



Crisis Resource Management in Emergency Medicine: an Italian medical students' experience

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Abstract

Crisis Resource Management (CRM) is a training technique which follows the procedures used for improving aviation safety. CRM can be used in many contexts, including emergency medicine training. This technique includes three steps: presentation of the problem, high fidelity simulation and debriefing. In particular, CRM carefully analyzes behavioral factors related to the management of critical events. This way, trainees and instructors can discuss and improve management and leadership. In fact, key factors of CRM are communication, roles management and priority definition. In order to apply CRM in Emergency Medicine, the Italian Medical Students' Secretariat organized the Emergency Medicine Simulation Seminary (EMSS). At the end of EMSS, we asked the 26 participants to give their feedback on the acceptance level of such medical training to assess the possibility of proposing CRM to other institutions as a method for emergency medicine training. Results show that Italian students have less simulation experience than international attendees. Also, CRM is a powerful training tool to rapidly improve knowledge on critical cases management; particularly if simulations are presented in high-fidelity settings by experienced instructors and with a proper training time to investigate, rehearse and fully understand the concepts.

Keywords: CRM, medical simulation, medical education, emergency medicine

1. Introduction

CRM is a training technique used for improving aviation safety (Salas, Bowers, and Rhodenizer 1998). Particularly, it strengthens the human factor into the management of a critical situation. Through simulation, trainees face emergency situations by taking advantage of previous knowledge and abilities. At the end of the simulation, video recordings are

presented to the learners, such that management skills, namely communication skills, role definition, priority classification can be increased.

Studies assessing the efficacy of simulation in medical training revealed that the realism of the simulation is important during training and skills acquisition (Gunz 1994); this makes aviation training suitable for medical emergency training (Gaba et al. 2001; Salas, Bowers, and Rhodenizer 1998).



CRM includes 3 steps: presentation of the problem (bibliography, clinical cases, familiarization); high-fidelity simulation (23–45 minutes); debriefing (analyses on communication, leadership, roles and priorities) (McDonnell, Jobe, and Dismukes 1997). In particular, it is important to perform the training in a high-fidelity environment, as realistic as possible. Clinical cases should be designed with increasing difficulty, and roles should be frequently rotated, as trainees can learn from different perspectives, also increasing communication skills. Each group has a team leader and observers who watch the simulation at distance. Finally, during the debriefing phase, learners share their point of view, analyze strengths and weaknesses of their actions and errors and also report real life experiences. All the debriefing, which is the most important part of the whole simulation, is guided by an experienced instructor (McDonnell, Jobe, and Dismukes 1997) following the video recording of the simulation.

Within this framework, Italian Medical Students' Secretariat organized the Emergency Medicine Simulation Seminary (EMSS), focused on CRM applied to Emergency Medicine (EM) scenarios. This course targeted medical students from three to one year prior to the degree. We then analyzed attendees' feedback to understand the level of acceptance of such medical training and whether CRM could be proposed to other institutions as a method for emergency medicine training. Results highlighted that Italian attendees have less experience in medical simulation courses with respect to foreign trainees, supporting the idea that Italy should invest more on medical simulation as it is reported to increase medical skills (Levine et al. 2013).

2. Background

CRM is a training technique born in the United States in the 80s from a collaboration between NASA and Air Force (Foushee et al. 1986; Wiener, Kanki, and Helmreich 1995). The initial aim of CRM was to train pilots how to deal with unlikely emergency situations, needing experience and decision-making ability. In fact, this approach has been reported to improve pilots' skills.

In the medical field, CRM results into higher satisfaction levels of students who prefer hands-on activities with respect to traditional teaching methods; greater self-confidence and stress control in critical situations, ultimately resulting in better outcomes in patients' care (Adobor and Daneshfar 2006; Arias-Aranda 2007).

In 1998, (Gaba et al. 2001) used simulation to assess the limitations of anesthesiologist teams working in surgical settings. Results highlighted three gaps: (i) lack of standardized emergency procedures. This is due to the fact that physicians were following the manuals without considering the inter-variability among

patients; (ii) lack of non-technical skills training to manage emergency situations; (iii) inability of medical doctors to combine technical and non-technical skills in critical situations. This is probably the consequence of the unpredictability of the emergency situation and the impossibility to record and review these situations and the following behaviors and actions (Gaba et al. 2001). Analysis on the decision-making skills during the emergency highlighted that critical situations are completely different from classical medicine (Groen and Patel 1985; Patel, Evans, and Kaufman 1990). In particular, emergency situations need a naturalistic decision-making approach which is a complex, dynamic and rapid model evolving over time according to the patient's outcome (Klein et al. 1993; Orasanu and Connolly 1993). In fact, emergency medicine needs dedicated training. The first example of CRM applied to emergency medicine is the Anesthesia Crisis Resource Management Curriculum (ACRM) developed at the university of Stanford (Howard et al. 1992). According to (Howard et al. 1992) clinical cases are ill-structured as they are unpredictable and evolving over time. In addition, physicians work under pressure and have to comply with management and cultural rules. As for medical problems, also goals are ill-defined and strictly connected to each other. Finally, emergencies are usually managed by a multidisciplinary team.

Currently, CRM-based courses are homogeneous in terms of standard, interventions and effects (Gross et al. 2019; Parsons et al. 2018). The goal of this study is to collect and analyze feedback of students attending a course based on CRM for emergency medicine, in order to assess whether CRM can be an appropriate teaching method for Italian medical students. Furthermore, responses of Italian participants have been compared with those of students attending medical school abroad, in order to highlight differences in terms of medical knowledge, previous experience and outcomes.

Materials and Methods

EMSS, took place in 2018 at the Center for Advanced Simulation and Learning of the University of Genova, Italy. Prior to the course, we carefully assessed the motivations letters of the candidates, in order to select those having previous experience in either medical simulation or emergency medicine (EM). Then, we divided the students into four homogeneous groups.

EMSS took place in the high-fidelity area (shock room) of the simulation center. Simulations are managed from the control room and recorded for subsequent debriefing. The seminary started with theoretical classes on EM basic procedures, with particular attention to CRM in Advanced Cardiovascular Life Support (ACLS), highlighting the key concepts for a successful teamwork. The rest of the course was simulation-oriented, and it was managed by an expert instructor having several years of experience in the field. Particularly, participants

learned how to simulate different techniques and situations, particularly focused on CRM training.

At the end of the seminary trainees completed a questionnaire giving feedback on the topics investigated during the practice (Tab. 1), namely the way the instructor explained every part, the ratio between theory and practice, the setting in which the simulation took place, the materials proposed. Briefly, the questionnaire included 1 open-ended and 12 close-ended questions ranging from 1 (completely disagree) to 5 (completely agree). Specifically, to assess the outcome of CRM within the course we used the Maastricht Skillab model (Adobor and Daneshfar 2006), which is largely used to assess the quality of educational courses. Our ultimate goal was to define how our event could be improved and thus extended to other medical schools in Italy.

Table 1. Post course questionnaire

1	The objectives of the course were clearly defined
2	The simulations were explained clearly by the instructor
3	The ratio between theoretical and practical parts was adequate
4	The length of practical parts was adequate
5	The instructors were clear and communicative
6	The instructors have answered the proposed questions
7	The instructors were kind and ready to satisfy any request
8	The instructors were collaborative with students
9	I want to participate to other clinical skill lab like this
1	Video and audio facilities were adequate
0	
11	Instruments and materials were adequate
1	Mannequins and box trainers were in good conditions
2	

3. Results and Discussion

26 students from 10 countries attended EMSS in January 2018. Specifically, 11 students were attending

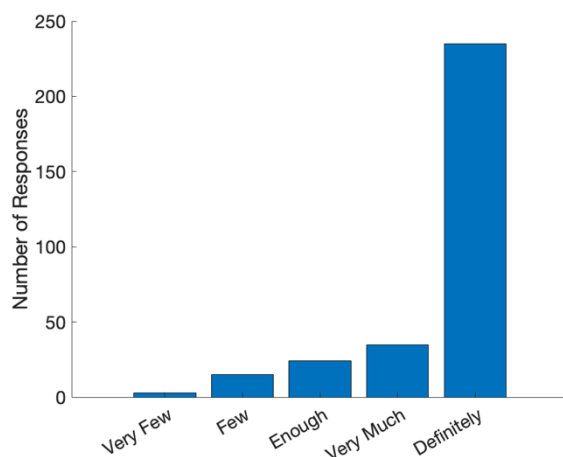


Figure 1. Number of Responses divided by scale

medical school in Italy, the others were studying in the UK, USA, Honduras, Slovakia, Hungary, Syria, India, Turkey, Bulgaria. Participants were divided into 4 homogeneous groups, according to their knowledge in medical simulation and emergency medicine. As expected, students enjoyed the course (Fig. 1). Interestingly, trainees were diverse in terms of simulation experience: learners from Italy had no experience in high-fidelity simulation, and only two of them attended basic simulation courses (i.e. CPR). Conversely, 40% of foreign students had previous experience with medical simulation; also, half of them had already experienced CRM. Yet, 8 out of 26 students had some experience in emergency medicine.

A critical point that emerged was the diversity of the students in terms of previous knowledge. Among them there were paramedics, a teaching assistant in anesthesiologists, a disaster medical team member and an intensive care intern, as well as medical students with no previous experience. We believed this was an added value to our course, as novice students could learn the basics of CRM, while skilled trainees observed beginners and grasped the criticisms of training. However, for novice learners this was a challenging aspect of the seminary, while expert students found it a limitation as they were distracted by unexpert learners who needed basic information. Despite that, students liked the setting and the simulators used, as well as the expertise of the instructor and the amount of time spent on each part of the course, as reported by the overall score (4.6/5; Fig. 1; Appendix A).

This pilot study allowed us to make considerations of CRM training in medical emergency procedures: the majority of Italian students had never experienced medical simulation prior to EMSS. This information suggests that Italian universities, as opposed to foreign ones, are not giving importance to medical simulation; despite international literature agrees on the importance of this educational method to increase medical skills (Levine et al. 2013). Open questions highlighted that many students found it extremely difficult to apply academic knowledge, resulting from theoretical classes, in a realistic and stressful scenario

4. Conclusions

Overall, results from this study support the importance of practical training to prepare medical students before clinical practice. In fact, being a skilled medical doctor is the result of several experiences. In this context, CRM and more generally medical simulation are useful tools to build up the basis of medical knowledge.

EMSS was one of many successful examples of using new teaching methods to improve medical learning carried out at the University of Genova, Italy (Bagnasco et al. 2014; Bracco et al. 2017; Calandrino et al. 2020; Frascio et al. 2009; Girau et al. 2019; Ricci et al. 2019). Particularly, EMSS used CRM to increase students' self-confidence in emergency situations. Indeed, we

think this approach may be transferred to other universities, as students have appreciated this type of training. As reported, this can be defined as a pilot study, as only 26 participants attended the seminary and were interviewed. Indeed, more participants should be enrolled and asked about the efficacy of the proposed training to make firm conclusions. Nonetheless, we strongly believe that investing funds for medical simulation would positively affect student's skills, ultimately resulting in better clinical practice.

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Appendix A

Table A1 includes all the responses of the post-course survey.

Table A1. Single Subject responses to the post-course questionnaire

ID		1	2	3	4	5	6	7	8	9	10	11	12
1	F	2	2	2	2	2	2	2	2	2	2	2	2
2	F	5	5	3	2	4	4	4	4	4	4	4	4
3	F	5	5	5	5	5	5	5	5	5	5	5	5
4	F	5	5	4	4	5	5	5	5	4	5	5	5
5	F	5	5	5	5	5	5	5	5	5	5	5	5
6	F	3	3	3	4	4	5	5	5	3	3	5	5
7	F	5	5	5	5	5	5	5	5	5	5	5	5
8	F	5	5	5	5	5	5	5	5	5	5	5	5
9	F	5	5	4	5	5	5	4	5	5	4	5	5
10	F	5	5	5	5	5	5	5	5	5	5	5	5
11	F	5	5	5	5	5	5	5	5	5	5	5	5
12	F	3	3	3	3	3	3	3	3	3	3	3	3
13	F	5	5	3	2	5	5	5	5	5	4	5	5
14	F	5	5	5	5	5	5	5	5	5	5	5	5
15	F	5	5	5	5	5	5	5	5	5	5	5	5
16	I	5	5	5	5	5	5	5	5	5	5	5	5
17	I	5	5	5	5	5	5	5	5	5	5	5	5
18	I	5	5	5	5	5	5	5	5	5	5	5	5
19	I	5	5	5	5	4	3	3	3	5	5	5	5
20	I	5	5	5	5	5	4	1	1	5	1	5	5
21	I	5	5	5	5	5	5	5	5	5	5	5	5
22	I	5	5	5	5	5	4	2	3	5	4	5	5
23	I	4	5	4	4	5	5	5	5	5	5	5	5
24	I	5	5	5	5	5	5	5	5	5	5	5	5
25	I	3	4	4	4	4	4	4	4	4	4	4	4
26	I	5	5	5	5	5	5	5	5	5	5	5	5

I: Italian participant; F: foreign attendees; 1: Very Few; 2: Few; 3: Enough; 4; Very Much; 5: Definitely

References

Adobor, Henry, and Alireza Daneshfar. 2006.

"Management Simulations: Determining Their Effectiveness." *Journal of Management Development* 25: 151–68.

Arias-Aranda, Daniel. 2007. "Simulating Reality for Teaching Strategic Management." *Innovations in Education and Teaching International* 44(3): 273–86.

Bagnasco, Annamaria et al. 2014. "The Role of Simulation in Developing Communication and Gestural Skills in Medical Students." *BMC medical education* 14(1): 1–7.

Bracco, Fabrizio et al. 2017. "Adaptation of Non-Technical Skills Behavioural Markers for Delivery Room Simulation." *BMC pregnancy and childbirth* 17(1): 1–7.

Calandrino, Andrea et al. 2020. "Peer Collaboration in Italy during COVID-19 Pandemic: The Experience of an Online Bottom-up Backed Platform Designed for Medical Students."

Foushee, H Clayton, J K Lauber, M M Baetge, and D B Acomb. 1986. "Crew Factors in Flight Operations: 111. The Operational Significance of Exposure to Short-Haul Air Transport Operations." *NASA Technical Memorandum* 88322: 99–136.

Frasco, Marco et al. 2009. "New Teaching Models for the Medical School of Medicine: Comparison between Oral and Online Classes. The Experience of the Genoa School of Medicine." *Journal of e-Learning and Knowledge Society* 5(3): 43–48.

Gaba, David M et al. 2001. "Simulation-Based Training in Anesthesia Crisis Resource Management (ACRM): A Decade of Experience." *Simulation & Gaming* 32(2): 175–93.
<https://doi.org/10.1177/104687810103200206>.

Girau, Elisa et al. 2019. "A Mixed Reality System for the Simulation of Emergency and First-Aid Scenarios." *Conference proceedings: 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual Conference* 2019: 5690–95.

Groen, G J, and Vimla L Patel. 1985. "Medical Problem-solving: Some Questionable Assumptions." *Medical education* 19(2): 95–100.

Gross B, et al. 2019. "Crew resource management training in healthcare: a systematic review of intervention design, training conditions and evaluation." *BMJ Open* 9(2):e025247.

Gunz, Hugh. 1994. "Learning from a Realistic Simulation: A Case Study." *Journal of Management Education* 18: 45–60.

- Howard, S K et al. 1992. "Anesthesia Crisis Resource Management Training: Teaching Anesthesiologists to Handle Critical Incidents." *Aviation, space, and environmental medicine* 63(9): 763–70.
- Klein, Gary A, Judith Orasanu, Roberta Calderwood, and Caroline E Zsombok. 1993. *Decision Making in Action: Models and Methods*. Ablex Norwood, NJ.
- Levine, Adam I, Samuel DeMaria Jr, Andrew D Schwartz, and Alan J Sim. 2013. *The Comprehensive Textbook of Healthcare Simulation*. Springer Science & Business Media.
- Mcdonnell, Lori, Kimberly Jobe, and Key Dismukes. 1997. "Facilitating LOS Debriefings: A Training Manual."
- Orasanu, Judith, and Terry Connolly. 1993. "The Reinvention of Decision Making." *Decision making in action: Models and methods* 1: 3–20.
- Parsons JR, et al. Filling the Gap: Simulation-based Crisis Resource Management Training for Emergency Medicine Residents. *West J Emerg Med*. 2018 Jan;19(1):205–210. doi: 10.5811/westjem.2017.10.35284. Epub 2017 Dec 14. PMID: 29383082; PMCID: PMC5785195.
- Patel, V L, D A Evans, and D R Kaufman. 1990. "Reasoning Strategies and the Use of Biomedical Knowledge by Medical Students." *Medical education* 24(2): 129–36.
- Ricci, Serena et al. 2019. "Design and Implementation of a Low-Cost Birth Simulator." In *41st Engineering in Medicine and Biology Conference*,.
- Salas, E, C A Bowers, and L Rhodenizer. 1998. "It Is Not How Much You Have but How You Use It: Toward a Rational Use of Simulation to Support Aviation Training." *The International journal of aviation psychology* 8(3): 197–208.
- Wiener, Earl L, Barbara G Kanki, and Robert L Helmreich. 1995. *Cockpit Resource Management*. Gulf Professional Publishing.