

Emergency medicine training: A prospective, comparative study of an undergraduate clinical clerkship and an army programme

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Summary

Objectives: To evaluate and compare the educational impact of the University of Geneva Faculty of Medicine (UGFM) emergency medicine clerkship training with that provided by the Swiss Army medical officer cadets school (ARMY). The assessment was designed to assess students' clinical knowledge and competency in major emergency situations, ACLS (Advanced Cardiac Life Support) and ATLS (Advanced Traumatic Life Support).

Methods: Prospectively, 56 UGFM students were compared with 52 ARMY officer cadets by a multiformat pre- and post-training examination. The exam consisted of a multiple-choice questionnaire (MCQ), a standardised vignette-based oral exam (SOE) and a standardised practical cardio-pulmonary resuscitation (CPR) exercise.

Results: Overall, on the pre- and post-training testing, total scores improved significantly for the UGFM by 10% (from 63 to 73%) and for the ARMY by 9% (from 60 to 69%). Knowledge assessed on the MCQ improved for the UGFM by 8% (64 to 72%) but not significantly for the ARMY. Performance on the SOE improved by 10% for UGFM (54 to 64%) and the ARMY (47 to 57%) as well as performance on the CPR, which improved by 15% for UGFM (72 to 87%)

and 19% for the ARMY (67 to 86%). Post-training performance indicated that, respectively, UGFM scored significantly higher than the ARMY on the MCQ (72 and 68%) and the SOE (64 and 57%) but not on the CPR. Internal reliability indexes for the MCQ, SOE and CPR were respectively 0.72, 0.86 and 0.92. Correlations between the MCQ, SOE and CPR varied between 0.07 to 0.19.

Conclusions: In general, the multimethod assessment seemed to provide a complementary approach to evaluation of the trainees' competency in emergency training. Except for the ARMY MCQ performance, both training programmes seemed to be effective in improving trainees' overall knowledge and clinical performance. The trainees' performances are reviewed and discussed in terms of the specific skills assessed on the SOE, the context of the trainees' expected level of performance, the teaching and evaluation approaches, and implications in establishing the equivalence of the two programmes.

Key words: ACLS/ATLS; clinical competence; emergency medicine training; Standardized vignette-based Oral Exam (SOE); Problem Based Learning (PBL)

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Study-group authorship and acknowledgements

The study was designed and conducted by TS, who also collected and analysed the data and wrote the paper. OD was substantially responsible for the study design and data analysis, and assisted in writing the paper. BV planned and supervised the study, contributed to the data analysis and in writing the paper. NVV contributed to planning the study, the data analysis and substantially helped in the writing of the paper.

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Introduction

In Switzerland, emergency medicine is not yet formally recognised as a medical speciality [1]. Based on the German model [2], emergency pre-hospital care and hospital admissions in Switzerland have been predominantly in the hands of preclinical emergency physicians or general practitioners, instead of paramedics as in the United States [1]. In-hospital emergency medical practice varies with hospitals and in large hospitals often consists of representation of different specialists coordinated or directed by a specialised trained emergency medicine physician. Overall, since there is no emergency medicine speciality, its teaching at the undergraduate level often takes up a few days and usually includes aspects of disaster medicine. Given this context, attempts have been made to introduce formal undergraduate Emergency Medicine (EM) training programs to prepare students for work and patient care in common emergency situations during their first years of residency in any speciality they choose to exercise in the future. The purpose of this study is to describe, evaluate and compare two such programmes. One is the Surgical and Medical Emergency clerkship introduced in 1996 at the University of Geneva Faculty of Medicine and the other is the Emergency Medicine programme delivered by the Swiss army medical officer school.

The 4-week Surgical and Medical Emergency clerkship was first introduced in 1996 with the

implementation of a new problem-based curriculum at the University of Geneva Faculty of Medicine (UGFM) [3, 4]. The feasibility of this clerkship was in great part due to the existing emergency medicine service created in 1976 at the University Hospitals of Geneva. The Swiss Army has no medical school with a complete health education programme, and its officers are recruited from the five Swiss Medical Faculties including the UGFM. The 9-week Emergency Medicine programme of the Swiss Army Medical Officer School (ARMY) is offered only to medical students who wish to become commissioned officers. It is considered as a complementary module to the other five Swiss Medical Faculties' training. Its aim is to prepare commissioned officers for work, also in peacetime, as general health professionals in army basic training schools as well as in front line Battalion Aid Stations in war theatres at Echelon II described by the US Army [5]. In addition to the disaster and war medicine specificities, the programme also has an integrated emergency medicine module. Since military service is compulsory in Switzerland and male students must take time out of medical school to complete their army training, the issue which has often been raised by both representatives of the Faculty and the Army is whether the UGFM and ARMY programmes are equivalent, and if so, can they be interchanged in the future?

Method

Programme description

The UGFM Surgical and Medical Emergency clerkship is offered in 4-week rotations of five to eight students per rotation during the 4th or 5th year of the 6-year curriculum. Instructional activities include problem-solving based small group sessions, interactive medical and radiology seminars, practical skills sessions, and emergency ward direct supervision and teaching. To acquire theoretical as well as practical skills, students were supervised in the Emergency Department by the physicians for two weeks, then by the nurses for another two weeks. Problem-based learning sessions were given for a total of 24 hours and practical seminars for 8 hours. Overall, physicians from various specialities provide the teaching. The physicians include general practitioners and specialists in emergency medicine, internal medicine, anaesthesiology and intensive care. Given that most emergency situations require of physicians a rapid assessment and decision-making process under stress and uncertainty, the clerkship had adopted the organised ABC concepts developed by the ATLS/ACLS model to structure its teaching and training. This approach aims to standardise the learners' initial evaluation of the patients and allows them to develop a rational approach in order to identify appropriate therapeutic actions. The clerkship is designed to familiarise students with key emergency situations and emergencies frequently encountered in different specialities, and to acquire the basic emergency technical skills.

Key emergency situations are septic shock, coma, respiratory distress, thoracic pain, polytrauma, hypothermia and acute pain. Besides disaster medicine, emergencies of the medical specialities include patients with myocardial infarction, intoxication, sepsis, emergency antibiotic therapy, meningitis, tetanus prevention, coma, and infected wounds. Basic technical skills include cardio-pulmonary resuscitation, haemorrhage control, non-invasive ventilation, suturing, insertion of urinary and nose-gastric catheters and administration of local anaesthesia.

The ARMY 9-week commissioned officer programme is attended by 4th to 5th year medical students-officer cadets recruited from the five Swiss Medical Faculties, and is offered in an educational military hospital environment that does not actively treat patients. Instructional activities mainly include lectures given by physicians from various specialties, such as for the UGFM. The programme objectives are to teach basics of general medicine specific to the army and competencies in emergency medicine, sanitary services and disaster medicine. A specific "emergency" week includes practical exercises given on ACLS Megacode Simulators for 16 hours, 18 hours of lectures and a one-day exercise simulating a major disaster event in collaboration with civilian security forces. This specific emergency medicine module includes management of respiratory insufficiency and circulatory problems, administration of analgesics, techniques in resuscitation and in basic and advanced life

To assess students' emergency medicine knowledge, clinical and practical competencies acquired during their training, multi-method pre- and post-tests were designed and developed by the authors. The test included a 13-item multiple-choice (MCQ) exam, a standardised vignette-based Oral Comprehensive Exam (SOE) [8–12] and a standardised practical Cardio-Pulmonary Resuscitation (CPR) exercise. The pre- and post-tests were designed to cover criteria described in Miller's pyramid of clinical competence [13, 14]. All the test items were derived from the objectives and competencies common to both programmes and focus on principal and frequent emergency case situations. The SOE examinations were developed by the UGFM clerkship teachers and the authors. The authors wrote up test items for the MCQ and CPR examinations.

The 10-minute MCQ exam was identical for the pre- and post-test and assessed various criteria related to intubation. The SOE exam is a 20-minute standardised oral examination where students were assessed on a case vignette selected from a case pool of nine vignettes. The vignettes were designed to assess various emergency clinical medicine competencies (table 1) as well as addressing common medical emergencies (table 2). The vignettes were assigned randomly to the students in the pre- and post-test in such a way that each student had a different vignette in the pre- and post-test. Thus, for each pre-session, we randomly assigned three vignettes. At post-sessions, three other vignettes from the remaining six were randomly chosen to ensure equal distribution of all the nine vignettes. The SOE examiners are five senior six-year students who were specially trained by the senior author and co-author on the evaluation content and process

of the nine SOE core vignettes. Because the examinations were administered at each testing site, the origin of the examinees cannot be blinded. However, students at each testing site were randomly assigned to the six examiners. The same examiners were used both in the pre- and post-tests at both UGFM and the Army. In the CPR exercise, students were evaluated for ten minutes by an examiner on their practical application of the ACLS ventricular fibrillation flow chart. The CPR examiners were four military nurses who were specially trained to score CPR tests. Session assignment and student randomisation was equal for the CPR examiners and for the six OCE assessors. Scores on the three exams were standardised and varied between 0 and 100.

Data analysis

Primary outcomes are the overall scores obtained on the pre- and post-test MCQ, SOE and CPR examinations by trainees in the UGFM and ARMY programmes. Each examination form is equally weighted. Secondary outcomes are the validity and reliability of the multi-method approach used for the pre- and post-test.

Descriptive statistics, multivariate analyses of variance and T-tests for normally distributed variables were performed to describe and compare students' background and the pre- and post-clerkship performances.

The required sample sizes for detecting an improvement are estimated with EpiInfo®: To measure a supposed score improvement from 50% (pre-clerkship testing) to 80% (post-clerkship testing) for any examination with the required standard power of 80% and interval confidence of 95%, the minimum estimated sample is forty-five students in each educational programme.

Results and discussion

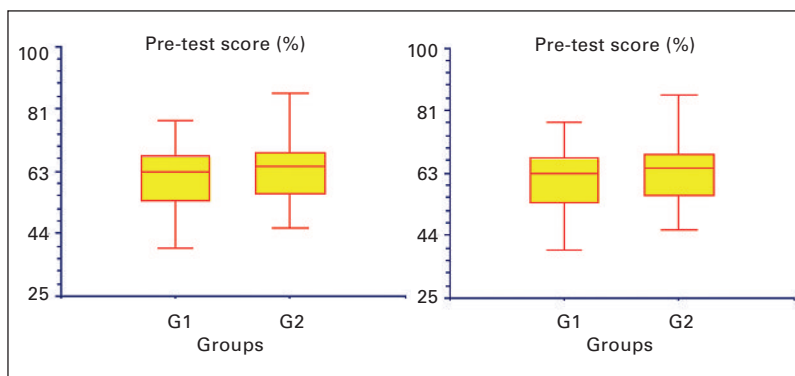
During the study year (2001), eight examination sessions were administered on the UGFM site and three on the ARMY site. Of the 80 enrolled UGFM students, 24 were dropped from the study due to illness or incomplete data on the pre- and/or post-examination. Of the 61 enrolled officer cadets, three were not included due to their limited group size and six for the same reasons as the UGFM students.

Students in both programmes had studied for some 4–5 years in medical school before enrolment in our study. There was a slight difference of age group: the UGFM students' mean age was 23.8 years (95% CI from 23.3 to 24.3) and the officer cadets 25.3 years (95% CI from 24.6 to 26.0). Geneva University students began to study medicine in 1997 and the officer cadets in 1996. Hence both groups were at the same civilian education level during the study year, given a small age difference. Gender distribution differs considerably between the UGFM (46% female) and the ARMY (1%).

For the purposes of analysis and discussion of the study results, a score of 65 or higher (maximum score 100) on the MCQ, SOE and CPR examinations was considered a satisfactory performance. This score reflected the most commonly adopted institutional standard for this type of exam and level of students.

Based on the MCQ exam pre-test results, two of the 13 questions were removed due to detected biases in the questions. The calculated reliability of the pre- and post-test was respectively 0.71 and 0.72 (homogeneity index) for the MCQ and 0.66 and 0.78 (Cronbach-alpha) for the CPR. The reliability (Cronbach-alpha) of each of the nine SOE cases varied between 0.70 and 0.90 and 0.60 and 0.80 respectively for the pre- and post-test.

Figure 1
Box Plot of total achieved scores.



G1: Swiss Army medical officer cadets school (ARMY)
G2: University of Geneva Faculty of Medicine (UGFM)

Where the middle line represents the median (50th percentile), top and bottom of the boxes the 25th and 75th percentiles. The upper adjacent value is the largest observation that is less than or equal to the 75th percentile plus 1.5 times interquartile range (IQR). The lower adjacent value is the smallest observation that is greater than or equal to the 25th percentile minus 1.5 times IQR. No outliers measured in this study.

Table 3

Overview of results of Multiple-choice questions (MCQ), Objective Clinical Exam (SOE), and Cardio-Pulmonary resuscitation (CPR) examinations.

	University			Army			Army vs University
	PRE	POST	Mean Δ (95%CI)	PRE	POST	Mean Δ (95%CI)	Mean Δ (95%CI)†
MCQ [%]	64	72	8 (4-12)*	69	68	-1 (-6 to -3)	-9 (-15 to -3)*
SOE [%]							
Primary survey	46	70	24 (16 to 33)*	42	61	19 (11 to 27)*	-6 (-17 to 6)
Immediate treatment	55	74	19 (6 to 31)*	51	67	14 (-4 to 31)*	-5 (-26 to 6)
History-taking	61	60	-9 (-24 to 6)	36	48	14 (2 to 27)*	23 (4 to 42)*
First working hypothesis	68	74	6 (-4 to 16)	64	66	2 (-11 to 15)	-4 (-20 to 12)
Physical examination	51	65	14 (1 to 27)*	45	63	18 (5 to 31)*	4 (-15 to 22)
Second working hypothesis	63	65	-20 (-76 to 35)	54	67	9 (-20 to 38)	29 (-22 to 80)
Patient monitoring	51	59	9 (-9 to 26)	45	45	-1 (-18 to 17)	-9 (-33 to 15)
Complementary diagnostic tests	46	57	11 (2 to 20)*	39	44	5 (-3 to 14)	-6 (18 to 6)
Treatment and supervision	48	55	7 (-4 to 18)	44	51	7 (-5 to 20)	0 (-16 to 17)
Diagnosis of patient's complaint	68	56	-5 (-23 to 13)*	70	64	-4 (-19 to 12)	1 (-22 to 25)
Total SOE	54	64	10 (5 to 15)*	47	57	10 (4 to 15)*	0 (-8 to 7)
CPR [%]	72	87	15 (10 to 20)*	67	86	19 (13 to 25)*	4 (-2 to 10)
TOTAL [%]	63	73	10 (8 to 13)*	60	69	9 (6 to 12)*	-1 (-5 to 3)

* p <0.05

† Mean value of the difference between each trainingship difference (comparing the impact given by Army and the impact given by the University)

Table 4

Comparison of post-test performance results of ARMY and UGFM Multiple-choice questions (MCQ), Objective Clinical Exam (SOE), and Cardio-Pulmonary resuscitation (CPR)

	Score University post	Score Army post	University - Army (Risk difference)†
MCQ [%]	72	68	-4 (-9 to 62)
SOE [%]			
Primary survey	70	61	-9 (-17 to -1)*
Immediate treatment	74	67	-8 (-21 to 6)
History-taking	60	48	-12 (-24 to -1)*
First working hypothesis	74	66	-8 (-19 to 3)
Physical examination	65	63	-3 (-15 to 10)
Second working hypothesis	65	67	3 (-16 to 21)
Patient monitoring	59	45	-14 (-31 to 3)
Complementary diagnostic tests	57	44	-12 (-23 to -2)*
Treatment and supervision	55	51	-4 (-17 to 9)
Patient's complaint diagnosis	56	64	8 (-7 to 22)
Total SOE	64	57	-7 (-14 to -1)*
CPR [%]	87	86	0 (-5 to 4)
TOTAL [%]	73	69	-4 (-8 to -1)*

* p <0.05

† Risk difference between post-test scores achieved in both trainingships

Pearson correlations between the MCQ and the SOE (0.09) and the CPR (0.19) and between the SOE and CPR (0.07) suggested that the three examinations may measure different competencies, are complementary to one another and are best taken into consideration together to assess students' overall level of emergency knowledge and performance.

Comparisons between ARMY and UGFM mean performance indicated that both types of training improved the global scores; see table 3 and figure 1. The ARMY cadets progressed sig-

nificantly from the pre- to the post-test on two of the three examinations, mainly the SOE and the CPR, and the UGFM students improved significantly on all three examinations. The lack of improvement in ARMY performance in the MCQ pre-post-test scores could not be entirely explained by the high score obtained on the pre-test (69), hence a ceiling effect, since the UGFM high score in the pre-test (64) was accompanied by a significant score increase in the post-test (72). The MCQ results suggested that while both groups had already acquired beforehand a relatively good level of knowledge on various aspects of intubation, the UGFM acquired further knowledge after their rotation in emergency medicine. Particularly assessed in the MCQ were the students' ability to determine in which clinical situations a patient has to be intubated or provided with direct fluid administration. The results seem to suggest that the UGFM PBL and patient-based training further improved students' knowledge of intubation criteria than the lecture system and the rare access to patients in the ARMY program.

Analysis of the SOE exam revealed an overall test score improvement from the pre- to the post-test for both the ARMY and the UGFM. However, significant differences in performance were found both for the ARMY and the UGFM scores on the ten SOE sub-competencies. For the UGFM there were significant score increases for five of the ten competency scores: Primary survey, Immediate treatment, Physical examination, Complementary diagnostic tests and Diagnosis of patient complaints. No meaningful score changes were observed for History-taking, Generation of the first working hypothesis, Patient monitoring and Patient treatment and supervision competencies. For the ARMY there were significant score

increases for four of the ten competencies: Primary survey, Immediate treatment, History taking, and Physical examination. No major changes were measured for the competencies in Generation of the first working hypothesis, Complementary diagnostic tests, Patient monitoring, Treatment and supervision, and Diagnosis of patient's complaint. In general, the lack of significant pre- and post-test subscore increases could be explained, to a certain extent, for one competency (i.e., Generation of first working hypothesis), given the high score (e.g., a score of 65 or higher) already obtained on the pre-test. Furthermore, it was observed that while the pre-test scores for the diagnosis of the patients' complaint were relatively high for both the ARMY (70) and UGFM (68), there was an overall decrease in the post-test mean score. The decrease is only significant for UGFM and not for the ARMY. One possible explanation could be that, since students have not only to list a correct diagnosis but to justify it, the examiners may be more lenient in scoring students' justification of their diagnosis in the pre-test than in the post-test. Overall, the absence of significant increases in the above competencies (Generation of the first working hypothesis, Complementary diagnostic tests, Patient monitoring, Patient treatment and supervision, and Diagnosis of patient's complaint) resulted from a lack of improvement of these competencies during the training. The approach adopted for teaching and evaluating these skills needed to be fur-

ther reviewed and adapted appropriately (table 1).

Results in the CPR exam revealed that in spite of the high scores the ARMY and UGFM obtained in the pre-test (72 and 67), significant increases in the post-test scores were obtained respectively (86 and 87).

The impact of both training types on the total scores is significant and does not differ statistically (table 3). To establish an equivalence of both groups we would like to see the same scores in the post-test; however, they are not equal (table 4).

Overall, the mean post-test scores of the ARMY and UGFM were respectively 68 and 72 on the MCQ, 57 and 64 on the SOE, and 86 and 87 on the CPR examination (table 4); As described above, while the ARMY and UGFM performed significantly better in the post-test in respectively two and three out of the three examinations, post-test results indicated that UGFM mean performance was significantly higher than the ARMY in the SOE and the total scores (table 4). These results suggest that with a standard of performance set at 65%, both the ARMY and UGFM performed relatively satisfactorily in all three examinations. However, both curricula and training need to be reviewed to determine how to further improve students' competencies in history-taking, elaborating the second working hypothesis, ordering complementary diagnostic tests, and monitoring, treating and supervising the patient.

Limitations

Given its context, our study had two main limitations. The first is the impossibility of following up the learners to determine whether the knowledge and competencies acquired during training are maintained over time, especially since

skill deterioration over a period of time has been observed in the literature [15–17]. The second limitation is the difficulty of randomising the learners and introducing a baseline control group.

Conclusions

If the UGFM Medical and Surgical Emergency Clerkship and the military Emergency Medicine's common objectives are to prepare students in acquiring the basic knowledge, technical skills and competencies needed in key and common emergency situations, the present study indicated that both programmes were effective, to various degrees, in improving their trainees' knowledge and competencies. Most specifically, if satisfactory performance is set at a score of 65 (out of a total of 100), it was found that trainees in both programmes attained a satisfactory performance level in knowledge and technical skills at the end of their training. Concerning their competency in addressing common clinical emergency situations, while the medical school students have attained a

satisfactory mean overall performance level, the military trainees are still in need of further improvement. Analysis of the specific skills needed to work up the common clinical emergency situations indicated that both the medical school and the military programmes need to place greater emphasis on their trainees' skills in elaborating the patient's second working hypothesis and diagnosis, in ordering the required complementary diagnostic tests and in monitoring, treating and supervising the patient. In addition, the military programme needs to place greater emphasis on the development of their cadets' history-taking skills. However, these suggestions would need to be further discussed and reviewed in the context of the following three considerations.

First, although the three exam formats have shown themselves to be reasonably reliable and seem to provide, when considered together, a more complete evaluation of the trainees' competency, they need to be further improved and administered to one or more classes before the above suggestions can be validated and reviewed for implementation. In addition, with the present lack of a commonly agreed satisfactory standard of performance it is difficult to determine whether the level of performance achieved by the trainees of both programmes is adequate and satisfactory for their level of training. Finally, while the goals and training objectives of both the medical clerkship and military programmes were to provide the trainees with the basic theoretical knowledge, technical skills and clinical competency in common emergency situations, it is not yet clear whether they are adequately prepared and ready to function in the context of any speciality residency training or the cadets' assigned duties in the army. To further refine the clerkship and army training programmes and to establish their equivalence, what would be most useful is probably that speciality residency training iden-

tify the basic emergency competencies all beginner residents should already acquire. Similarly, in the context of the army [18–20], the medical officers' roles and responsibilities need to be further redefined and established. For example, a commander returning from Iraq criticised poor airway management due to the underutilisation of emergency specialists proximal to the battlefield [21]. Once the basic emergency competencies required of beginner residents and medical officers are defined and established, the changes and adaptations which the training and evaluation programmes need to undergo can be more appropriately determined.

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