Role of emotional competence in residents' simulated emergency care performance: a mixed-methods study

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ABSTRACT

Objective Emergency situations can generate negative affect in medical personnel, which can negatively impact on the quality of care. Several studies have demonstrated a positive influence of emotional competence (EC) on negative affect. The goal of this study was to test the effect of EC level on simulated emergency care situation in medical residents.

Methods The sample included 21 medical residents caring for a simulated seriously wounded person whose condition suddenly deteriorated. Medical performance was scored by expert medical doctors (MDs). EC level and affective states were evaluated with self-assessment questionnaires. Finally, the origin of the negative affect experienced by the residents was identified through individual interviews.

Results Higher EC levels were found to be associated with better medical performance and a lower intensity of negative affect. The latter two variables were found to correlate negatively. The main source of negative affect for residents was the inability to establish a diagnosis, regardless of their EC level and their medical performance.

Conclusions The results suggest that residents who have a high EC level are better able to manage negative affect, so that they are better able to put their medical knowledge to work and explore alternative diagnoses. Emotional-management training for residents who, as new MDs, have limited experience may be beneficial to complement simulation exercises. Additional studies should be considered to better define the links between the affect experienced by MDs and their thought processes during establishment of a diagnosis.

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INTRODUCTION

Research on medical doctors' (MDs') affective state during the practice of medicine plays an important role in improving patient safety because such emotions can impact negatively on the quality of medical care.[1–3] A previous study on emergency care by medical residents revealed that during a low-stress trauma resuscitation simulation, their technical performance is usually better than during a similar simulation with higher stress.[4] Negative affects appear to be triggered primarily by medical complications, time pressure, distractions and interruptions, or, more generally, by increased workload.[5 6] In residents, who are potentially subject to chronic stress, the main origins of negative affects are high workload and severity of the patient's condition.[7 8] Exposure to socio-emotional stressors (eg, an individual disrupting the provision of medical care) can also lead to an increased perceived workload in MDs.[9 10] However, not all stress is bad—for example, examination stress has been found to result in improved surgery performance.[11]

Faced with so many stressful situations, MDs may develop emotional regulation strategies that allow them to maintain control over the situation. For example, they can re-evaluate the situation, consider alternative action plans, verify the availability of resources, or avoid displaying their emotions to the rest of the medical team.[6] Such an ability to regulate one's emotions is referred to as emotional competence (EC). EC refers to 'individual differences in the identification, understanding, expression, regulation and use of one's own emotions and those of others'.[12] This model for EC stems from a combination of two

dominant views on emotional intelligence (EI). From one point of view, EI can be considered to be the 'ability' to manage emotions and those of others; from another point of view, it can be considered to be a trait pertaining to emotion-related dispositions.[13–15] According to the EC model, EC is expressed on three different levels: knowledge, ability and trait. These three levels can be improved with training and can continue to improve even 1 year after training.[16 17] In the medical field, EC is recognised as a necessary competence for nurses, although training for development of this competence is rarely offered.[18 19] Positive effects of EC have been demonstrated in various domains: healthcare quality, group cohesiveness, symptoms of burnout, and stress.[20–22] However, few studies have investigated the activity of MDs and, to our knowledge, no study has demonstrated an effect of EC on a specific aspect of medical activities, such as the quality of emergency care.

Emergency care challenges EC and lack of EC can have devastating consequences. It often involves extreme constraints, including risks to the patient, uncertainty concerning the patient's state, and a need for fast-paced medical and managerial decisions.[23] These challenges may be even more extreme for medical personnel whose practical experience is limited, such as medical residents.

The aim of our study was to (1) test the effect of EC level on negative affect, (2) test the effect of EC on residents' medical performance during a simulated emergency care situation and (3) identify the origins of negative affect.

METHODS

Study design

The study used a mixed-method approach following human factor principles[24] comprising (1) observations to evaluate medical performance, (2) semi-structured interviews to access residents' mental representations related to their medical reasoning and their emotional experience, and (3) questionnaires to assess the intensity of negative and positive affects experienced by the participants and their level of EC. A between-subjects design was used to compare residents with low EC level with residents with high EC level.

This research is consistent with the Human Factors and Ergonomics Society Code of Ethics[25]: participants were exposed to minimal risk since simulations and medical debriefing were part of their training programme and thus only questionnaires and interviews were added for research purposes; participation was voluntary using a consent form; all identifying information was removed to guarantee anonymity of the participants.

Participants

Participants were first-year military residents specialising in general practice who were destined to work in military medical centres and to be deployed in a theatre of war. As part of their education, these residents perform practical exercises using a high-fidelity patient simulator in the Simulation Center for Operational Medicine of the French Ecole du Val-de-Grace, which is used to prepare military residents and physicians for prehospital trauma care under combat conditions.

The study was performed near the end of a practical-training module, during a full-scale, global simulation of a prehospital emergency care situation. This practical training was performed for pedagogical purposes without any evaluation and it was the residents' first practical exercise using the high-fidelity patient simulator. They had only used a patient simulator for technique training. Their experience in emergency care was also very narrow, with only one trimester completed in an emergency department before their residency.

Medical simulation

The simulation involved an emergency care situation featuring the equipment and resources available in the battlefield. A collaborator of the lead investigator, a resident in anaesthesiology, played the role of a paramedic. He was instructed to respond to the requests of the resident without making any suggestions about actions.

A high-fidelity patient simulator mannequin (SimMan Laerdal) was controlled by an expert MD who managed the clinical scenario from an adjacent room. The history of the patient variables, the medical actions performed on the simulator, and the monitoring-screen display seen by the residents throughout the exercise were recorded with Media Recorder software, along with videos of the scene captured by three different cameras. The video recording was used as an educational support during medical debriefing and to score a posteriori the medical performance.

The clinical scenario included two phases. First, the resident was called upon to take care of an unconscious wounded patient who had a gun shot wound to the head. Residents were expected to (a) identify that the patient was in a coma and (b) prepare the patient before medical evacuation by injection of anaesthetic and intubation. Second, residents were confronted with a well-known but difficult-to-diagnose life-threatening situation: anaphylactic shock. This diagnosis is perceived as difficult because residents have limited experience with intubation even though they theoretically know about it. In practice, 2 min after the injection of anaesthetic, the patient's condition suddenly worsened, with rapid arterial hypotension, abrupt tachycardia and bronchospasm. The paramedic was requested to signal to the resident that the patient was becoming red (a symptom that could not be reproduced on the mannequin). All these

symptoms should direct residents toward the diagnosis of anaphylactic shock, requiring an immediate injection of adrenaline, the only medical action that will stabilise the condition of the patient. The simulation lasted approximately 20 min.

In order to avoid potential biases related to insufficient knowledge or lack of practice with either intubation or the mannequin, residents participated in a preliminary session, which took place 1 month ahead of the experiment. During this preliminary session, residents were given the opportunity to learn about intubation and its potential complications, and to practise on the mannequin.

Measurement of EC

The EC level of the participants was evaluated using the validated French-language version of the self-evaluation Trait Emotional Intelligence Questionnaire (TEIQue).[26 27] This questionnaire consists of 153 items, with answers on a 7-point scale from 1 (completely disagree) to 7 (completely agree). These items are divided into 15 subscales with four factors: well-being, self-control, emotionality and sociability. The questionnaire has a global score, scores for each of the four factors, and scores for each of the 15 subscales. The French-language version has a high internal-consistency score: the Cronbach α for the global score is 0.94 for men and 0.95 for women.

The questionnaire was given to all participants during the first session. They were then divided into two groups reflecting their EC level, based on the median of their TEIQue scores: EC+ group and EC− group.

Evaluation of emotional state during the simulation

Emotional state is expressed through four components, providing four different types of measure[28]: subjective experience, reactions from the autonomic nervous system, central nervous system reactions and behavioural responses. In this study, only subjective measures were collected since (a) reactions from the autonomic nervous system do not rely on only emotional reactions but also physical and cognitive activity, such as workload,[29] and (b) the last two types of measure were not technically adapted to our settings.

Subjective experience, which can be verbalised by the individual and can therefore be evaluated using self-evaluation questionnaires or interviews, has the advantage of reflecting what the person experienced during the situation; as such, it has the potential to provide very rich and precise information concerning the emotional state felt. However, these measures have some limitations. In addition to a potential social-desirability bias, studies have shown that some individuals have difficulty identifying, or conceptualising, their emotional state.[28]

The self-evaluation Positive and Negative Affect Schedule (PANAS) questionnaire was used to evaluate the intensity of negative and positive affect experienced by the participants.[30] In this questionnaire, 20 adjectives describing an affective state are presented, and respondents indicate the extent to which they experienced each affective state on a 5-point scale. The questionnaire was completed twice by each participant: (1) just before the simulation, at which time participants were asked to evaluate their present emotional state; (2) just after the simulation, at which time participants were instructed to evaluate their emotional state during the simulated emergency care. Because negative and positive affect are scored separately, four scores were obtained: two scores for negative affect (corresponding to the participants' emotional states before and during the simulation) and two scores for positive affect.

After the last questionnaire, a semi-structured interview was performed. The aim of these interviews was to access the residents' medical reasoning associated with the nature of their emotional experience. Therefore, the interview protocol was based on the four stages of the scenario, with questions about information collection, representation of the situation, choices of actions and queries about their emotional state, their origin and their potential link with medical activity (table 1).

One human factors expert conducted all the interviews, which lasted around 30 min. The qualitative data enabled us to identify the nature and valence of affects experienced during emergency care and to categorise the origin of negative affects.

Medical care performance

A medical performance score (between 0 and 5) was obtained based on two dimensions: diagnostic accuracy and relevance of therapeutic actions (table 2). A maximal score (5 points) was received by residents who both correctly identified the anaphylactic shock and injected adrenaline. No points were given to

Table 1 Semi-structured interview protocol

Themes	Questions
Information processing	Which piece(s) of information did you need/seek at that moment?
Medical situation representation	What representation of the state of the patient did you have at that moment?
Plans of action	What action(s) did you consider? For what goal?
Emotional state	Could you describe your emotional state while providing care? Could you identify the origin of this emotional state?
Link between emotional state and healthcare activity	Do you think your emotional state impeded the quality of the care you provided? If yes, could you describe how?

Themes were discussed for each incident of the scenario: discovery of the medical situation; performance of emergency actions; deterioration of the patient's condition (anaphylactic shock); performance of therapeutic responses.

Table 2 Medical performance scoring grid

	Medical diagnosis		
Therapeutic action	**Anaphylactic shock**	**Hypovolaemic shock**	**Other**
Adrenaline injection	5	4	3
Other	2	1	0

residents who neither identified the anaphylactic shock nor injected adrenalin. The performance of each participant was scored by an expert MD after each simulation.

Data analysis

To assess the validity of the TEIQue results for the present study sample, we computed the internal consistency score. The result was equal to 0.93, which is very close to the score obtained during the original validation of the test.

To test for an effect of EC, we first checked that the medical emergency simulation used in this study induced a particular emotional state. To this aim, repeated-measures analysis of variance was used to compare the intensity of affect before versus during the simulation.

We also checked for statistical differences in affect intensity between the two groups before simulation using a planned comparison test.

Analysis of variance was used to assess the statistical significance of the effect of EC on PANAS scores. Concerning the medical performance scores, the distribution in the sample was U-shaped and departed significantly from the assumption of a normal distribution (Kolmogorov–Smirnov test; $d=0.24$, $p<0.10$). Accordingly, the statistical significance of the effect of EC on medical performance was investigated using a non-parametric (Mann–Witney U) test.

The relationship between intensity of affect and medical performance was quantified using a correlation analysis.

In order to compare sources of affective states, participants were also divided into two groups based on their medical care performance. The 'PERF+' group consisted of residents whose performance was equal to 3 or higher, indicating that they performed the therapeutic action (adrenaline injection) necessary to stabilise the patient's condition, regardless of the diagnosis arrived at. The 'PERF−' group consisted of residents whose performance scores were equal to 2 or less, indicating that they did not perform the required therapeutic action, even if they made the correct diagnosis.

RESULTS

Twenty-one residents (10 female and 11 male) participated in the study. Their mean age was 25 years (SD=0.91). They had little practical emergency care experience, with only one trimester completed in an emergency department before their residency. The most experienced resident had carried out about 15 more shifts in an emergency department and in a fire department.

Global EC scores ranged from 3.79 to 5.80; the mean score was 4.71 (SD=0.44) and the median score was 4.72. The EC+ group included 10 residents who had high EC scores; the EC− group included 11 residents who had low EC scores.

Intensity of positive and negative affect

A significant increase in the intensity of negative affect was observed, which increased from 20.81 points on average (SD=1.10) before the simulation to 29.41 points on average (SD=1.67) during the simulation, $F(1, 19)=37.67$, $p<0.001$, partial $\eta^2=0.66$. No statistically significant difference in the intensity of positive affect between before and during the simulation was observed: 31.59 points on average (SD=1.20) before the simulation and 29.91 points on average (SD=1.33) during the simulation.

Before the simulation session, no significant differences between the two EC level groups were observed for either positive or negative affect.

In contrast, a statistically significant difference between the two groups was found for negative affect during the simulation: the intensity of negative affect was significantly higher for the EC− group (mean=34.00, SD=2.42) than for the EC+ group (mean=24.82, SD=2.31), $F(1,19)=6.24$, $p<0.05$, partial $\eta^2=0.25$ (figure 1). No statistically significant difference was observed for positive affect.

Medical performance

Medical performance scores varied from 0 to 5 and were equal to 2.57 on average (SD=2.25) across the entire study sample. Of the 21 residents who participated in the study, nine made the correct diagnosis (anaphylactic shock); of these, eight also chose the appropriate therapeutic response (adrenaline injection). Three other residents chose the appropriate therapeutic response even though they did not make the correct diagnosis. Thus, 11 residents belonged to the PERF+ group and 10 to the PERF− group.

A statistically significant difference in medical performance scores was observed for the EC+ and EC− groups: the former had a higher mean performance score (mean=3.90, SD=0.60) than the latter (mean=1.36, SD=0.57), $U=21.50$, $Z=2.32$, $p<0.05$ (figure 2).

Relationships between negative affect intensity and medical performance

A statistically significant correlation was observed between medical performance scores and intensity of

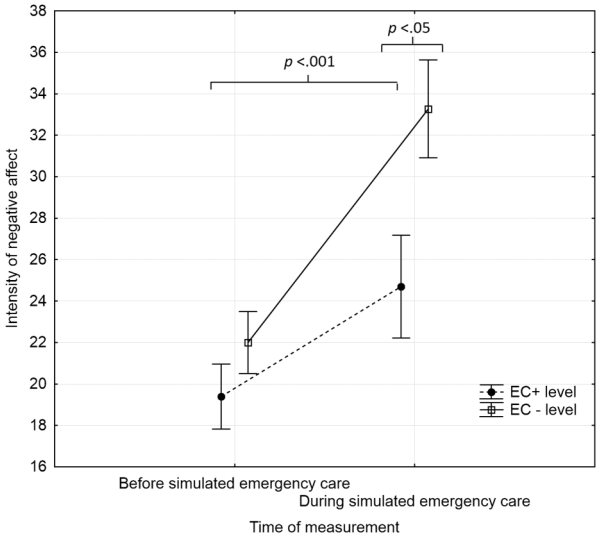

Figure 1 Intensity of negative affect as a function of emotional competence (EC) level before and during the simulated emergency care situation (means and SDs).

negative affect felt during the emergency care situation, $r=-0.53$, $p<0.05$, $r^2=0.28$ (figure 3).

No statistically significant correlation between medical performance and intensity of positive affect was found.

Origin of negative affect

Analysis of the interviews after the simulation session revealed that 16 of the 21 residents (with as many from the EC+ group as from the EC− group) reported experiencing negative affect. Among the five residents who indicated not experiencing negative affect, two reported experiencing a neutral state (for example: 'I felt calm' or 'I was alert and focused'); the three other residents expressed no affect.

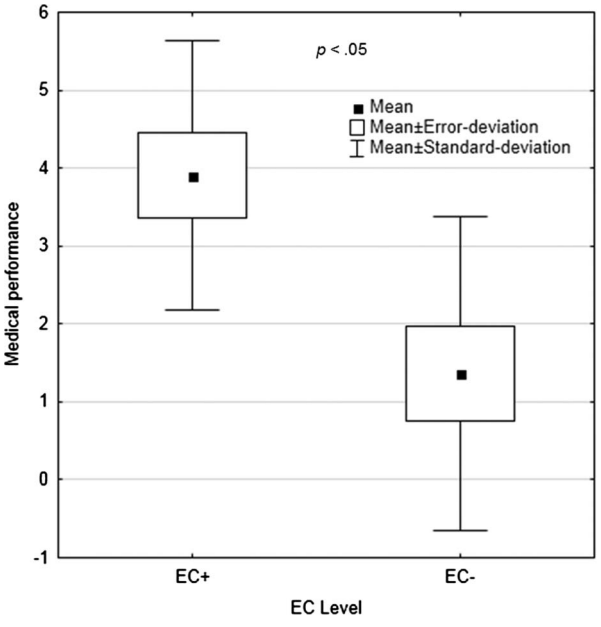

Figure 2 Medical performance scores for the emotional competence (EC)+ and EC− groups.

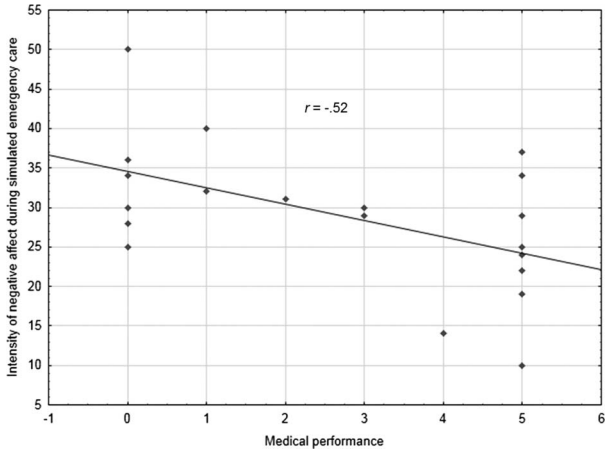

Figure 3 Scatterplot of individual medical performance versus negative affect intensity.

Four distinct origins of negative affect were identified for 15 residents.

- *Difficulty associating a known diagnosis with the situation.* This is the most commonly expressed source of negative affect; it was expressed by 10 of the 15 residents. For example, several residents said 'I did not know what to do'; one said 'I did not understand why he was red'.
- *Confrontation with vital risk.* This source of negative affect was verbalised by three residents. For example, one resident said 'I felt helpless because his (the patient's) state was worsening'; another one said 'I was stressed because I did not manage to ventilate, so I went with a 'conio' (coniotomy) even though it wasn't rational'.
- *Poor self-confidence.* This source of negative affect was expressed by two residents, one of whom belonged to the PERF+ group while the other belonged to the PERF − group. For example, the resident in the PERF− group said 'I was focused on what I had injected. I felt worthless'; the resident in the PERF+ group said 'I was stressed because I have no self-confidence'.
- *Difficulty managing human and material resources.* A single resident, in the PERF+ group, pointed to this origin for his negative affect. He mentioned experiencing 'a little stress in managing the team and technical aspects'.

Figure 4 shows the distribution of the four origins of negative affect depending on performance and EC groups.

These results reveal that the most frequently expressed origin of negative affect is difficulty in attaching a known mental scheme to the situation; this is the case regardless of medical performance or EC level. The majority (four out of six) of the residents in the EC+ group who experienced this affect belonged to the PERF+ group, while none of the

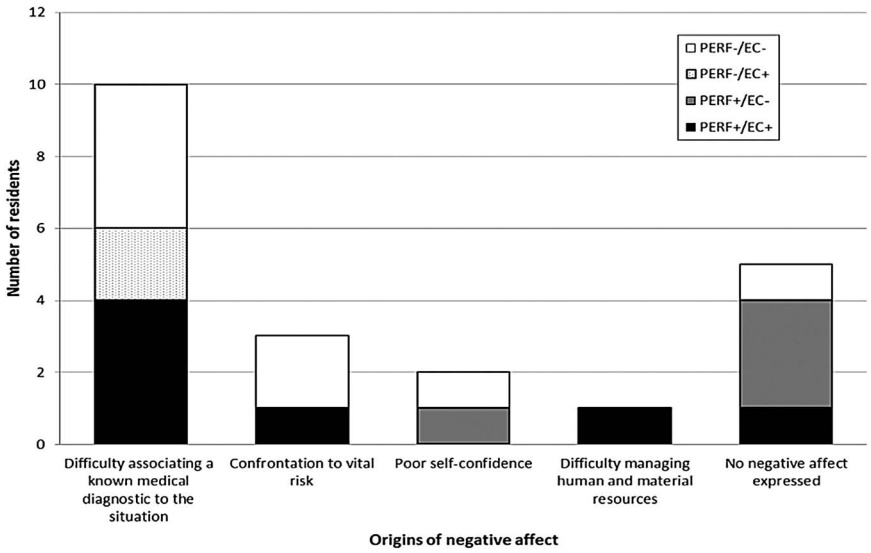

Figure 4 Distribution of the origins of negative affect depending on performance and emotional competence (EC) level.

other four residents in the EC− group succeeded with the emergency care. The results also show that four out of the five residents who expressed not having experienced negative affect succeeded with the emergency care and three of these four residents belonged to the EC− group. Confrontation with vital risk led to successful performance for one resident in the EC+ group, but not for either of the two residents in the EC− group. Poor self-confidence was reported by two residents, one of whom succeeded in the emergency care while the other did not; both belonged to the EC− group.

DISCUSSION

While few studies have investigated the role of EC in performance of a specific medical task that induces emotions, our research shows that medical residents who have a high level of EC are significantly more successful in an emergency care simulation. These results are in agreement with those of other studies showing a relationship between EC and work performance in various professional fields and in medical activities.[20 31–33] Moreover, medical residents with high EC experienced less intense negative affect during the emergency care situation than residents who had a lower EC level. This finding is consistent with the results of a previous study which demonstrated the predictive validity of the French-language TEIQue and in which a statistically significant negative correlation between the TEIQue global score and the PANAS negative affect score was observed; note that these two questionnaires were both used in our study.[27] In another study, it was found that participants who had a low EI score experienced more 'worry' states than those with a higher EI score.[34]

Our interviews with the residents after the simulation revealed that the main source of negative affect is the inability to formulate a diagnosis. One may surmise that, in our experiment, the intensity of negative affect was particularly high, as the patient's condition deteriorated and as the residents had little practical experience. This result is noteworthy because it was observed for both residents who had a high EC score and residents who had a low EC score, and similarly regardless of the medical performance. Therefore, it would seem that, faced with negative affect from the same origin, successful EC+ individuals were able to manage this affect in such a way that it perturbed their reasoning ability less, to the point that they were eventually able to make an accurate diagnosis. The results show that what it is most important for residents faced with a sudden, unexpected deterioration in a patient's condition is to manage to not let negative affect impact on their thinking, so that they remain able to make alternative diagnoses. Residents have limited practical experience and in a new situation they must access the theoretical knowledge that they have acquired. Cognitive activities such as recall of knowledge stored in the memory, and reasoning, are rapidly affected by stress.[35] In contrast, for experienced MDs, prior experience of situations similar to the current one can be easily recalled, in a more or less automatic fashion, because this ability is less affected by stress.

In this context, it may be useful to develop emotional-management training programmes for residents to complement simulation exercises. Several studies have shown the benefits of EC training.[36 37] This training is based on teaching flexibility when confronted with emotionally difficult situations and teaching how to control emotions that impede activity.[17 38] On the basis of our results, training programmes may be focused on emotions felt during a 'rapidly degrading patient' situation that elicits negative affect, which are likely to impact on reasoning and knowledge recall. Note that eliciting negative

affect should be handled with caution because of potential psychological negative consequences.

Limitations and implications for future research

Our study has several limitations. Negative affects were only measured through self-report measures and the results did not allow us to ascertain the causal link between negative affect and medical performance. Although a statistically significant negative correlation was found between negative affect and performance, it remains unclear whether negative affect results in poor performance or whether poor performance led to negative affect. While some of the residents' verbalisations suggest the former, more thorough interviews should be performed in future studies to allow participants to better explain the links between the affect that they experienced and their reasoning, in particular using self-confrontation interviews.

Another limitation is that only one medical scenario was used in the study. In further studies, the effects of EC could be tested with several scenarios—for example, comparing low-affective and high-affective scenarios.

The monocentric study design limited to a convenience sample of a small number of participants may have resulted in selection bias. Thus, the results of our study cannot be generalised to the whole population of French military residents. Therefore, further research with a multicentric study design and a larger sample would be useful to confirm our results with military residents and even senior MDs.

In addition, our study suffers from the usual limitations of simulation settings compared with real practice.[39]

CONCLUSION

EC appears to influence the quality of prehospital emergency care provided by medical residents in simulated settings. Better EC allows residents to better manage negative affect experienced during a sudden and unexpected worsening of the condition of a patient. In addition to theoretical and practical medical training, residents could receive emotional-management training, similar to that used to improve the safety skills of practitioners.[40] Such training is especially likely to be useful because residents have limited practical experience, yet they can be required to manage complex situations on their own. Future studies should be performed to further investigate the relationships between negative affect and clinical reasoning.

Contributors LB managed the project in collaboration with BD. MB developed and conducted the medical part of the simulation exercises, and J-CA developed and conducted the technical part of the study. AV served as scientific adviser. Chrisptophe Micheyl proofread the manuscript in English.

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