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The impact of psychological factors on the management of intraoperative haemodynamic events in children

Management of cardiac arrest in children

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Abstract

Introduction: Paediatric anaesthesia requires specific theoretical knowledge and practical training. Non-technical skills and psychological factors might influence learning and practice. The aim of this study was to assess personality type and decision-making styles of paediatric anaesthesiology residents during the management of simulated intraoperative life-threatening cases.

Method: Residents in anaesthesiology (between 4 and 5 years of training) participated in a simulated hypoxic cardiac arrest in the operating theatre. Their performance was evaluated using a score derived from international recommended management algorithm. They were asked to answer self-assessment questionnaires regarding both their personality (the five personality factors) and their decision-making style. Correlations between performance and personality were investigated.

Results: Thirty-eight residents participated in the simulation session and 36 accepted to answer the questionnaires. Good management scoring was positively correlated with agreeableness and conscientiousness personality traits but was negatively correlated with avoidance and spontaneous decision-making styles.

Discussion: The current study identified personality traits and decision-making styles that might influence the management of critical situations during paediatric anaesthesia. The proper identification of these factors might allow targeted personalised training to improve knowledge mobilisation and translation in the clinical context.

Keywords: cardiac arrest, children, intraoperative, personality, simulation

Introduction

Paediatric anaesthesia, especially in infants younger than one year, is still associated with a high risk of perioperative complications (1). According to recent studies, 20 % experience serious postoperative complications (2). Moreover, surgery and anaesthesia are associated with higher perioperative mortality and serious neurological disabilities when compared to other populations, including older patients (3).

Recent evidences have shown that experience prevents the occurrence of perioperative complications in the paediatric population (1, 4, 5). Most anaesthesiologists worldwide, including in France, are trained to paediatric anaesthesia during their residency. This training, associated with the classical academic curriculum, is considered sufficient to manage paediatric anaesthesia. However, given the rarity of perioperative complications in paediatrics, this training is probably insufficient for the management of critical situations (6, 7), as highly suggested by the impact of experience in the decrease of perioperative paediatric complications (1, 4, 5). Therefore, identifying factors that might enhance the acquisition of adequate skills to manage critical events during paediatric anaesthesia is a challenge. This is essential to improve the quality of the training and perioperative care.

Non-technical skills have been identified as key elements to insure adequate management of patients during critical situations (8, 9). Among those non-technical skills, psychological factors such as personality trait might also impact the management of those critical situations. These constitutive traits have been shown to be a good predictor of academic success and some professional achievements (including healthcare practice) (10, 11). However, little is known about the involvement of psychological factors during emergency management in anaesthetised patients, especially in physicians with little

professional experience. Identifying such factors might help teachers in tailoring specific training according to the physician psychological profile insuring an optimal acquisition of the most appropriate skills for each medical students (12). The goal of the present study was to evaluate the impact of psychological factors, namely: personality trait and decision-making behaviours, on the management of simulated critical cases of paediatric anaesthesia (intraoperative haemodynamic instability and cardiac arrest in paediatric patients during a manikin-based simulation session) by anaesthesiology residents.

Material and Methods

Study design

This is a prospective single centre simulation study, approved by our IRB (Comité d'Evaluation de l'Ethique des Projets de Recherche Biomédicale - CEERB–Robert Debré chaired by Pr Aujard: # 312/2016 obtained on March 04, 2016), and written consent was obtained from all participants. The study was not registered given that no patient was involved in the current study.

Objectives of the study

The primary objective of the study was to evaluate the impact of psychological factors such as personality trait and decision-making behaviours on technical skills during a simulated haemodynamic instability followed by a cardiac arrest in an anaesthetised child. We assessed the management by residents with a minimal training in this field (see below for further details and justification).

Simulation scenario

The scenario was the case of a 3-month-old infant with a bradycardia (heart rate = 70 bpm) associated with an oxygen desaturation (SaO₂ = 85%) rapidly evolving to cardiac arrest with asystole followed by a ventricular fibrillation. The infant was intubated and anaesthesia was maintained with a 1 MAC sevoflurane in a mixture of O₂/Air (50%/50%). The full version of the scenario is available in figure 1.

The management of this scenario was submitted to three experienced paediatric anaesthesiologists with at least 10 years experience in the management of paediatric

patients to obtain a consensus on the optimal therapeutic steps necessary for this case. Those experts were asked to determine the optimal sequence according to the international recommendation on the management of cardiac arrest as published by the American Heart Association (13). The therapeutic steps identified by those experts were as follows: increase the inspiratory fraction of oxygen to 100%; increase the O₂ flow to at least 6 L per minute; diagnosis of the cardiac arrest; check and secure the venous access; beginning of the thoracic compressions with at least 100 compression per minute; pulmonary auscultation; stop surgery; call for help; ask for the defibrillator device; adaptation of ventilation; stop the administration of the volatile anaesthesia; stop any other treatment; administration of the first epinephrine bolus, administration of the second epinephrine bolus, cardiac shock (after the rhythm changes to ventricular fibrillation) and administration of the third epinephrine bolus. An independent observer collected all those items with the corresponding timing (one single observer for all sessions).

Given the absence of pre-existing validated score from the literature for scoring the studied situation (intraoperative haemodynamic instability followed by a cardiac arrest), a score including one point for each of those items (a total of 17 points) added to one point for the appropriate dosing of epinephrine (100 µg kg⁻¹) for each bolus (a total of 3 boluses were mandatory during the scenario) and another point for the intensity of the electric shock (2 joules kg⁻¹) was constructed (total points of the score = 20 with each item scored as 1 if performed). Importantly, the order of the different steps was not considered in the score reason why a complementary analysis describing the timing of each item was added to analyses.

In addition to its construction based on relevant items for the management of the studies situation, this twenty-item score underwent a face and a content validity by ten

experienced anaesthesiologists. Although the high concern about the face validity in the medical education literature (14), this was performed as one compound for the overall validation process of the scoring system. It was assessed by asking the physicians about the relevance of each item of the score for the purpose of evaluating the management of the scenario. As previously published, item with more than 75% of positive responses were considered as belonging to the explored topic (15). The content validity was measured using the Lawshe method (corrected by Wilson et al.) (16): same physicians were given the scenarios and the goal of the study; they were asked to indicate if each item scored was “essential”, “useful, but not essential” or “not necessary”. Number of physicians responding essential was reported for each item and the content validated ratio was calculated ($CVR = \frac{\text{Number of physician indicating essential for the item} - (N/2)}{(N/2)}$; N = number of ratter). According to the table indicating a significant effect of CVR for 10 responders a value of 0.62 indicate a significant effect and could indicate that the item can be kept for the scoring. Finally, the last stage in the validation of this score was the comparison of scores between experienced anaesthesiologists and residents. Results were expected to be significantly different given the effect of experience in the performance of physicians in managing critical perioperative situations (5).

Study date

The study was performed between November 01, 2017 and May 01, 2018.

Realisation of the scenario

During the study period, every resident from the anaesthesia department were invited to participate to the study. Upon informed consent, residents participated in the

simulation study after a minimal required period of 3 months of clinical training and academic teaching of basic principles of paediatric anaesthesia, as suggested by the European guidelines for training in paediatric anaesthesia. This insured they all had the required knowledge to manage the simulated cases of the scenario. The simulation study lasted one day. The participants were isolated in the meeting room before the simulation session and asked to keep secret the scenario from all their colleagues and other residents afterwards. Ten senior physicians (different from those who performed the validation of the score), with a minimal 5 years' experience in the field of paediatric anaesthesia (fellowship were thus excluded from the analysis), participated to the same simulation and their performance were afterwards compared to the residents using the same developed scoring system.

Psychological evaluation

After the ending of the study all the residents included filled out a questionnaire on personality and decision-making behaviours called the General Decision Making Style (17) in its French validated version (18). This questionnaire explores decision-making processes. It distinguishes five decision styles (each one scored from 1 to 5): A rational style emphasizes a thorough search and logical evaluation of alternatives; an avoidant style makes postponing and avoiding decisions; a dependent style establishes a search for advice and direction from others; an intuitive style focuses on reliance on hunches and feelings and a spontaneous style presents a sense of immediacy and a desire to get through the decision-making process as soon as possible. Personality was assessed using the validated French version big-five inventory questionnaire (19) (each personality style was scored from 1 to 5), which includes extraversion (Energy, positive emotions, assertiveness, sociability and the

tendency to seek stimulation in the company of others, and talkativeness), agreeableness (A tendency to be compassionate and cooperative rather than suspicious and antagonistic towards others; it is also a measure of one's trusting and helpful nature, and whether a person is generally well-tempered or not), conscientiousness (a tendency to be organised and dependable, show self-discipline, act dutifully, aim for achievement, and prefer planned rather than spontaneous behaviour), neuroticism (identifies certain people who are more prone to psychological stress) and openness to the experience (appreciation for art, emotion, adventure, unusual ideas, curiosity, and variety of experience. Openness reflects the degree of intellectual curiosity, creativity and a preference for novelty and variety a person has. It is also described as the extent to which a person is imaginative or independent and depicts a personal preference for a variety of activities over a strict routine).

Statistical analysis

Data were expressed as median [range] (scores) or mean \pm SD for continuous outcomes and number of patients (N) and their percentage for discrete variables. Data comparisons were performed using the Mann & Whitney non-parametric test or the X^2 (of Fisher test) for continuous and discrete variables, respectively. Correlations assessments were performed using the Spearman correlation test. When the same data was used for multiple comparisons, a Bonferroni correction was applied.

Given the absence of any previous data in the literature about the relation between psychological factors and the management of critical anaesthesia situations to allow the estimation of a sample size, we empirically determined the number of physicians needed to

find a significant correlation of 0.5 with an alpha risk of 5% and a beta risk of 80%¹. Results indicate that 29 physicians had to be included, we thus considered including a minimum of 30 residents. Given the number of residents (12 per 6 months session) we intended to recruit for 3 sessions to recruit the target sample. The inclusion period lasted 18 months.

¹<http://www.sample-size.net/correlation-sample-size/> Last access November 2019.

Results

Overall, 38 residents and 12 senior anaesthesiologists (excluding those who evaluated the most appropriate sequence of treatments and the validation of the score) were included in the study. Two residents agreed to perform the simulation session but refused to undergo the psychological evaluation, consequently the primary end-point of the study was analysed for 36 residents.

The median [range] overall rotations performed by residents were 8 [7 to 10] 6-months rotations and the experience of seniors in paediatric anaesthesia was 8 [6 – 10] years. The number of rotations was the same for the three included session of residents (8 [7 – 10] $p = 0.9$).

As previously detailed in the method section, the score for the steps of the scenario was built on a maximum of 20 points. The face validity of the scoring system was between 80% and 100% for all items and the content validated ratio for all items was ≥ 0.8 . Finally, residents achieved a lower score in comparison to seniors (15 [8 – 19] *versus* 18 [12 – 19], respectively, $p = 0.001$). Given those results, all items were used for scoring the management of the scenario that ranged from 0 to 20 (supplemental file 1).

Concerning the primary outcome of the study, descriptive statistics are displayed in table 1. Correlations between the decision-making styles and the personality traits; and the performance scores are displayed in table 2. The score was inversely correlated to the avoidant and spontaneous decision trait and positively correlated to the agreeableness and conscientiousness personality traits.

Concerning the timing of realisation of the required steps (when steps were performed), figure 2 displays the comparison between residents and seniors. Residents were less efficient regarding the following steps: auscultation, diagnostic of the cardiac arrest,

beginning of the chest compressions, check the venous access, call for help and stopping the volatile agent. The details of the proportion of physicians performing each step (and the comparisons between the two samples) are displayed in table 3. A statistical difference was found between residents and seniors regarding the following steps: cessation of the surgery, call for help and administration of the third bolus of epinephrine.

Discussion

Our study showed that during a simulated haemodynamic instability and cardiac arrest (performed on manikins), performing the adequate treatment was inversely correlated to avoidant and spontaneous decision-making styles and positively correlated to the agreeableness and conscientiousness personality traits.

Given the absence of pre-existing validated score to assess the technical skills during the intraoperative sequence studied (haemodynamic instability followed by a cardiac arrest in children) at the time the study was performed, our study used a standardised scenario with the adequate steps based on international recommendations and experience of a panel of experienced anaesthesiologists in the specific field of paediatric anaesthesia. The score used was then validated. In addition, results indicate that both this constructed score and the timing of realisation of the steps during advance life support were significantly different between experienced anaesthesiologists and residents (table 2 and figure 2). Consequently, this score is very likely to discriminate competencies of physicians during this scenario.

Literature on personality trait and on its relation to the choice of a particular medical career already exists. For instance, surgeons have been shown to score higher than the general population for extraversion, conscientiousness and openness to experience (20). Personality has also been found to correlate with both educational performances and job performance (including medical performances) (10, 11, 20-23). In 1991, Tett et al. published a meta-analysis of studies showing that conscientiousness was a strong predictor of job performance in non-healthcare providers (11). Personality trait evaluated with the Myers-Briggs Type Indicator (derived from the Jung's personality types: extravert-introvert, sensing-intuition, thinking-feeling and judging-perceiving) showed an improved performance during

anaesthesiology examination (24) for extraverted and sensing students. The California Personality Inventory (exploring 23 personality sub-types) showed that introversion and flexibility were predictor of a poor clinical experience during residency (25). According to this literature (10, 26), some authors have suggested to use personality trait assessment tools in order to identify residents and/or to personalise the educational strategy according to each personality type (27). This has been supported by some studies showing the association between personality pattern and the choice of medical specialty. Our results found that agreeableness and conscientiousness were positively associated with the proper management of a simulated emergency. This is in accordance with the description of those personality types that favour communication with surrounding healthcare providers and results of one study that found those personality traits to avoid aggressive communication with other people (28). This allows: (a) a better coordination between caregivers and (b) a more rigorous application of theoretical knowledge to manage such a critical case. This is clearly supported by a study that found a positive correlation between these two personality traits and competence and autonomy at work in nurses (29). However, the association between extraversion traits and improved success in examination and clinical skills (23-25) was not confirmed by our study. Emergency situations might require communication, confidence and team coordination, which might be favoured with residents exhibiting agreeableness personality traits. Concerning conscientiousness, this personality trait is associated with a tendency to be organised and reliable, to show self-discipline, to act dutifully, to aim for achievement, and to prefer planned rather than spontaneous behaviour. All behaviours required to adequately learn and apply management strategies, especially during acute situations. Rhoton et al. found the same results concerning this personality trait during critical situation management by residents (8). Consequently, both agreeableness -

which promotes team coordination - and conscientiousness - which promotes planned organisation and discipline in applying adequate measures - appear as the ideal combination insuring successful management of acute critical conditions (8, 10, 20).

Decision-making style is defined by “the learned habitual response habit pattern exhibited by an individual when facing a contextual situation” (17). Finding that both avoidant and spontaneous decisions-making styles were negatively correlated to the technical performances for the management of this scenario is not surprising. Decision-making styles have been found to correlate with personality traits: avoidant style was found negatively correlated to conscientiousness and spontaneous style negatively correlated to both conscientiousness and agreeableness (30), which supports current results. Those two styles are defined by: an attempt to avoid decision-making (with a possible delayed or even absence of adequate action) and an immediacy of decision in order to get through the decision-making process. As stated by their definition, both styles are likely to generate inadequate responses to these specific situations due to the absence or the inadequacy of responses. Although, they may partially depend on constitutive factors (such as personality traits) (30), decision styles are also acquired and contextual (17, 31); they can theoretically be changed for another more appropriate decision-making style (such as the rational one) or be modulated by an imposed self-discipline.

The main question arising from our findings is whether formal psychological evaluation should be used for the assessment of residents. Although, psychological and behaviours evaluation is still poorly used during medical studies for the acquisition of knowledge and practical training, the relevance of using those elements is questionable. As previously stated, decision-making styles are acquired and one can change inadequate behaviours in order to favour more appropriate actions. As for personality traits, academic

content could be adapted given the fixed nature of personality traits. One can easily imagine that people with a low agreeableness and conscientiousness might be taught how to improve organisation skills and follow appropriate paths in emergency situations. In this context, simulation appears to be a valuable training tool. However, such an evaluation, if mandatory requires more research, a consensus among teachers and students and a deep ethical questioning about the appropriateness of this practice in the academic field.

The current study suffers some limitation. First, the technical skill was scored using a new scoring system validated for the purpose of this study. However, this scoring system was based on the international recommendations as stated by the American Heart Association (13). Another limitation of the study was the scoring of technical skill that was performed by only one independent observer with a possible bias. The effect size was limited and no power could be determined before the study, this might impact some results such as the involvement of the extraverted trait in the successful management of the simulated case. No exploration of the causes of success or failure was performed (internal issues such as poor knowledge or self-confidence; external ones such as being repeatedly told that are not good at a task). However, this was not the goal of the study and the sample size would be too small for exploring those questions. Finally, we did not explore the relation between decision-making styles and personality traits. This was mandatory, and adjustment of the alpha risk while the sample size was too limited for such an exploratory study.

In conclusion, the current simulation study found that performance in managing intraoperative haemodynamic instability and cardiac arrest in children during a simulation session on manikins are correlated to specific decision-making styles and personality traits. These results should be confirmed by further researches. If confirmed, these results should encourage educators to focus on these factors in order to help change some inappropriate

acquired decision styles and adapt their educational content to the personality of residents.

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Legends of figures

Figure 1: Description of the simulation scenario. HR: Heart rate; BP: Blood pressure (systolic/diastolic); ETCO₂: End-tidal CO₂

Figure 2: Comparison of ALS realisation timings between senior physicians and residents. CA: Cardiac arrest, DD: defibrillator device,

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Table 1: description statistics of decisions-making styles and personality traits. Data are expressed as median [range]

Decision-making style				
Rational	Intuitive	Dependant	Avoidant	Spontaneous
4.1 [3.2; 4.8]	3.4 [1.4; 4.4]	3.7 [2.6; 5]	1.9 [1; 4.2]	2.4 [1.6; 3.8]
Personality traits				
Extraversion	agreeableness	conscientiousness	neuroticism	openness
3.3 [1.3; 4.9]	4 [3; 4.8]	3.9 [3; 4.9]	2.5 [1; 3.9]	3.1 [2.2; 4.3]

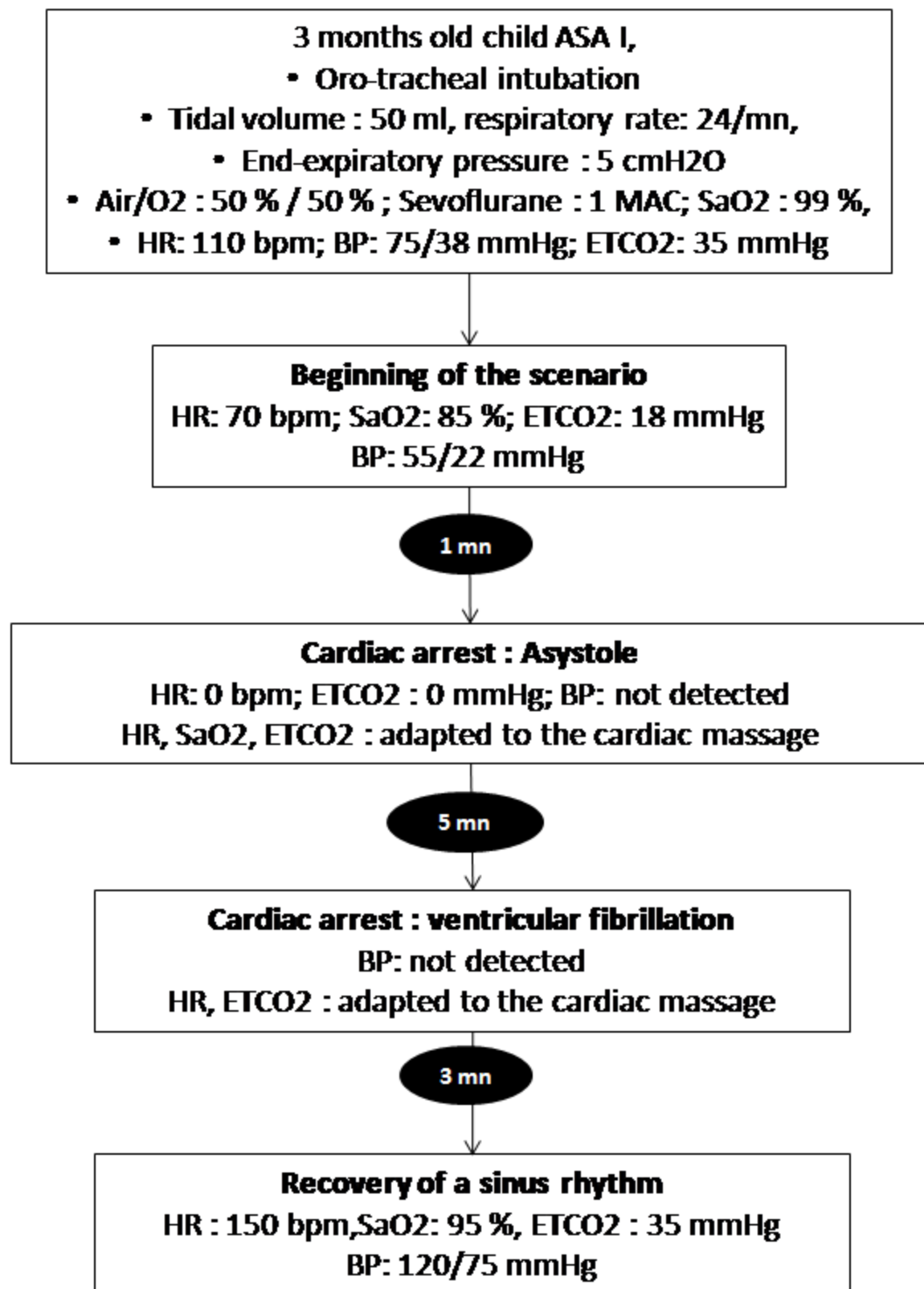
Table 2: Correlations between the decision-making styles and the personality traits, and the score in performing the scenario. Bolt dimensions indicate significant correlation.

	Dimension	Spearman correlation coefficient	<i>P</i> (level of significance)
Decision-making styles	Rational	0.006	0.9
	Avoidant	-0.4	0.01
	Dependent	0.03	0.8
	Intuitive	-0.019	0.9
	Spontaneous	-0.4	0.02
Personality traits	Extraversion	0.3	0.55
	Agreeableness	0.35	0.04
	Conscientiousness	0.4	0.02
	Neuroticism	-0.27	0.1
	Openness	-0.17	0.3

Table 3: Details of the proportion of physicians (senior) and residents achieving each step of the scenario. CA: Cardiac arrest, DD: defibrillator device,

	Seniors (N = 12)	Residents (N = 38)	<i>P</i>
FiO2 = 1	10 (83%)	38 (100%)	0.05
O2 Flow	10 (83%)	38 (100%)	0.06
Auscultation	10 (83%)	33 (87%)	0.5
Diagnostic CA	12 (100%)	38 (100%)	1
Cardiac massage	12 (100%)	38 (100%)	1
Venous assess	6 (50%)	15 (39.5%)	0.4
Stop Surgery	12 (100%)	26 (68%)	0.02
Call for help	6 (50%)	33 (87%)	0.01
Ask defibrillator device	10 (83%)	29 (76%)	0.5
Adapt ventilation	6 (50%)	16 (42%)	0.4
Stop volatile agents	10 (83%)	28 (74%)	0.4
Stop other treatments	8 (67%)	28 (74%)	0.4
Epinephrine bolus 1	12 (100%)	37 (97%)	0.7
Epinephrine bolus 2	12 (100%)	36 (95%)	0.6
ECC	12 (100%)	22 (58%)	0.05
Epinephrine bolus 3	12 (100%)	15 (39%)	< 0.001

Figure 1



Time (seconds)

