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## Simulation-based pediatric training: a French national survey

Short title: Simulation training in pediatrics

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**Abstract:**

*Introduction:* To have an overview of pediatric medical simulation within a country would be helpful to improve the offer and quality of teaching. The main objective of this study was to identify the scope for simulation-based teaching in pediatrics in France.

*Methods:* An assessment of professional practices was conducted by means of a national survey conducted among all university hospitals between 20 May and 6 August 2018. A standardized GoogleForm® was created and sent to heads of simulation centers or persons responsible for pediatric simulation. Descriptive analyses and comparisons of centers with and without university trainers as well as with and without research activity were performed.

*Results:* All 34 teaching hospitals or faculties of medicine responded to our survey. Of these, 31 had a simulation center. There was a median of nine trainers per center (interquartile range: 5–13). Most used simulation for communication and teamwork, as well as for technical and relational skills. These sessions were mainly dedicated to residents and health professionals. All centers reported working on high-fidelity newborn mannequins and 84% used low-fidelity newborn mannequins. Research activity was declared by 14 centers (45%), but only six of these had at least one publication. No difference was identified between centers with and without university trainers or with and without research activity.

*Conclusion:* Compared with the 2012 report, 19 new centers have emerged within 6 years in France (+158%). Pursuing research to evaluate the impact of simulation programs on physician skills and patient management would appear to be important.

**Keywords:** pediatric simulation; medical education; simulation centers

## **1. Introduction**

Simulation-based medical training is now accepted worldwide as an efficient teaching method [1–4]. Most studies use Kirkpatrick’s model of evaluation (reaction, learning, behavior, and results) here for patient care. In pediatrics, one meta-analysis identified 57 studies in 2014 showing that simulation was efficient versus no intervention in terms of knowledge, non-time skills, behavior with the patient, and time to accomplish a task [5].

In France, the first simulation center opened in Nice in 2008, followed by others in various medical schools and teaching hospitals throughout the country. In 2012, a report by the Haute Autorité de Santé (HAS) identified simulation centers in every region of France [6]. In this report, the simulation activity in pediatrics was estimated at 1.9% of all simulation-based medical education. Pediatrics is a specific field with a need for specific scenarios and materials. In 2008, 110 European simulation centers were identified and 20 out of 28 respondents had sufficient pediatric activity to answer the survey [7]. None was French due to the lack of pediatric simulation activity at that time.

We do not have an updated overview of pediatric simulation in France. The main objective of this study was to identify the scope for simulation-based teaching in pediatrics in France. The secondary aim was to provide a publication in order to share knowledge and skills relating to pediatric simulation to support its improvement.

## **2. Methods**

### *2.1 Study design and definitions*

An assessment of professional practices was conducted by means of a national survey among

all university hospitals in France between 20 May and 6 August 2018.

We used the official HAS definitions for the different types of simulation: role play, standardized patient, low-fidelity mannequin, high-fidelity mannequin, procedural low fidelity, procedural high fidelity, hybrid simulation, virtual reality, augmented reality, serious games, three-dimensional (3D) reality, and in situ simulation. A simulation center for health teaching was defined as an institution with human, scientific, educational, estate, technical, and logistical resources used for teaching and learning for healthcare professionals [6].

## *2.2 Survey procedure*

A standardized form using GoogleForm® was created for this survey. It included multiple choices and open questions divided into five parts: (I) General information about the center, (II) type and aim of simulation offered, (III) human resources, (IV) accessibility, and (V) research activity.

The form was sent by email to the heads of simulation centers or persons identified as responsible for pediatric simulation. Multiple reminders were made by email and phone. All data were collected through GoogleForm® in a standardized Excel® spreadsheet.

## *2.3 Statistical analysis*

Descriptive analyses were conducted using SAS software v904. Continuous variables were given in median and dichotomous variables in proportions. Comparative analyses were performed to compare the characteristics (i.e., those collected in part I to part V of the questionnaire) between centers with and without university trainers and centers with and without research activity. Ethical committee consent was not needed for this type of study.

## **3. Results**

All of the 34 surveyed teaching hospitals or faculties of medicine responded to the survey. A total of 31 respondents had a simulation center. The other three respondents declared not having a dedicated simulation center, but all used simulation as a teaching method in pediatrics.

In all, 12 simulation centers (39%) were located in or next to the faculty of medicine, 15 (48%) were in or next to the hospital, and four were more than a 10-min walk from the faculty of medicine or hospital. There was a median of nine trainers per center (interquartile range [IQR]: 5–13). Most of these were hospital-attending physicians (median: 4; IQR: 2–6) and non-medical healthcare professionals (median: 2; IQR: 1–2). Other trainers were fellows (median: 1; IQR: 0–1) or professors (median: 1; IQR: 0–2). Trainers attended special training in 28 centers with a median of four trainers (IQR: 2–5.5). An analysis of characteristics between centers with or without a university professor or associate professor as a trainer did not show any statistical difference. Research activity was declared by 14 centers (45%), but only six had at least one publication on this field to date. The analysis between centers with or without research activity also showed no difference. The objectives declared by the simulation centers for pediatric training are presented Figure 1. Most of the centers used simulation for communication and teamwork, as well as technical and relational skills. Those sessions were mainly dedicated to residents (in pediatrics or not) and healthcare professionals (Figure 2). Sessions were mandatory for residents in 81% of centers. Nine centers declared mandatory sessions for medical students, eight for health professionals, and one for pediatricians from university hospitals. A simulation program was integrated in the internship for 21 centers, in the standard university curriculum for 19, in continuous professional development for 19, and integrated in the activity of the clinical unit in 14 centers. In 11 centers (36%), training was

not free for professionals of university hospitals. Access was also charged for professionals working outside the university hospital for 23 centers (74%).

Simulation for newborns was used in every center. Infant and child simulation was used in 26 (84%) and 24 (77%) centers, respectively. The types of simulation used are presented on Figure 3. All centers reported working on high-fidelity newborn mannequins: 84% used low-fidelity newborn mannequins, while 71% used high-fidelity with infant and child mannequins and low-fidelity procedural simulation. Screen-based simulation such as virtual and augmented reality, serious games, or 3D environment was used in only two centers to teach emergency situations, reasoning ability, consultation, and management of adverse effects.

The main scenarios concerned high resuscitation procedures such as neonatal resuscitation after delivery, cardiac arrest, or shock (Figure 4). The procedural techniques predominantly taught at the simulation centers were intubation (81%), intra-osseous access (74%), and umbilical vein catheterization (71%) (Figure 5). Although one center indicated that it targeted pediatric simulation to teach delivering bad news (Figure 1), standardized patient and role play were actually used in practice to teach announcing critical illness, as reported by 14 centers (45%), and complex relationships between parents and physicians in nine centers (29%). In situ simulation took place in delivery rooms (32%), pediatric emergency departments (29%), pediatric intensive care units (ICUs) (23%), neonatal ICUs (26%), and conventional departments (10%). Interprofessional sessions with professionals working in the same department were offered at 25 centers (81%) to pediatric residents and nurses. In all, 17 centers offered multidisciplinary and interprofessional sessions from different departments, once again for pediatric residents (16/17) and nurses (13/17).

#### **4. Discussion**

The 34 centers offered simulation as a teaching method, but only 31 had a simulation center. In 2012, the HAS identified 12 simulation centers attached to universities or university hospitals in France [6]. Thus, 19 new centers have emerged in France (+158%) within 6 years. Overviews of simulation have been made worldwide. In 2008, Lasalle et al. identified 38 simulation centers throughout Europe where pediatric simulation was performed (none in France) for a survey [7]. Later, in the United States, the Association of American Medical Colleges (AAMC) counted 136 simulation centers out of 140 responding medical colleges in 2013–2014 [8]. In 2014, 36 simulation centers were identified in German-speaking European countries [9] out of 40 respondents. More recently in Switzerland, 20 out of 30 hospitals offered pediatric teaching by simulation (five of these were university hospitals) [10]. In our study, centers had a median of nine trainers, with a median of four who received specific training. According to HAS recommendations [11], all trainers should receive specific training, with more thorough instruction for regular trainers. We did not survey the type of training each trainer received, but some centers spontaneously gave us this information. We noted a great disparity, with training ranging from half a day to 1-year courses with a university diploma. Training for trainers could be standardized within centers, but also on a national scale. In addition, we did not survey the real time spent in a simulation center by each trainer. In Switzerland, seven instructors out of 71 had a dedicated time in excess of 10% for simulation [10]. Another study conducted in North America noted that two-thirds of respondents reported a lack of time dedicated to simulation [12].

As declared by the centers, the aims were mainly communication, teamwork, as well as technical and relational skills. These were comparable to a Swiss study [10], in which 96%

of the focus was on technical skills and communication. However, in a US study [13], the primary goals were medical knowledge and patient care before communication skills. Most of the training was for residents and healthcare professionals as part of their studies, which was consistent with Lasalle et al.'s study [7]. In our study, 19 centers used simulation for continuous professional development. Centers used mainly high- or low-fidelity mannequins and only three had screen-based simulation. Wong et al. showed similar data without screen-based simulation by the students surveyed [14]. On the other hand, in the AAMC survey [13], 55% and 60% of university hospitals and medical colleges, respectively, declared offering screen-based simulation. In our study, mannequins were used for newborn resuscitation, cardiac arrest, acute respiratory distress, and hypovolemic shock. In German-speaking European countries [9], simulation was used for European Pediatric Immediate Life Support (EPILS) and European Pediatric Advance Life Support (EPALS) in 30 (75%) and 26 (65%) centers, respectively, out of 40. In 2009, Lassalle et al. reported that hypovolemic shock, severe bronchiolitis, asthma, and cardiac arrest accounted for 75% of the proposed scenarios [7]. Regarding technical skills learned through procedural simulation, airway control with intubation was widely taught in other studies as well as in our own (100% of centers for Lassalle et al. [7] and 63% for Fandler et al. [9]). Interprofessional and multidisciplinary teaching was used in 17 (55%) and 25 (81%) centers, respectively. In the AAMC study, multidisciplinary or interprofessional sessions were offered in 100% of centers [13]. However, differences may appear between what is offered and what is actually carried out in terms of interprofessional and multidisciplinary teaching. Several studies investigated the efficiency of multidisciplinary or interprofessional sessions in terms of confidence, knowledge, behavior, and clinical performance [1, 3, 15]. We did not detail aims, types, and

frequency of multidisciplinary/interprofessional sessions, which could represent a future work. Research activity was reported by 45% in our study. A Swiss publication reported research in 17% of centers [10], but HAS reported 55% [6]. This went up to 89% in the study of Doughty et al. in 2012 [12].

Our study had a 100% response rate for centers attached to faculties of medicine or university hospitals. We did not send the survey to military or private centers, but their pediatric activity is most probably limited. Our survey focused on what was organized by centers. We might have missed “spontaneous” sessions in departments or during courses, which might have underestimated certain types of simulation such as role play. Some items were difficult to analyze, such as opening times and prices, or inaccurate, such as the number of professors in pediatrics involved (which might include pediatric surgeons or pediatric anesthesiologists). Other responses reached 100% rates. The survey was completed by only one person, who might not be aware of all the training offered, and there might have been a memory bias. Even if we noted a diversified offer between centers, some technologies seemed to be unanimously unused, such as screen-based simulation or high-fidelity procedural simulation. Efficiency of interprofessional in situ simulation was shown for anaphylactic shock [16] and pediatric emergency department admission [17]. Although some studies did not note any difference between high-fidelity simulation in centers and low-fidelity in-situ simulation [18], realism seems to be improved when simulation was in situ [19].

Expanding teaching by simulation depends on human and financial resources. Our survey evaluated number of trainers and not time spent by each trainer on simulation training. In a French survey of residents in 2018, the mean number of simulation training sessions was 1.6 per resident per year, decreasing with seniority [20]. A study published in 2017 described

the widespread use of high- and low-technology mannequins and task trainers in the United States and Canada and stated that one-third of pediatric emergency medicine fellowship programs reported providing more than 20 h of simulation per year [12]. The same year, another study reported that 90% of Canadian fellows surveyed said that, ideally, simulation programs should include neonatal resuscitation and 60% cited procedural skills. More than half felt that 21 h or more of simulation per year was ideal [14]. In order to improve teaching and patient safety, dedicated time for trainers is needed. Simulation is a tool with patient safety as its main goal. Many investigations have studied trainees' reaction, learning, or behavior [1, 3, 5, 6, 21], but very few have studied impacts on patient safety [16, 17, 22, 23].

## **5. Conclusion**

Compared with the 2012 report, 19 new centers have emerged in France (+158%) within 6 years. Pursuing research to evaluate the impact of simulation programs on physician skills and patient management seems to be important.

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Figures:

**Figure 1.** Aims of pediatric simulation reported by simulation centers ( $n=31$ ).

**Figure 2.** Status of trainees participating in pediatric simulation sessions in 2018.

*\*midwives or student midwives*

*UH: university hospitals; ICU: intensive care unit*

**Figure 3.** Type of simulation taught in French simulation centers in 2018 (31 centers).

**Figure 4.** Scenarios developed for mannequins ( $n=31$  centers).

**Figure 5.** Scenarios available for procedural simulation ( $n=31$  centers).

*\* specific procedural teaching for the use of machine-assisted ventilation (1) and for upper respiratory tract clearance (1)*









