

# High Fidelity Simulation Experience in Emergency settings: doctors and nurses satisfaction levels

Diletta Calamassi<sup>1</sup>, Tiziana Nannelli<sup>2</sup>, Andrea Guazzini<sup>3</sup>, Laura Raserio<sup>4</sup>, Stefano Bambi<sup>5</sup>

<sup>1</sup> School of Nursing, University of Florence; <sup>2</sup> University of Florence, Versilia Hospital, USL Nord-Ovest Toscana; <sup>3</sup> Centre for the study of complex dynamics - CSDC - University of Florence; <sup>4</sup> Department of Clinical and Experimental Medicine, University of Florence (Italy); <sup>5</sup> Emergency & Trauma Intensive Care Unit, DAI DEA, Azienda Ospedaliero Universitaria Careggi, Florence (Italy)

**Abstract.** *Background and aim of the work:* Lots of studies describe High Fidelity Simulation (HFS) as an experience well-accepted by the learners. This study has explored doctors and nurses satisfaction levels during HFS sessions, searching the associations with the setting of simulation events (simulation center or on the field simulation). Moreover, we studied the correlation between HFS experience satisfaction levels and the socio-demographic features of the participants. *Methods:* Mixed method study, using the Satisfaction of High-Fidelity Simulation Experience (SESAF) questionnaire through an online survey. SESAF was administered to doctors and nurses who previously took part to HFS sessions in a simulation center or in the field. Quantitative data were analyzed through descriptive and inferential statistics methods; qualitative data was performed through the Giorgi method. *Results:* 143 doctors and 94 nurses filled the questionnaire. The satisfaction level was high: on a 10 points scale, the mean score was 8.17 (SD±1.924). There was no significant difference between doctors and nurses satisfaction levels in almost all the SESAF factors. We didn't find any correlation between gender and HFS experience satisfaction levels. The knowledge of theoretical aspects of the simulated case before the HFS experience is related to a higher general satisfaction ( $r=0.166$   $p=0.05$ ), a higher effectiveness of debriefing ( $r=0.143$   $p=0.05$ ), and a higher professional impact ( $r=0.143$   $p=0.05$ ). The respondents that performed a HFS on the field, were more satisfied than the others, and experienced a higher "professional impact", "clinical reasoning and self efficacy", and "team dynamics" ( $p < 0,01$ ). Narrative data suggest that HFS facilitators should improve their behaviors during the debriefing. *Conclusions:* Healthcare managers should extend the HFS to all kind of healthcare workers in real clinical settings. There is the need to improve and implement the communication competences of HFS facilitators.

**Key words:** High-Fidelity simulation, emergency, satisfaction, nurses, doctors

## Background

The satisfaction level of the students that experienced simulation sessions with high fidelity mannequins, can ease the learning process during the educational events (1).

Some studies suggest the presence of a positive correlation between the students satisfaction levels and

the performance levels reached during the simulation experience (2).

High Fidelity Simulation (HFS) is a method of learning well accepted by the students, especially when compared to other traditional educational methods. In a US cross-over study involving emergency medicine program students, the enrolled participants were randomized to a simulation phase of the course, while

the other group began the educational experience with a discussion phase. After completing each learning process phase, the two groups were inverted, exposing each to both different educational approaches. At the end of the 2 rotation phases of the study, the satisfaction levels of the students were assessed through the administration of a 5 point Likert scale questionnaire. The satisfaction evaluation considered the “perception of the scenario adherence compared to reality”, the “stress” of it and the entertainment experienced. According to the answers of the 88 students completing the survey, the simulation experience has been perceived as more pleasant (mean 4.5; 95% CI: 4.3-4.6), more stimulating (mean 4.7; 95% CI: 4.5-4.8) and more stressing (mean 4.1; 95% CI: 3.9-4.3) if compared to the discussion experience. The simulation experience was also identified as closer to the real clinical setting (mean 4.6; 95% CI 4.4-4.7) (3).

The multiprofessional simulation experiences are also associated to high levels of student satisfaction (4).

The concepts related to the usefulness of simulations for the teamwork are common in many published studies. The simulation has an important value for the improvement of non-technical skills, as communication skills, the ability to offer aid without (or before) it is asked by the other team members, and the lower tendency to blame others when errors occur (5).

Students expressed that simulation is useful in improving their value as team members and to test their patient assessment skills. They believe that the simulation experience represents a link between theory and clinical practice (6). Other studies showed that participants of other simulation experiences agree that simulation helps in easing the comprehension of theoretical concepts listened during the lectures sessions (7). Some students also state that simulations connect theory to practice, and increase their self-confidence (8).

The usefulness of simulations seems to be strictly related to how the student lived this experience and what they learn during the debriefing (9).

In a correlational study involving nursing students in a US public university, the tools used to record the satisfaction levels were the “Student Satisfaction and Self Confidence in Learning Scale” and the “Simulation Design Scale” (10). The considered variables were

the “aims”, the “fidelity/realistic experience of the simulation scenario”, the “problem solving”, the “support offered to the students”, and the “debriefing”. The outcomes included knowledges, competencies, satisfaction levels in learning, critical thinking and self-confidence (10). Students were satisfied about this teaching methodology, showing a mean overall satisfaction score of 4.5 (SD±0.5) on a 5-points scale (10).

The mean satisfaction score provided by students with work experience was 4.5 (SD±0.5), compared to 4.6 (SD±0.4) recorded by the students without experience, but there was no statistically significant difference (10). The mean self-confidence score was 4.2 (SD±0.5) in students with work experience versus 4.3 (SD±0.4) in student without (10).

The results of the Simulation Design Scale show that students had positive feelings about the aims, fidelity/lifelikeness of simulation scenario, problem solving, support offered to them, and the debriefing (10). Lastly there were no evidence of significant correlation between satisfaction and self-confidence levels and the gender, age, simulation experience, previous work experiences in healthcare settings, or previous education of the participants (10).

An anonymous survey performed with 55 pediatrics students in a Spanish hospital after 6 simulations courses explored several features of the simulation experience (11). Their satisfaction was rated with a 10-point scale ranging from 1 (scant or low) to 10 (very good or high) (11). The trainees expressed positive opinions about the simulation courses, highlighting satisfaction associated to the lifelikeness and pragmatism there of. The mean satisfaction scores about surveyed features were: “information” 8.9 (SD±0.6), “documentation” 9 (SD±0.6), “organization” 9.2 (SD±0.3); “locations” 8.9 (SD±0.5); “materials” 9.2 (SD±0.4), “course duration” 8.6 (SD±0.2); “teachers” 8.6 (SD±0.5), “students number per session” 9.8 (SD±0.1), “lifelikeness of the simulation system” 9.0 (SD±0.5), “simulated cases duration” 8.9 (SD±0.5), “number of cases” 9.0 (SD±0.4), “accomplishment of the expectations and aims” 7.9 (SD±1), “usefulness in clinical practice” 9.6 (SD±0.3) (11). The agreement range on each learning outcome was between 83% and 98%. This study suggested that the inclusion of advanced simulation courses of pediatric emergencies

in the education programs can be a useful and appreciated education method by the trainees (11).

However, some students state to have some difficulty to accept the idea that during HFS the patient is in fact a mannequin (12).

A qualitative study showed 4 themes/fundamental concepts related to the students lived experiences during simulation sessions: “interaction with other disciplines”, “real life situations”, “experiencing with a code” and “uncertainty”. A student stated that the simulation session was the first work experience with other disciplines, and another one commented that simulation aided to overcome the inexperience of working in collaboration with nurses (13).

Shrader et al. reported that students enjoyed to work with other professionals and wish to participate in similar educational experiences (4).

A recent literature review (9), highlighted the need to perform further researches about HFS. The main areas to be explored are related to feedback, data support during the simulation session, communication among the participants and the student satisfaction (9).

Following the suggestions emerged from the review above, we performed a study with the aim to explore the satisfaction levels among the doctors and nurses who participated in simulation sessions with high fidelity mannequins in 2 different settings: a simulation center (SC), and on the field (in a pediatric hospital).

## Materials and methods

Since the trainee satisfaction is a complex phenomenon, we designed a mixed methods study, with quantitative and qualitative data collection (14).

This study covered the following operational areas:

- recording of participants satisfaction levels
- analysis of the differences in the participants perceptions related to specific variables (such as age, gender, length of service, clinical setting, theoretical knowledge about the clinical case before the simulation event, specific education, setting in which the simulation is performed).

- comparison between the results obtained to the trainees that experienced the simulation on the field (OTFS) and in the SC
- qualitative analysis of themes emerged from the answers given by the participants to an open question included in the satisfaction measurement tool

The sample was composed by 900 healthcare professionals (doctors and nurses), who attended to a simulation session performed in a SC, and on the field, in a pediatric hospital, in Florence (Italy) from 2002 to 2012.

The tool chosen to measure the satisfaction levels of the participants was the Satisfaction of High-Fidelity Simulation Experience (SESAF) questionnaire (15).

The SESAF questionnaire is composed by 48 closed items and one open question (free comments about the simulation lived experience). 40 items were designed with a 5 point Likert or numerical scale answers, while the other 8 questions used a 10 points numerical scale. SESAF explores 7 factors: “Overall Satisfaction”, “Facilitator and Debriefing”, “Clinical Reasoning and Self-Effectiveness”, “Team Dynamics (Team Factor)”, “Professional Impact”, “Safeguards and Materials”, “Difficulty and Distress”. This tool has been validated in Italian, through an explorative factorial analysis. The test retest validity showed high correlations of factors ( $>0.733$ ) and they were all significant (15). Internal consistency was excellent (Cronbach Alpha 0.97) (15).

The SESAF questionnaire was administered online, following the methods used by Miloslavsky et al. in their survey (16).

The internet address link to access and fill the questionnaire was sent by e-mail.

We asked to all the participants to fill the SESAF questionnaire recalling the experienced simulation scenario related to cardiac arrest and implementation of Basic Life Support – Early defibrillation, according to the European Resuscitation Council guidelines (17). Since the cardiac arrest scenario was common for all the healthcare professionals who attended the simulations experiences, the risk of bias related to different numbers and kinds of clinical cases was decreased.

Statistical descriptive and inferential analysis were performed through parametric (t test, Pearson's r) and non-parametric tests ( $\chi^2$ ) according to the normal

(or not normal) distribution of the variables. Socio-demographic variables were particularly taken in account for these analysis. It was conducted an hoc sampling with Bootstraps method (18).

Quantitative data was analyzed through the SPSS® Statistics software version 20 (19).

Qualitative analysis of the thematic contents was performed on the open ended question using Giorgi's descriptive phenomenological methodology (20). In the first phase the answers to the SESAF open ended question were scrutinized from two separated researchers. Mean themes called "Themes" were identified and collected from recurrent expressions and words. In the second phase, the results of two researchers' analysis was compared, and an agreement on main themes and meanings was reached.

Data was collected in anonymous fashion and analyzed in aggregated form. Privacy of the participants to our study was rigourosely maintained in all phases of the research. The subjects were safeguarded according to Helsinki Declaration and Oviedo Convention.

## Results

### *Quantitative data*

237 subjects (143 doctors and 94 nurses) participated in this survey. 210 (88.6%) experienced simulation sessions at the SC, while the others performed the OTFS at the Pediatric Hospital. The demographic characteristics of the sample were: male 48.1%, mean age 41 years ( $SD \pm 10.7$ ; range 23–62 years). Table 1 summarizes the answers to the SESAF items given by the respondents. The larger part of the sample (82.7%) did not receive any specific education as simulation facilitator.

53 respondents (22.4%) were instructors in BLS, Pre-hospital Trauma Care (PTC), or Advanced Life Support (ALS) courses (17).

There is a significant statistical association between being an instructor in BLS, PTC, or ALS courses and having received a specific education as simulation facilitator ( $\chi^2 19.928 - p < 0.01$ ).

Moreover, the respondents who had received an education as HFS facilitators were also instructors of HFS facilitators ( $\chi^2 86.909 - p < 0.01$ ).

Before starting the simulation, 10.5% (n. 25) of the respondents knew the clinical case "little" or "not at all", from a theoretical point of view, while 81.4% of the subjects (n. 193) had already faced a similar case in the real life clinical practice.

86% of the participants (n. 204) thought that the clinical case was "fairly" to "very much" complex.

During the study period 182 (76.8%) of the respondents were working in the Emergency Department, while other 25 subjects had ED work experience in the past.

We performed a data analysis to find statistical associations among the state of having faced a similar case in real life clinical practice before the simulation sessions, specific perceptions about the usefulness of simulations and some participants' characteristics such as age, length of service, theoretical knowledge of the clinical case before the simulation sessions, etc.

To obtain this result, we selected 2 different sub-sample: the first one composed by those that had faced a similar clinical case before the simulation experience (44 respondents), second one was composed by an equal number of persons randomized (Bootstraps method) from those without any real life experience of the clinical case used for the simulation sessions. The participants who had experienced in the past, a real life clinical case similar to that used for the simulation were meanly older and they had a longer time in work contexts of than the other respondents (t test=7.287  $p=0.01$ , and t test=4.992  $p=0.01$ , respectively). Moreover, they knew the theoretical aspects of the simulated case better than the younger sub-sample (t test=3.205  $p=0.01$ ).

The participants without previous real life experience in clinical practice settings found higher difficulties with the simulated scenario (t test=-4.188  $p < 0.01$ ). However, the simulation experience improved their education level, due to the provided occasion to reflect about their abilities (t test=-2.179  $p=0.05$ ), and their points of strength and weakness (t test=-2.058  $p=0.05$ ). There was a larger positive effect on the clinical practice in the previously experienced sub-sample (t test=2.301  $p=0.05$ ).

We did not find any significant differences in the satisfaction levels between doctors and nurses, except for the factor of "Clinical Reasoning and Self Effec-

**Table 1.** Mean scores obtained from SESAF administered to HFS experience participants

Questionnaire factors/dimensions	Item scoring	Items	Mean	Standard deviation
<b>Overall Satisfaction</b>	<b>Scoring range: 1-5</b> 1: not at all 2: slightly 3: somewhat 4: very 5: extremely	The SIMULATOR allows learning through team work very effectively	4.18	0.903
		It was worth participating in the SIMULATION	4.55	0.738
		The clinical case was realistic	4.04	0.562
		Degree of effectiveness of the simulator in re-creating the scenario (effectiveness as far as the proposed difficulties were similar to those of real cases experienced)	3.70	0.807
		The SIMULATOR permits you to learn the necessary procedures for patient management	3.89	0.884
		The simulation was a valuable learning experience	4.19	0.732
		The SIMULATION session has improved my level of professional training	3.73	1.034
		<b>Score range: 0-10</b> 0: Not at all (negative) 10: Extremely (positive)	Develops of clinical reasoning skills through the simulation experience	8.03
	Satisfaction about the simulation experience		8.17	1.924
	Possibility of clinical learning through the simulation		7.97	1.901
	Possibility of learning by efficiently working in a team		8.60	1.520
	Fidelity/realism on simulation scenario		7.65	1.794
	Usefulness of simulation in work procedures		8.17	1.946
	Usefulness of debriefing after the simulation		8.55	1.645
	<b>Facilitator and Debriefing</b>	<b>Scoring range: 1-5</b> 1: not at all 2: slightly 3: somewhat 4: very 5: extremely	I received feedback during the debriefing that helped me to learn	3.89
The facilitator provided feedback during the debriefing that helped me to develop my clinical reasoning skills			3.83	0.785
I had the opportunity to reflect on and discuss my performance during the debriefing			4.04	0.691
The debriefing provided an opportunity to ask questions			4.07	0.667
The facilitator provided constructive criticism during the debriefing			4.08	0.643
The facilitator explained important things during the debriefing			4.11	0.596
The facilitator made me feel comfortable and ease during the debriefing			3.98	0.794
The facilitator questions helped me to learn			3.88	0.763
Degree of competence in the management of the debriefing by the facilitator			3.89	0.751
Degree of competence in the management of the scenario by the facilitator			3.76	0.718
Reflecting on and discussing the simulation enhanced my learning			3.96	0.758
<b>Score range: 0-10</b> 0: Not at all (negative) 10: Extremely (positive)			The facilitator was expert	7.95

*(continued)*

**Table 1.** Mean scores obtained from SESAF administered to HFS experience participants

Questionnaire factors/dimensions	Item scoring	Items	Mean	Standard deviation
<b>Clinical Reasoning and Self-Effectiveness</b>	<b>Scoring range: 1-5</b> 1: not at all 2: slightly 3: somewhat 4: very 5: extremely	The simulation caused me to reflect on my clinical ability	4.04	0.636
		The simulation developed my clinical reasoning skills	3.86	0.643
		The simulation developed my clinical decision making ability	3.77	0.730
		The simulation tested my clinical ability	4.08	0.696
		The simulation helped me to recognize patient deterioration early	3.78	0.770
		The simulation enabled me to demonstrate my clinical reasoning skills	3.78	0.790
		The simulation helped me to recognize my clinical strengths and weaknesses	4.07	0.767
		The simulation helped me to apply what I learned from the case study	3.97	0.789
<b>Team Dynamics (Team Factor)</b>	<b>Scoring range: 1-5</b> 1: not at all 2: slightly 3: somewhat 4: very 5: extremely	My team were interested and paid attention during the debriefing	3.85	0.718
		My team was interested and paid attention during the SIMULATION	3.87	0.714
		Did you participate actively in the debriefing after the SIMULATION?	3.73	0.784
		Did your peers in the debriefing provided feedback on the performance expressed by the team as well as by individuals?	3.64	0.846
<b>Professional Impact</b>	<b>Scoring range: 1-5</b> 1: not at all 2: slightly 3: somewhat 4: very 5: extremely	Were the learnt elements during the simulation, useful for the clinical practice?	3.49	0.886
		How much of what you learned during the SIMULATION have you applied to your daily work?	3.35	0.947
		The SIMULATION helped me to understand what my role would be in a similar emergency situation	3.56	0.860
		If I had not participated in the simulation, my work performance would have been worse compared to what I actually had	3.45	1.010
<b>Safeguards and Materials</b>	<b>Scoring range: 1-5</b> 1: not at all 2: slightly 3: somewhat 4: very 5: extremely	The safeguards/materials were adequate in order to recreate the scenario	3.73	0.803
		The Health-system technologies were adequate in recreating the scenario	4.08	0.583
		The setting was suitable in that it created the scenario	3.79	0.806
<b>Difficulty and Distress</b>	<b>Scoring range: 1-5</b> 1: not at all 2: slightly 3: somewhat 4: very 5: extremely	During the SIMULATION I felt discomfort	2.85	1.113
		The SIMULATION was a stressful moment/a source of anxiety	3.08	1.070
		I found it difficult to face the clinical case during the SIMULATION	2.46	0.767

tiveness" (t test  $-2.929$ ,  $p < 0.01$ ), like wise, we did not find significant correlation between the participants' gender and their satisfaction levels.

In table 2 we summarized the main correlations between some studied variables and the satisfaction levels about the simulation experience. The temporal proximity to the simulation experience showed a positive correlation with the quality perception of safe-guard and materials  $r = 1.149$   $p = 0.05$ ).

The increasing of the students' age negatively correlates with overall satisfaction ( $r = -0.237$   $p = 0.05$ ), the experienced stress ( $r = -0.163$   $p = 0.05$ ), the perception of simulation usefulness for clinical practice ( $r = -0.209$

$p = 0.05$ ), and the appreciation of the facilitator and the debriefing ( $r = -0.209$   $p = 0.05$ ).

The knowledge about the theoretical aspects of the clinical case before the simulation session is positively correlated to the overall satisfaction ( $r = 0.166$   $p = 0.05$ ), the perception of a better effectiveness of the debriefing ( $r = 0.143$   $p = 0.05$ ), and a higher professional impact ( $r = 0.143$   $p = 0.05$ )

The more the clinical case was considered complex by participants, the more they were satisfied and considered their experience useful to the development of clinical reasoning and self-effectiveness ( $r = 0.225$   $p = 0.05$ ;  $r = 0.173$   $p = 0.05$ , respectively).

**Table 2.** Correlation matrix about Pearson's r, between socio-demographic variables and the satisfaction about the simulation experience (in this table are reported only variable with a correlation at least significant at a p value < 0.05)

	Overall satisfaction	Facilitator and Debriefing	Clinicals Reasoning and Self-Effectiveness	Team Dynamics (Team Factor)	Professional Impact	Safeguards and Materials	Difficulty and Distress
I took part in a simulation session for the first time in year...						0.149	
The last time which I took part to a simulation session was the in the year...:	0.230	0.254	0.231	0.250	0.160	0.153	
Age	-0.237	-0.209	-0.269		-0.153		-0.163
Number of years spent in the current working position	-0.227	-0.203	-0.234	-0.143			
Before to start with the simulation, did you know the clinical features of the simulation case from a theoretic point of view?	0.166	0.143			0.143	0.212	
The clinical case scenario was complex	0.225		0.173		0.204		
Respect of the team performance, me and my colleagues managed at our best, the situation	0.230	0.221	0.178	0.152	0.138	0.174	0.218
The simulation experience was a pleasant moment	0.429	0.412	0.356	0.409	0.262	0.147	0.266
I found myself in agreement with the team with which I collaborated during the simulation session	0.451	0.447	0.406	0.410	0.386	0.187	0.206
How much part of what you have learnt during the simulation experience was impossible to implement in daily practice?				-0.133	-0.188		

The better team management of clinical scenario and the higher level of agreement among team members correlated with higher points for every factor.

The more fun the simulation experience was, the more it was stressful and useful ( $r=0.266$   $p=0.05$ ). To have fun during simulation experience is associated to higher scores of overall satisfaction (table 2).

Data displayed in table 3 show a difference in the impact on clinical practice between the settings where the simulation experience took place. Participants to OTFS were more satisfied than those who attended the SC, since they experienced a larger effect on the “professional impact”, “clinical reasoning and self-efficativeness” and “team dynamics” factors ( $p<0.01$ ).

The answers given by participants related to the

simulation experience satisfaction levels and the will to repeat the experience are reported in table 4.

The more a subject wishes to repeat the simulation experience, the more he/she was satisfied and the more he/she felt difficulty and stress (“overall satisfaction” 0.622  $p<0.01$ ; “difficulty and distress” (0.446  $p=0.05$ ).

*Qualitative data*

Regarding the qualitative data analysis, 59 respondents answered to the open question. The sample was composed by 37 doctors (15 female), and 22 nurses (9 female). 4 Themes emerged from the analysis (figure 1).

**Table 3.** Statistical association between the experience of simulations at simulations center or on the field at Pediatric Hospital and the SESAF 7 factors

	I experienced field simulations at Meyer’s Pediatric Hospital:	N	Mean	Standard deviation	Mean standard error
<b>Overall Satisfaction</b>	Yes	24	0.4948	0.71673	0.1463
	No	27	-0.0806	0.78129	0.15036
Facilitator and debriefing	Yes	24	0.3697	0.89035	0.18174
	No	27	0.0406	0.77324	0.14881
Clinical Reasoning and Self-Effectiveness	Yes	24	0.6847	0.68365	0.13955
	No	27	-0.1696	0.82732	0.15922
Team Dynamics (Team Factor)	Yes	24	0.5042	0.83634	0.17072
	No	27	-0.2624	0.94076	0.18105
Professional Impact	Yes	24	0.6941	0.83209	0.16985
	No	27	-0.2384	0.78517	0.15111
Safeguards and Materials	Yes	24	0.1325	0.8763	0.17887
	No	27	0.1309	0.74476	0.14333
Difficulty and Distress	Yes	24	-0.2759	1.08368	0.22121
	No	27	-0.2856	0.97703	0.18803

	T -test			
	t	df	Sig. (2 -tails)	Difference between means
<b>Overall Satisfaction</b>	2.729	49	p. <0.01	0.5754
Facilitator and debriefing	1.413	49	ns	0.32904
Clinical Reasoning and Self-Effectiveness	3.99	49	p. <0.01	0.85429
Team Dynamics (Team Factor)	3.059	49	p. <0.01	0.76661
Professional Impact	4.116	49	p. <0.01	0.93248
Safeguards and Materials	0.007	49	ns	0.00155
Difficulty and Distress	0.34	49	ns	0.00976

**Table 4.** Fisher's correlation between the SESAF factors and the will to participate to a new simulation experience

Factors	Be willing to repeat the experience
Overall Satisfaction	0.622 p<0.01
Facilitator and Debriefing	0.429 p<0.01
Clinical Reasoning and Self-Effectiveness	0.421 p<0.01
Team Dynamics (Team Factor)	0.315 p<0.01
Professional Impact	0.382 p<0.01
Safeguards and Materials	0.105 ns
Difficulty and Distress	0.166 p<0.05

#### 1<sup>st</sup> Theme - Effectiveness of simulation education

The experience of simulation is considered formative: *"In my opinion simulation is lived as a good experience and strengthen the knowledges learned during lectures"*; *"Excellent experiences related to every aspect, and every session I have attended"*; *"Wonderful experience"*; *"I think that simulation is a very useful experience in this working setting, and I'm ready to repeat it"*; *"Very happy to have attended to this event (...omissis)"*; *"Excellent learning method"*; *"I have highly appreciated the emergency code simulation experience"*; *"Unique and essential experience, allowing you to practice what you have learned in theory, and making you aware about your lacks"*; *"Very precious and important"*; *"Unique experience"*; *"Essential experience to achieve an effective life-saving organization (...omissis)"*; *"(...omissis) the simulation empowers more non-technical skills than the technical skills"*.

The benefit of simulation is often described as the occasion of learning the way to work effectively in a team: *"It helps to work in team"*; *"The simulation is the best way to learn how to work effectively in team"*; *"It is useful mainly to get used to working in a team"*; *"The simulation is an excellent tool to improve the emergency equipe performances, and, overall, to learn to respect others' roles, reducing dangerous overalppings, and to expand the*

*skills to manage the emotionality, since it is very realistic"*. *"It helped me to better understand and practice the work in equipe"*.

#### 2<sup>nd</sup> Theme - Simulation for all the healthcare workers in the reality

The participants recommend that all the colleagues should have been offered the opportunity to take part in simulations: *"(...omissis) the opportunity to experience the simulation should be given to all doctors and nurses"*; *"(...omissis) In my opinion it should be repeated more often in professional courses, and extended to daily practice"*; *"It should be implemented in a scheduled fashion for every working setting (...omissis)"*; *"It should be essential to transfer the simulation study method in the clinical setting, performing the simulation sessions together with all the real team members"*; *"(...omissis) Proposing simulation sessions to all the hospitals institutions could be a good idea to educate all the healthcare personnel working in the emergency clinical setting"*; *"(...omissis) it should be repeated more times inside professional courses, extending it to the daily practice (at maximum bimestrally)"*; *"It could be useful to share the experiences and gain for clinical practice a global vision achieved during the simulation session. Unfortunately, the on the field experiences are quiet different, and not all the professional have the same competences, that is the same methodology"*; *"Local HFS sessions should be subsidized, involving all the personnel working in the same hospital, to improve the collaboration among coworkers"*; *"It could be useful for emergency healthcare professionals to attend to simulation sessions repeated more times every year"*.

Implementing simulation sessions in the real working setting, with the contribution of the actual personnel, could increase the lifelikeness of the scenario, and probably lessen the negative emotion related to the sensation of incompetence for playing in unreal settings. Some subjects state that considering the simulation scenario not realistic is an individual limit: *"It's a limit of mine, I recognize it, I feel to be not adequate to this kind of training"*; *"I think that reality is quite different from the simulation. If you simulate a flight, you will be never a pilot!"*; *"I can't adapt to the fact that it's a mannequin, I recognize that it's a flaw of mine"*; *"(...omissis) my difficulty was to try to consider all the scenarios as realistic"*.

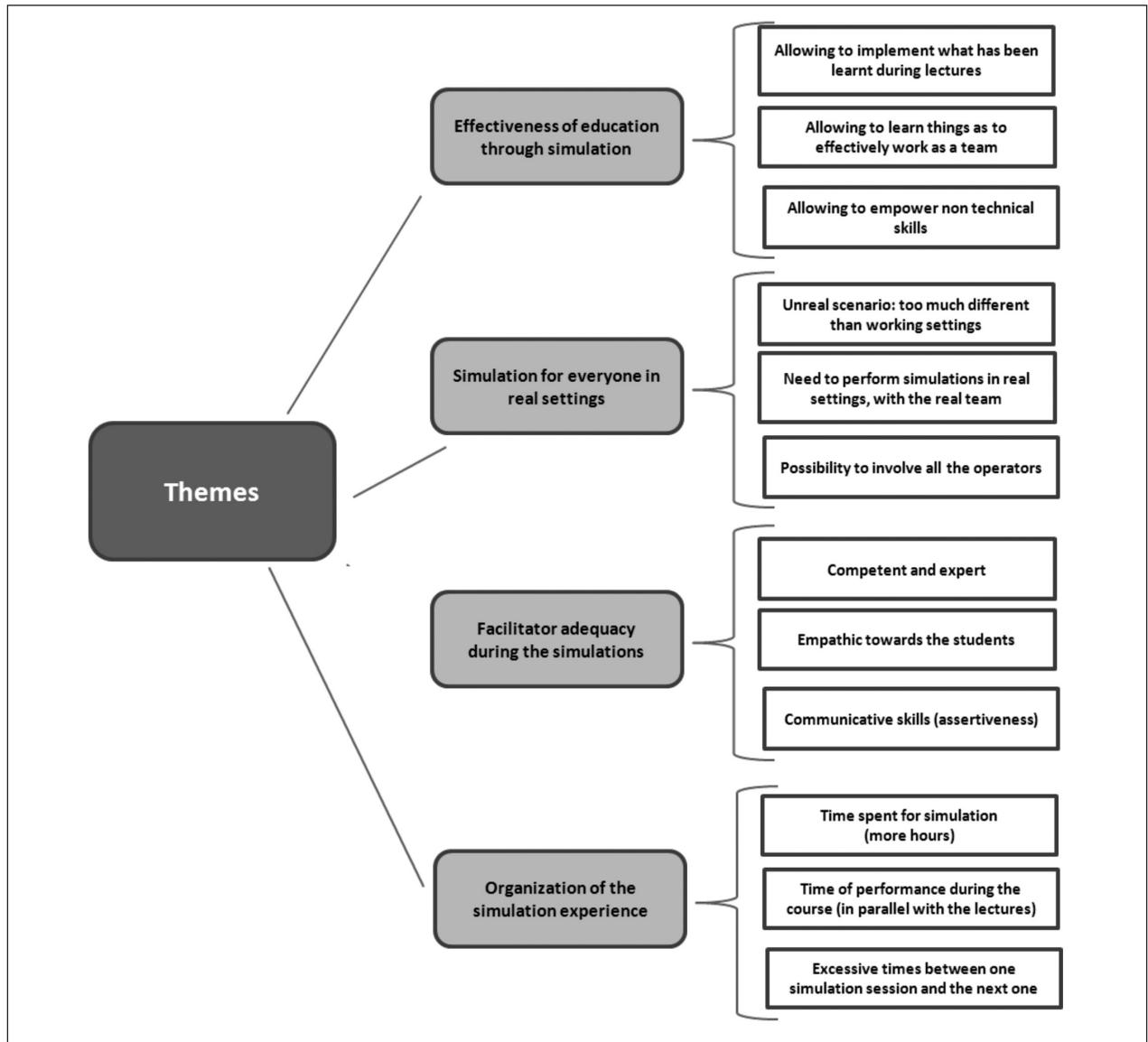


Figure 1. Themes with related codes

Other respondents think that reality is too complex to be perfectly simulated, but do not deny that simulation represents an effective education method: “The simulations, even if realistic, are included in a simulation mentality, surely important for personal education, but in the reality the situations dramatically change, due to lots of reasons. During the simulation sessions, we work with professional ability to manage and to help the management of clinical cases. In the reality, we work with volunteers. Even if some of them are competent, they remain a volunteers, therefore the difficulties generated during the

simulation are very different from those encountered in real clinical cases. And the real cases are more challenging than simulated cases. This consideration does not implicate that simulations are worthless; on the contrary, simulation experiences are very useful (...omissis) to get the skill of team-working”; “The reality is more complex than the simulation that is performed in a protected environment, and with the presence of a lot of operators that are absent in the real clinical practice settings”; “Unfortunately in the reality there’s not enough number of personnel or enough training to implement the contents that are showed in the

*simulations: underage or retired volunteers employed in the rescue ambulances; nurses that are offended by the request of "close the circle" in the emergency department".*

### 3<sup>rd</sup> Theme - Facilitator's adequacy during the simulations

According to the students, the facilitator in a fundamental figure, and the effectiveness of education and the overall appreciation of the simulation experience seem to depend from this role: *"The facilitator's competence is fundamental"; "I experienced the simulations in 2 separate occasions: during the first experience the facilitators were not knowledgeable as the second experience (when cardiac arrest case was performed), and my judgement is definitely negative. During the second experience, instead, the competence of the facilitators (...omissis) made the simulation experience an occasion of education quiet satisfying and useful for my professional practice"; "The facilitator has to be very experienced"; "He/she should be more kind with the weaks (...omissis), listen politely to the questions and answer without offending the weak"; "A unique experience, led by a competent and emphatic professional".*

The only 2 persons that considered negatively the simulation experience wrote: *"(...omissis) an ill-concealed and inopportune sensation of self-satisfaction showed by the facilitators about their competence counterposed to our ignorance"; "The simulation is useful only to the instructor to waste their time".*

### 4<sup>th</sup> Theme - Organization of the simulation experience

Lots of participants gave their opinions about organizational aspects related to the performed simulations and the time deserved to them, inside the course: *"I'd have liked to experience more simulation hours during the Master program"; "Very limited concerning quantity"; "Too scarce time for simulation sessions. Every student played the team leader role only once during the simulations day"; "Too little to take advantage of the opportunity offered by a simulation scenario as that we're talking about".*

Other comments are related to the times, even between 2 simulation sessions, and the need that simulation be preceded by an adequate theoretic knowledge: *"It should be periodically repeated!"; "Too much time passed between one simulation and another one"; "Increase the simulations hours with different clinical cases, to be managed in the emergency department setting and the out*

*of hospital emergency setting"; "It should be advisable to programme simulation retraining sessions as for ACLS, and other courses"; "(...omissis) it must be preceded by an adequate theoretic knowledge"; "(...omissis) it should be advisable to include the simulation sessions before the apprenticeship, to guarantee the continuity with theoretic lectures about ACLS and PHTC".*

## Discussion

### Quantitative data discussion

The results of this study confirm those coming from the previous researches. Almost all students are satisfied by the simulation experience, and agree about that participation in the simulation was a precious learning experience, was worth performing, and that all the learning elements are useful for the clinical practice.

As Eyck et al. (3) revealed, our data showed that the more the simulation was stressful, the more it was fun. The higher was the stress level, the higher was the participants satisfaction, leading the will to repeat the simulation experience. Therefore, the stress seems to be positively considered by the students.

The more the clinical case was considered complex, the more the satisfaction levels were higher, and the simulation was considered useful to the development of clinical reasoning and self-effectiveness. This results suggests that the stimulation of student during HFS experiences through challenging scenarios could positively affect their satisfaction levels.

The existing correlation among the theoretical aspects of the clinical case before the simulation, the high overall satisfaction, the perception of a higher effectiveness of the debriefing simulation and the professional impact, indicates the importance of theoretic knowledge before the simulation experience (7).

The theoretical knowledge about the clinical case seems to be important before the simulation event. In fact, it's related to an higher professional impact, a greater effectiveness perceptions about debriefing, and a larger overall satisfaction.

We did not find any associations between gender and satisfaction level, nor between working setting

and satisfaction levels. These results were similar to the findings of Smith and Roehrs (10).

However, in our study the respondents that had faced in their daily practice a real clinical case similar to that experienced with the simulation, were meanly older and had a longer length of service than those who did not experience a real clinical case.

In the respondents without previous clinical practice experience, the simulation improved the competence levels, because it allowed a more critical reflection related to their abilities and skills.

Concerning the sample, the higher proportion of participants composed by doctors than by nurses (60.34% vs 39.66%) could be a consequence of a greater number of education programs for the physicians, such as master degrees courses, emergency medicine certification programme etc..

The statistical significant association between being BLSD, PTC, or ALS courses instructor, and being a simulation certified facilitator suggests that this role can be achieved after having completed a series of special educational steps.

To be a simulation facilitator and currently an instructor of simulation courses using high fidelity mannequins implicates a congruent resources utilization and an adequate employment of instructors' competences.

Having received an education to become facilitator was associated to the "Professional Impact" factor, and there's an association between being nurses and the "Cilinal Reasoning and Self-Effectiveness" factor. So, a relationship between the satisfaction levels and the previously clinical case experience and education variables seems to exist, conversely to the results of the Smith & Roehrs' study (10).

The temporal proximity of the simulation experience with the perception of material and equipment employed showed a moderate positive correlation. These results can suggest that equipment and material improved with the passing of time.

It is noteworthy that OTFS is associated with several factors as "Overall satisfaction", "Team dynamics", "Clinical reasoning and self-effectiveness", and "Professional impact", but not with "Safeguard and Material" factor.

It's probable that the advantage of OTFS relies on the interaction with the real operative team, and

there is no association of the physical setting and/or of equipment and materials employed with the scenario lifelikeness.

### *Qualitative data discussion*

The theme "Effectiveness of simulation education" points out the high satisfaction level about the simulation experience performed by the students, especially concerning learning how to work effectively in a team, and the improvement of non technical skills.

Some students perceptions, such as the inability to accept the patient is a mannequin, are the same as those recorded by Lasater (12).

In the theme "Simulation for all the healthcare workers in the reality", the data showed the need to extend the simulation as education method to all the healthcare workers. According to the respondents' opinions the simulation should be performed in the real clinical setting and should engage also the non-healthcare personnel, generally get involved in the clinical case management (eg. nurses aids, volunteers...). For this reason, we should reflect about the potential limits to the the scenarios lifelikeness given by the making up of omogeneous groups (eg team made up by nurses aids or specific course students only) to engage in the simulations.

The contents emerged from the theme "Facilitator's adequacy during the simulations", indicate the need to enhance the education for the simulation facilitators, that are fundamental in determining the satisfaction levels. Weaver, in a recent literature review (9), found that the usefulness of simulation experience is strictly related to the way it was lived by the students, and to what they have learnt during the debriefing, conducted by the facilitator. Therefore, the facilitators' competences can't be restricted to the knowledge of clinical aspects and the management of scenarios, but requires also the knowledge about emotional features of human beings, and effective assertive communication skills.

The theme "Organization of the simulation experience" has highlited the need to improve the connections between the educational courses managers (Master program, or other educational courses) and the simulation program managers. The better integra-

tion between these professional figures should guarantee sufficient number of hours dedicated to simulation experiences, appropriate interval time between one simulation and another, and adequate theoretical knowledge before the simulation experience.

## Conclusions

Since OTFS recorded higher satisfaction levels than that performed in the SC, and the request by healthcare professionals to perform a major number of simulation events involving all the colleagues, hospital managers should reflect about the opportunity to extend the simulation to all the healthcare workers in their real clinical settings. These kind of choices should take in account the benefit/risk balancing, considering the increasing of patients safety, and the ethical implications. Further studies are needed to explore the satisfaction levels in larger samples of students and more various learning programmes.

## References

1. Prion S. A practical framework for evaluating the impact of clinical simulation. *Clin Simul Nurs* 2008; 4 (5): e69-e78.
2. Bremner M, Aduddell K, Bennett F, VanGeest J. The use of human patient simulators: best practice with novice nursing students. *Nurse Educ* 2006; 31 (4): 170-4.
3. Ten Eyck R, Tews M, Ballester J. Improved medical student satisfaction and test performance with a simulation-based emergency medicine curriculum: a randomized controlled trial. *Ann Emerg Med* 2009; 54 (5): 684-91.
4. Shrader S, McRae L, King W, Kern D. A simulated interprofessional rounding experience in a clinical assessment course. *Am J Pharm Educ* 2011; 75 (4): 61.
5. Gupta A, Peckler B, Schoken D. Introduction of hi-fidelity simulation techniques as an ideal teaching tool for upcoming emergency medicine and trauma residency programs in India. *J Emerg Trauma Shock* 2008; 1 (1): 15-8.
6. McCaughey C, Traynor M. The role of simulation in nurse education. *Nurse Educ Today* 2010; 30 (8): 827-32.
7. Heitz C, Brown A, Johnson J, Fitch M. Large group high-fidelity simulation enhances medical student learning. *Med Teach* 2009; 31 (5): e206-10.
8. Mould J, White H, Gallagher R. Evaluation of a critical care simulation series for undergraduate nursing students. *Contemp Nurse* 2011; 38 (1-2): 180-90.
9. Weaver A. High-fidelity patient simulation in nursing education: An integrative review. *Nurs Educ Perspect* 2011; 32 (1): 37-40.
10. Smith S, Roehrs C. High-fidelity simulation: factors correlated with nursing student satisfaction and self-confidence. *Nurs Educ Perspect* 2009; 30 (2): 74-8.
11. Mencía S, López-Herce J, Botrán M, Solana MJ, Sánchez A, Rodríguez-Núñez A, et al. Evaluation of advanced medical simulation courses for training of paediatric residents in emergency situations. *An Pediatr (Barc)* 2013; 78 (4): 241-7.
12. Lasater K. High-fidelity simulation and the development of clinical judgment: students' experiences. *J Nurs Educ* 2007; 46 (6): 269-76.
13. Reese CE, Jeffries PR, Engum SA. Learning together: Using simulations to develop nursing and medical student collaboration. *Nurs Educ Perspect* 2010; 31 (1): 33-7.
14. Sandelowski M. Combining qualitative and quantitative sampling, data collection, and analysis in mixed methods studies. *Res Nurs Health* 2000; 23 (3): 246-55.
15. Calamassi D, Nannelli T, Guazzini A, Bambi S, Gioachin G, Pini R, et al. High-Fidelity in Urgency-Emergency Simulation: validation of a tool to determine the satisfaction of participants. *Acta Biomed* 2016; 87 Suppl 2: 28-37.
16. Miloslavsky M, Hayden E, Gordon J. Medical simulation for clinical decisionmaking training for internal medicine residents. *J Gen Intern Med* 2011; 26 Suppl. 1: S571-S572.
17. Koster RW, Baubin MA, Bossaert LL, Caballero A, Cassan P, Castrén M, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 2. Adult basic life support and use of automated external defibrillators. *Resuscitation* 2010; 81 (10): 1277-92.
18. IBM. IBM SPSS Bootstrapping 19. Copyright SPSS Inc. 1989, 2010. [http://www.cs.bme.hu/~kela/SPSSStatistics%20\(E\)/Documentation/Italian/Manuals/IBM%20SPSS%20Bootstrapping%2019.pdf](http://www.cs.bme.hu/~kela/SPSSStatistics%20(E)/Documentation/Italian/Manuals/IBM%20SPSS%20Bootstrapping%2019.pdf) Accessed 08-08-2016
19. IBM. Guida rapida di IBM SPSS Statistics 20. © Copyright IBM Corporation 1989, 2011. [ftp://public.dhe.ibm.com/software/analytics/spss/documentation/statistics/20.0/it/client/Manuals/IBM\\_SPSS\\_Statistics\\_Brief\\_Guide.pdf](ftp://public.dhe.ibm.com/software/analytics/spss/documentation/statistics/20.0/it/client/Manuals/IBM_SPSS_Statistics_Brief_Guide.pdf) Accessed 08-08-2016
20. Fain A. *La ricerca infermieristica, leggerla, comprenderla, e applicarla* (2 edizione ed.). Milano: McGraw-Hill, 2004.

Received: 5 August 2016

Accepted: 5 September 2016

Correspondence:

Stefano Bambi

Emergency & Trauma Intensive Intensive Care Unit,  
DAI DEA, Azienda Ospedaliero Universitaria Careggi,

Largo Brambilla 3, 50134 Florence (Italy)

Tel. +393392104670

E-mail: [stebam@hotmail.it](mailto:stebam@hotmail.it) [stefano.bambi@unifi.it](mailto:stefano.bambi@unifi.it)