identified by the students, according to the formation center (UCTUS: University Center for Training in Ultrasonography, UCHB: University Clinical Hospital Bucharest; UEHB: University Emergency Hospital Bucharest)

Professional competence that considered as needing improvement following participation in the program	**UCTUS Cluj**	**UCTUS Bucureşti Cantacuzino**	**UCTUS Bucureşti UCHB**	**UCTUS Iaşi**	**UCTUS Timişoara**	**UCTUS Bucureşti UEHB**
Theoretical knowledge	33.67	***68.75***	0.00	***56.25***	41.90	***69.52***
Practical knowledge and skills	***72.38***	***91.66***	***100.00***	***65.83***	***85.71***	***58.57***
Ability to work in a team	11.70	6.25	16.66	13.33	10.71	0.00
The use of ultrasound materials and equipment	***67.48***	43.75	49.99	***60.41***	***79.76***	***63.17***
Others	5.23	0.00	0.00	0.00	0.00	0.00

and dynamic images based on simulated cases (table IV).

Regarding the degree of professional competence improvement acquired during the program as it was perceived by the students, k*nowledge and practical skills in FAST technique ultrasound examination* was situated on the first place in all 4 training centers *(*between 58.57% UCTUS Bucharest-EUHB and 100% UCTUS Bucharest-UCHB). The necessity to improve *skills in using ultrasonographic equipments* was also identified in all 4 centers, while the need to enhance the *theoretical knowledge about the ultrasonographic technique* was mentioned in 3 centers (table V).

Discussions

The necessity to develop national training programs tailored for emergency medicine physicians is determined by the special features of the ED activity that is based on standardized protocols and team work. The ultrasonographic exam was included in the screening of trauma patients in the last 30 years as a result of several studies conducted in Germany, USA and Canada that showed the feasibility of the method in detecting abdominal lesions [2,12- 15]. Later on the FAST technique was extend and used in the ED of other European and Asian countries, as well as in many trauma centers in the US, gradually replacing the diagnostic peritoneal lavage. The FAST technique is a highly accurate method of detecting free abdominal, pleural and pericardial fluid. In many medical centers it became a mandatory stage of the primary/secondary exam of the trauma patient [16]. Yet the precision and accuracy of the examination depend on the qualification and experience of the examiner.

Over time numerous training curriculum were developed to train emergency medicine physicians [17-22] during the residency program, but also for the ED specialists, including trauma surgeons and radiologists (table VI). Analyzed in the context of the present international curriculum [23-25], the program proposed in Romania includes 8 hours of theoretical lectures regarding the examination technique and the ultrasound semiology, followed by a 4 hours course on the basic theoretical elements of the FAST examination. Literature recommendations for the "hands-on" duration and the minimum number of examinations mandatory for participating in the final exam vary from 10 to 50 examinations/ student [22]. In our curriculum we considered that 20 examinations/studentis an appropriate number in order to learn the examination technique. Several educational research found in literature defined the continuing medical education as a practical exercise for skill maintenance [10] of at least 25 examinations/year [8] in order to keep competence and integrate the FAST exam in an efficient decision-making algorithm for good quality medical assistance of the trauma patient.

A comparative analysis of the results obtained at the theoretical evaluation of the students enrolled in UCTUS-Cluj with the ones described by Mahler et al [24] after a training program meant for residents, using a curriculum with a similar teaching structure (12 hours the Romanian program versus 8 hours the Mahler program) showed that the students in our program gained better theoretical knowledge ($p<0.0001$) than the students in the Mahler program ($p<0.001$) and the differences were statistically significant. The positive results of the REMSSy IV may be caused by the structure of the course curriculum, as well as by the different levels of competence of our students, emergency medicine specialists and attending physicians versus residents.

Table VI. Curricular models for training in FAST, the unique ultrasonographic competence

Author	Year	Didactic	Hands-on	Clinical Stage	Models	No. of practical FAST exam	No. of exam for certification
Ma et al. [12]	1995	10 hours - not specified		Not specified	Video, normal	15-20	Sufficient practice
Thomas et al. [14]	1997	8 hours - not specified		Not specified	Normal, peritoneal dialysis	15	50
Rozycki et al. [15]	1998	Not specified		Not specified	Video, normal, abnormal	Not specified	50
Smith et al. [16]	1998	4	4	Not specified	Dialysis	10	25
Scalea et al. [17]	1999	4	4	Not specified	Not specified	200	Not specified
Shackford et al. [18]	1999	8	4	Not specified	normal	10	Not specified
Salen et al.[19]	2001	1	3	Not specified	UltraSim, Dialysis	Not specified	Not specified
REMSSy IV	2006	12	4-5h/student	3-4h/day, 10 days	Video, normal, abnormal	20	-
Neri et al. [7]	2007	8	-	1-3 month	-	15-30	30/year
Bennett [20]	2009	1 day		3 month	Not specified	50	150
Mahler et al. [21]	2011	8	8	1 month	3-4hours/day	50	-

A comparative analysis of the final theoretical and practical evaluations in the training university centers enrolled in the study *revealed for the first time in literature a statistically significant variance of the practical evaluation process in relation with the training center* and therefore with the trainers (F test, $p<0.005$). This element brings in discussion *the introduction of standardized practical evaluation charts* along with the elements that must be performed during the examination.

The present study brings *an element of originality in the identification of the educational instruments useful in the training process.* At UCTUS – Cluj the lower grades given by the trainers for the student's ability to give an clinical interpretation to the ultrasound findings (8.89 ± 0.93) were concordant with the observation made by the students that the number of "live" examinations on traumatized patients should be increased (65.61%). These findings highlight *the need to increase the minimum number of mandatory examinations and the hours of supervised clinical practice performed by the student until his examination/accreditation. WINFOCUS recommends 25 examinations in order to obtain the accreditation and 25 examinations/year in order to maintain it [10].*

The students in our study identified the importance of hands-on practice directly on the patient in the training process (between 52.5% and 87.77%), the results being similar to those described by Salen et al [22]. They reported as being very useful: the examination of the normal patient (78.6%) and that of the patient with dialysis induced ascites, as a human model simulated for a positive FAST exam (85%), versus an examination performed on an ultrasonographic phantom (40%) [22].

The students also identified the need for supervised practice in circumstances with real-life psychological impact, face-to-face with the traumatized patient (57.38% to 72.08%) and for discussions based on dynamic ultrasound images. Their findings reveal that the training instruments must be developed in a curricular mode. The result shows the role of the facilitator in the training process, but also ~~the~~ his role in decisional support for the student, a phenomenon described in the present literature where there is an accent on introducing computer simulated programs and individual practice on a mannequin [26- 29].

Our study represents an evidence data base for developing training programs in emergency ultrasonography, presenting some limits because of the variable level of training of the physicians included in the program and the reduced number of students. An objective appreciation of the training program in FAST emergency ultrasonography and of the curricular structure demands evaluation of the impact that the training has on the medical decision making of the students in their activity in medical assistance of the trauma patient and on the reduction of time until surgery. The practical impact of the training program, along with the training necessities identified by the students represent proof support for a future curricular optimization and adaptation to the national demands.

Conclusions

Summing up the results of the evaluation, the first national program for emergency medicine physicians training revealed the role of the proposed curriculum for an optimal theoretical and practical training of the students. At the same time a necessity for curricular reformation in agreement with the educational instruments that were described by the students was identified. The continuation of the educational research at the level of the expertise centers will lead to the generation of a unitary curriculum, developed based on evidence and adapted to the trauma medical assistance standards.

Conflict of interests: none

Acknowledgements

The present paper is part of the 4th phase of REMSSy national training program that took place between October 2005 and December 2007 in Romania under the rule of the Health and Family Ministry with the support of the Center for Health Services and Politics.

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