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GROUNDWORK

Strategy to Develop a Common Simulation Training Program: Illustration with Anesthesia and Intensive Care Residency in France

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ABSTRACT

Phenomenon: The urgency of having fair and trustworthy competency-based assessment in medical training is growing. Simulation is increasingly recognized as a potent method for building and assessing applied competencies. The growing use of simulation and its application in summative assessment calls for comprehensive and rigorously designed programs. Defining the current baseline of what is available and feasible is a crucial first step. This paper uses anesthesia and intensive care (AIC) in France as a case study in how to document this baseline. ***Approach***: An IRB-approved, online anonymous closed survey was submitted to AIC residency program directors and AIC simulation program directors in France from January to February 2021. The researcher-developed survey consisted of 65 questions across five sections: centers' characteristics, curricular characteristics, courses' characteristics, instructors' characteristics, and simulation perceptions and perspectives. ***Findings***: The participation rate was 31/31 (100%) with 29 centers affiliated with a university hospital. All centers had AIC simulation activities. Resident training was structured in 94% of centers. Simulation uses were training (100%), research and development (61%), procedural or organizational testing (42%), and summative assessment (13%). Interprofessional full-scale simulation training existed in 90% of centers. Procedural training on simulators prior to clinical patients' care was performed "always" in 16%, "most often" in 45%, "sometimes" in 29% and "rarely" or "not" in 10% of centers. Simulated patients were used in 61% of centers. Main themes were identified for procedural skills, full-scale and simulated patient simulation training. Simulation activity was perceived as increasing in 68% of centers. Centers expressed a desire to participate in developing and using a national common AIC simulation program. ***Insights***: Based on our findings in AIC, we demonstrated a baseline description of nationwide simulation activities. We now have a clearer perspective on a decentralized approach in which individual institutions or regional consortia conduct simulation for a discipline in a relatively homogeneous way, suggesting the feasibility for national guidelines. This approach provides useful clues for AIC and other disciplines to develop a comprehensive and meaningful program matching existing expectations and closing the identified gaps.

Abbreviations: AIC: anesthesia and intensive care; CBME: competency-based medical education; GME: graduate medical education; OSCE: objective structured clinical examination; UME: undergraduate medical education; UH: university hospital

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Introduction

Developing and positioning residency education and assessment to prepare clinicians for practice, while verifying that readiness is actually achieved remains a daunting task. This complicated task requires adopting and adapting evidence-based clinical and education practices into the design of acute care residencies. This

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task puts substantial demands on program directors, education teams, and accrediting bodies.[1,2] It is time and resources-consuming, and may direct attention away from other aspects of program oversight.[1,3–7] In the US, for example, the nationwide physician certification testing program involving simulation (US Medical Licensing Examination, Step 2 – Clinical Skills) was recently terminated, leaving behind a significant assessment and training gap. Medical student educators have made repeated calls for alternative simulation programs to ensure nationwide clinical competency among medical school graduates.[8] At the same time, the Coalition for Physician Accountability's report on the Undergraduate Medical Education-Graduate Medical Education (UME-GME) transition recommended that educators "*define and implement a common framework and set of outcomes (competencies) to apply to learners across the UME-GME transition*." (Recommendation 9).[9] In Canada, the "Competency by Design" initiative for residency has driven and measured a similar initiative for 10 years.[10] A decentralized approach in which individual institutions or regional consortia conduct simulation according to national guidelines, supported by national resources, is crucial in the context of a drive toward competency based assessment. Every healthcare discipline needs an integrated simulation curriculum within their competency-based medical education (CBME) strategy.[11,12] A growing emphasis on competency-based assessment of trainees makes simulation even more attractive as an educational modality, as training and assessments can be reliably standardized.[13–17] Developing a comprehensive simulation program could bring many benefits for both teaching and assessment.[17,18]

In Canada, Chiu et al., surveyed AIC program directors, instructors, and residents about their expectations of full-scale simulation scenarios, selected seven scenarios (Delphi method) related to the national program, created related assessment tools for technical and non-technical skills (Delphi method), and then standardized their implementation. However, a comprehensive simulation program is too resource-consuming for being developed at a program, center, or even small-network level. The concept of a limited and shared full-scale simulation curriculum (seven scenarios) has been proven doable in Canada for the 17 anesthesiology and intensive care (AIC) programs, all with sufficient resources (human and materials) to implement their curriculum, but its feasibility with a larger curriculum remains to be proven.[13] For a larger curriculum and/or a larger network with potentially more variable resources, critically assessing capabilities is mandatory. In fact, assessing the needed resources before developing a simulation center or program has been strongly advocated.[1,7,19] Without clear baseline knowledge, we are in the dark, unable to build a meaningful and efficient strategy to create a comprehensive and deliberate simulation program integrated within CBME and providing both formative and summative assessment opportunities.

While the findings we will report are specific to France, the need to work toward nationwide simulation programs is broader than this. Indeed, simulation plays an important role in teaching fundamental technical and non-technical skills.[20,21] In most healthcare disciplines, simulation is already used for teaching and sometimes for summative assessment.[11,13,17,22] An accurate appraisal of the baseline educational practices using simulation in any discipline (e.g., AIC) will provide a starting point to map the road. Robust, strategic skill development and assessment processes supporting CBME depend on this baseline appraisal. A large-network approach to adapting these curricula may optimize resources and results within a single discipline (e.g., AIC), and can also be applied to educational and scientific societies, institutions, programs directors, and education teams.[6] Starting from a common ground instead of reinventing assessments independently will allow these groups to invest their efforts in either developing or adopting a homogeneous core of guidelines, with a focus on practical training and assessment tools (both formative and summative), as well as making necessary adaptations.[13] This study aims to demonstrate the feasibility of this first strategic step to develop a common simulation training in a healthcare discipline by defining the baseline use by major academic teaching centers, using surveys targeted at AIC residency training in France.

Method

Design

The design and results of this survey are reported based on the CHEcklist for Reporting Results of Internet E-Surveys (CHERRIES).[23] The survey was an anonymous closed purposive survey designed to be completed by current AIC residency program directors and/or AIC simulation program directors from the 30 University Hospitals-affiliated simulation centers in France. One answer was expected for each center; Paris had three centers, and thus three responses, whereas all other cities had only one center. Thus, 33 centers were contacted but the maximum number of answers would be 31 because one centers was to open in 2022 and two geographically close university hospitals (Montpellier and Nîmes) had a common AIC program and provided one response for their center. Among the 31 responders, 29 were directly affiliated with one of the 30 university hospitals, one was affiliated with a military hospital (Toulon) and one was affiliated with foundation-related private hospital (in Paris).

IRB (institutional review board) approval and informed consent process

The survey was reviewed by the French Society for Anesthesiology and Intensive Care IRB on December 12, 2020 (Ref IRB 00010254-2020-240, chairperson Pr. JE Bazin) and was ruled exempt. Registration of the survey was reviewed by the information technology service at the University of Caen Normandy and was compliant with the European General Data Protection Regulation (Ref TG_RECHERCHE_POPULATION_00-20190705-01R1). Participants were given information about the research scope and aims, the length of the survey (approximately 20 minutes), and data confidentiality, as well as the scope of their own participation and their rights to withdraw their participation. Completion of the survey implied that participants had read and understood this information and had consented to participate in the research. Participation was anonymous, in that participants were not asked for any personal identifying characteristics. Participants were asked to identify their institutional affiliation, to control whether multiple responses were recorded from a single simulation center. Raw data was stored in the LimeSurvey platform within the University of Caen Normandy data center and was accessible only to the researcher (CB) who programmed the survey and downloaded the unidentifiable anonymous results for analysis.[24] If any identifiable data were provided in free-text qualitative responses, these were redacted prior to analysis.

Development and pretesting

The survey design emerged from discussion among the research team regarding the use of simulation for AIC training in France, specifically for AIC residents. Questions were constructed by CB and reviewed by the survey development team (AB, ML, JL), drawing on their combined experiences as AIC physicians, simulation educators, and researchers. A draft survey consisting of 64 questions across five sections was created and circulated to the research team for validation and review. Questions continued to be iteratively refined until no further improvement was deemed likely. The final survey consisted of 65 questions across five sections: centers' characteristics, curricular characteristics, courses' characteristics, instructors' characteristics, and simulation perceptions and perspectives. Questions were simple choice questions (39), multiple choices questions (nine), optional open-ended questions (6), whole numbers to complete (four), ticking tables (four), and tables to complete with numbers (three). Before being distributed to participants, the survey was piloted by the survey development team and four similar individuals of the targeted population recruited among the development team's network. Usability and technical functionality were assessed and adapted during the pilot phase.

Recruitment process and description of the sample having access to the questionnaire

The survey was distributed as a "closed survey," which targeted AIC residency program directors and AIC simulation program directors from the University-affiliated simulation centers in France: Amiens, Angers, Besançon, Bordeaux, Brest, Caen, Clermont-Ferrand, Dijon, Grenoble, La Réunion, Lille, Limoges, Lyon, Marseille, Martinique, Montpellier, Nancy, Nantes, Nice, Nîmes, Paris (three), Pointe-à-Pitre, Poitiers, Reims, Rennes, Rouen, Saint-Etienne, Strasbourg, Toulon, Toulouse, and Tours.[25] These participants were asked to provide one unique answer for their center. Using existing educational AIC (National College of AIC teachers; CNEAR) and simulation societal networks (French Speaking Society for Simulation in Healthcare; SoFraSimS), the targeted population was directly contacted and received individualized survey links in January and February 2021, over a period of six weeks.

Survey administration

The survey was administered using LimeSurvey (LimeSurvey GmbH), a free and open source on-line statistical survey web application hosted at the University of Caen Normandy. The survey was voluntary and participants could choose to exit the survey at any time. The survey was endorsed and supported by the French National Society of AIC (SFAR), the National College of AIC teachers (CNEAR), and the French Speaking Society for Simulation in Healthcare (SoFraSimS). As an option and separate from their answers, participants could choose to receive the survey results. This and the endorsement could be seen as incentives for participants. The survey link was open for responses over a six-week period. To prevent biases, when possible, items' order within the questions were randomized by the survey system. Survey design utilized adaptive questioning to ensure that participants answered questions relevant to their center and activities when possible. The survey had a total of 65 questions with nine to 21 questions displayed per page throughout five pages. A completeness check was performed using LimeSurvey before the questionnaire was distributed. Survey completeness was checked after each page of the survey was submitted. Mandatory unanswered questions were highlighted. All questions provided a non-response option such as "not applicable" or "I do not know" to ensure that all participants could select an option that matched their knowledge or situation. A back button was included in the survey design to allow respondents to review and change their answers throughout the survey.

Response rate

The participation rate was calculated by dividing the number of centers completing the survey by the total number (33) of simulation centers related to the 30 University Hospitals (UH) in France. A correction in the number of centers (31) was performed because one UH simulation center was scheduled to open in 2022 (Pointe-à-Pitre) and two UH simulation centers sharing the same program provided one common answer (Montpellier and Nîmes). Completion rate was calculated by dividing the number of respondents who completed the entire survey by the total number of respondents who started the survey by advancing past the informed consent page. To maximize the response rate, centers with incomplete responses in the database were sent a reminder email at three weeks and were called by phone at five weeks.

Preventing multiple entries from the same individual

Individual respondents were prevented from taking the survey more than once using a functionality in LimeSurvey, which used cookies to assign a unique identifier to each respondent to prevent multiple survey completions by a single respondent. IP addresses were not collected as part of the dataset. The log file was analyzed for identification of multiple entries from the same center. The first completed entry was considered as the one valid for the center and kept for analysis; any later entries were to be discarded.

Data analysis

Only completed questionnaires were analyzed. Questionnaires submitted with an atypical timestamp below 12 minutes were to be excluded. The 12-minute cutoff point was determined during the pilot phase as the fastest answering time performed by testers who were broadly aware of the questionnaire's content. No statistical corrections (such as weighting responses) were performed. Data were analyzed with Excel Software (Microsoft® Excel 2019, V2204). Data were analyzed descriptively: numbers with percentage, median with minimum and maximum, and mean with standard deviation. No test or statistical analyses were performed. Data Open-end questions (6) were optional for commentaries. None were used.

Results

The participation rate was 100%. Results were reported with absolute number of centers and percentages using denominators of centers for which the question was relevant. Neither duplicated entries nor atypical timestamps were received.

Center characteristics

All the centers except one were already built; one was under construction. Among them, all had a simulation space for AIC: dedicated ($N = 10$, 32%) or adaptable ($N = 20$, 65%). The majority were affiliated with a University ($N = 27$, 90%) but only three (10%) were nationally certified (Appendix).

AIC simulation activities

All 31 (100%) responders had simulation activities in AIC. In situ simulation was used by the majority of centers ($N = 25$, 81%) when the opportunity arose ($N = 15$, 60%), or routinely incorporated into resident training ($N = 10$, 40%). Resident training was mostly structured (meaning the center had a formal curriculum through which residents progressed, ($N = 29$, 94%) and involved more than 5 sessions per year for 23 (74%) of the centers. The use of simulation was for training ($N = 31$, 100%), research and/or development projects ($N = 19$, 61%), process, procedure, or organizational testing ($N = 13$, 42%), and summative assessment ($N = 4$, 13%). (Supplemental Digital Content 1) The median calendar year [min-max] when the centers began offering AIC residency training was 2013 [2005–2019].

Courses' characteristics

There was procedural training for AIC residents in 29 (94%) centers. More than half of the centers had residents' training in specific technical skills prior to

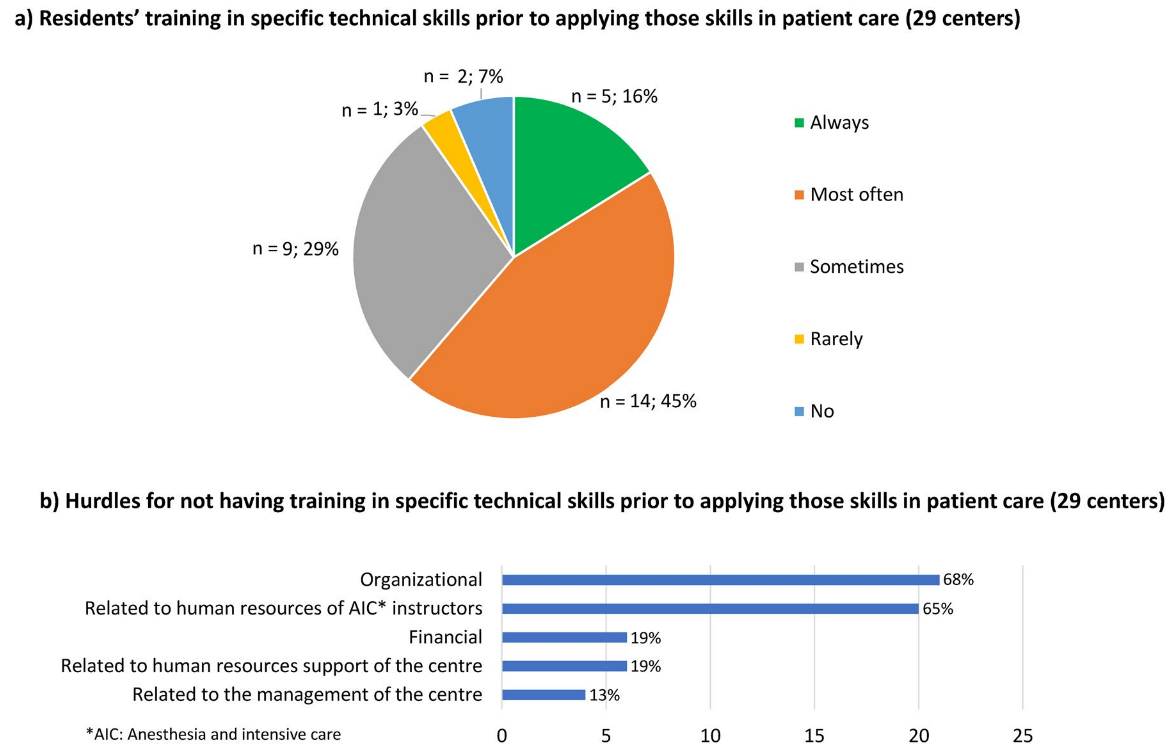

Figure 1. (a) Residents' training in specific technical skills prior to applying those skills in patient care and (b) hurdles for not having training prior to patient care.

applying those skills in patient care: always ($N=5$, 16%) or most of the time (14;45%) (Figure 1a). The main hurdles to training prior to patient care were organizational (68%) and related to human resources in AIC instructors (65%) (Figure 1b). All (100%) responders reported full-scale simulation training for AIC residents, and a majority (90%) had developed interprofessional simulation. The personnel associated with interprofessional full-scale simulation training including AIC residents included mainly anesthetic nurse students (79%), anesthetic nurses (71%), AIC seniors (64%), midwifery students (54%), surgical residents (50%) (Figure 2a). Nineteen (61%) of centers had simulated patient (SP) training for AIC residents. The people involved as SPs included mainly instructors (74%), professional actors (47%) (Figure 2b).

Curricular characteristics

Simulation activities for AIC residents were for 21 (68%) centers mandatory, for 9 (29%) mandatories for some activities and optional for others, and for 1 (3%) optional. For 15 (48%) of the responders AIC resident training simulation was part of the residency validation. The program was developed by the local AIC program director for 6 (19%) centers and with him/her for 27 (87%). Twenty-five (81%) centers had a bootcamp training for AIC residents first-year, which is for 14 (56%) based on the official description of AIC program.[26] An assessment score was used for some simulation sessions in 16 (52%) of the centers. Instructors were trained in the use of the assessment score before using it sometimes for 10 (62%), always for three (19%), and not for three (19%) of the responders. A mastery learning approach[27–29] was applied for some simulation training courses in five (16%) centers. A formalized peer-to-peer method[30–32] is used for some simulation training in 13 (42%) centers. Simulation-validated readiness for independent practice for some procedures or management in a clinical situation exsist in two (6%) centers. (Supplemental Digital Content 2)

Instructors' characteristics

Descriptions of simulation instructors for AIC are presented in Table 1. All but one center (30;97%) had at least one instructor trained as a simulation instructor (one-week instructor course); and 29 (94%) had at least one instructor with a university simulation instructor degree. The median number of instructors was 7 with notable differences between centers (minimum 2 maximum 27). The majority of centers had at least one instructor with part-time dedicated ($N=23$, 74%) but this represented a limited number of instructors (median 2 [min-max 1–12]) and a modest number of full-time equivalents (median 0.5 [min-max 0.1–3.0]).

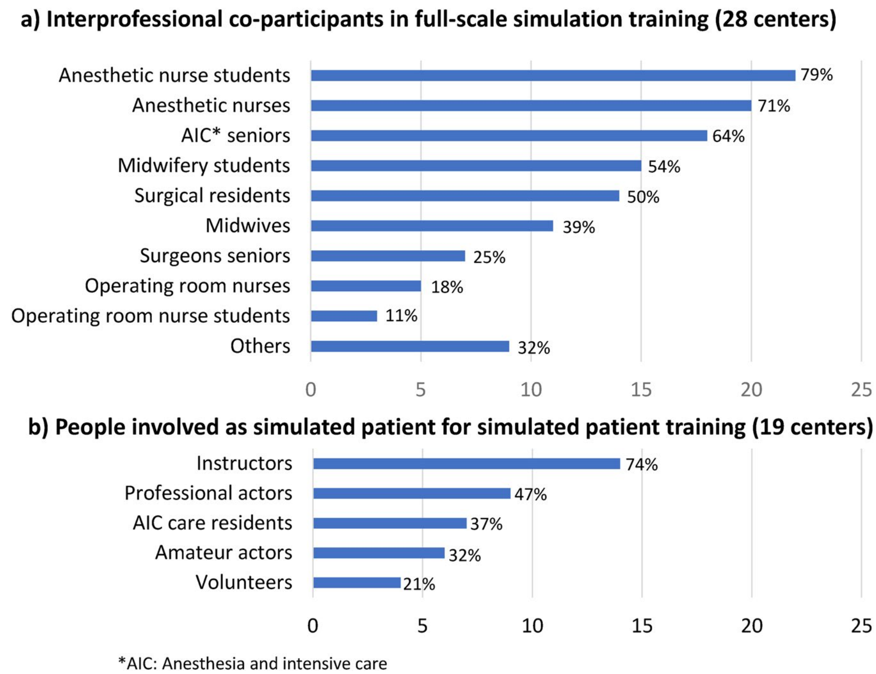

Figure 2. (a) Personnel associated with AIC residents in interprofessional full-scale simulation training. (b) People involved as simulated patients for AIC residents' training.

Table 1. Simulation instructors' characteristics.

Instructors' characteristics	Results
• Number of AIC* instructors in the center	7 [2–27]
• Number of centers with at least one instructor who graduated with simulation instructor train†ing†	30 (97)
• Number of instructors who graduated with simulation instructor training† per center	4 [0–14]
• Number of centers with at least one instructor who graduated with university diploma in simulation††	29 (94)
• Number of instructors who graduated with a university diploma in simulation†† per center	2 [0–15]
• Number of centers with at least one instructor having part time dedicated to simulation	23 (74)
• Number of instructors per center having part time dedicated to simulation	2 [1–12]
• Number of AIC instructor full-time equivalents dedicated to the simulation center	0.5 [0.1–3.0]
• Number of centers having instructors who were not AIC who conducted training alone (excluding sim technicians and instructors for interprofessional training)	5 (16)
Professions are: – Anesthetic nurse	2 (40)
• – Surgeon	1 (20)
• – Other physician(s)	3 (60)

*AIC: anesthesia and intensive care.
†Graduated with simulation instructor training: 3 to 5 days long structured and labeled training specific to simulation pedagogy and practice accredited by a University or an authorized accreditation institution.
†† Graduated with a university diploma in simulation: one academic year long structured and labeled training specific to simulation pedagogy and practice accredited by a University.
Results are in median [min-max] or number (percentage).

Perceptions and perspectives of simulation

Perception of the evolution of AIC simulation activities was mostly increased (21;68%) or stabilized (7;22%). The majority judged the training programs' maturity to be "mature and operational for some and others to be perfected or created" (28;90%) (Supplemental Digital Content 3). Twenty-two (71%) centers identified accelerators and 30 (97%) hurdles to simulation development in AIC. Among five items, the main accelerators and hurdles were related to the AIC instructors' human resources (68% accelerators vs. 83% hurdles) and the organization (36% accelerators vs. 70% hurdles). (Supplemental Digital Content 3) On Likert-scale (mean +/− standard deviation) from 1 "Totally disagree" to 5 "Totally agree," the four following assertions were rated: (i) "A national simulation training program in AIC would be useful." (4.5+/− 0.9); (ii) "We would use a national simulation training program in AIC if one existed." (4.3+/−1.0); (iii) "We would be willing to participate in the development of a national simulation training program in AIC." (4.3+/−1.1); and (iv) "We are currently able (human resources, equipment, and know-how) to make summative assessment in simulation." (2.9+/−1.1).

Simulation uses

The simulation modalities and uses presented in Figure 3 show that all modalities are principally used for training then research and development. There was little use of summative assessment (maximum 5;16% with simulated patient). Table 2 summarizes simulation modalities distributed by residency year and the median time allocated for each modality by residency year. Procedural simulation use was concentrated at the beginning of residency with 28 (90%) of

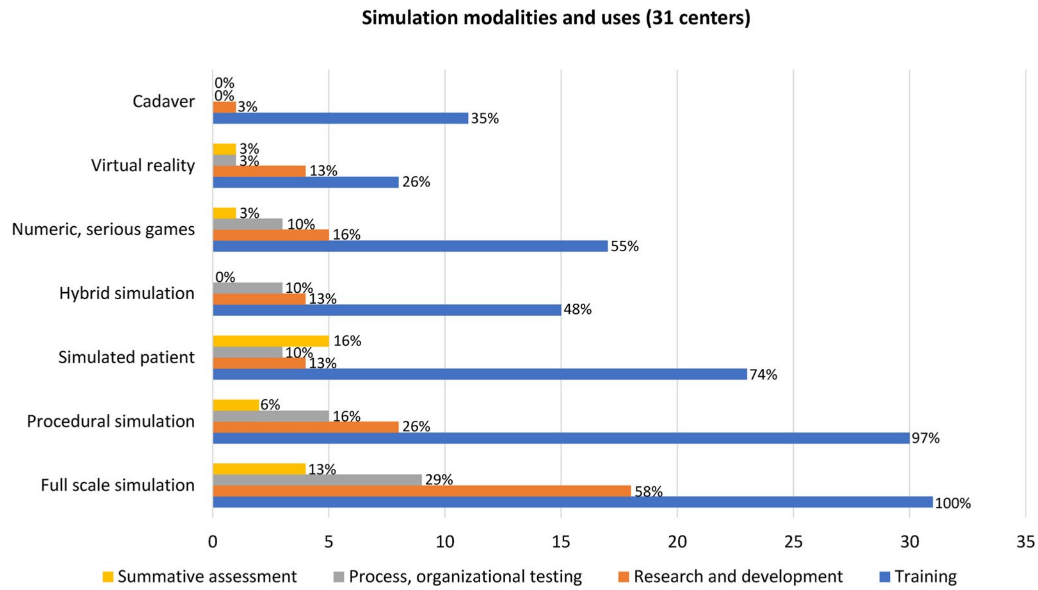

Figure 3. simulation modalities and uses (31 centers).

Table 2. Simulation modalities and training time allocated: number of centers (percentage) and median time allocated (in hours [min-max]) to simulation modalities per anesthesia and intensive care residency year (among 31 centers).

Simulation		Year 1	Year 2	Year 3	Year 4	Year 5
Procedural training	Centers (nb, %)	28 (90)	13 (42)	12 (39)	11 (35)	8 (26)
	Hours [min-max]	10 [2–16]	8 [1–20]	6 [1–16]	5 [2–16]	5 [4–16]
Full scale simulation	Centers (nb, %)	27 (87)	25 (81)	28 (90)	24 (77)	19 (61)
	Hours [min-max]	7 [2–14]	8 [3–24]	8 [3–21]	12 [3–20]	10 [4–20]
Simulated patient	Centers (nb, %)	13 (42)	9 (29)	5 (16)	7 (23)	7 (23)
	Hours [min-max]	4 [1–7]	4 [1–7]	8 [4–14]	4 [1–8]	4 [2–8]
Hybrid	Centers (nb, %)	3 (10)	2 (6)	3 (10)	4 (13)	3 (10)
	Hours [min-max]	5 [2–10]	7 [5–8]	5 [1–8]	5 [1–8]	5 [1–8]
Numeric, serious games	Centers (nb, %)	5 (16)	6 (19)	7 (23)	4 (13)	2 (6)
	Hours [min-max]	4 [2–6]	4 [2–6]	4 [2–6]	4 [2–5]	3 [2–4]
Virtual reality	Centers (nb, %)	–	–	–	1 (3)	–
	Hours [min-max]				3	
Cadaver	Centers (nb, %)	4 (13)	2 (6)	2 (6)	2 (6)	1 (3)
	Hours [min-max]	3 [2–3]	2 [2–2]	2 [1–2]	4 [1–6]	1

the centers using it in the year 1 and less than half after year 1. Full-scale simulation use was high and constant throughout the residency (from 90% to 61%). Less than half of the centers used other modalities. Ranked frequencies for teaching the 16 most commonly taught procedural skills out of 56 total skills (Supplemental Digital Content 4) and the 16 most commonly taught full-scale simulation themes out of 34 themes (Supplemental Digital Content 5), are presented in Table 3, along with the four common teaching themes for simulated patients. Of the 16 most taught procedural skills, half (8) were airway related. Half of the procedural skills (8) concerned everyday procedures (tracheal intubation, epidural anesthesia) while the other half (8) concerned less frequent procedures (use of defibrillators, chest tube insertion) or exceptional procedures (cricothyroidotomy, intraosseous access). The 16 most frequently taught full-scale simulation topics were all about life-threatening emergency situations with the risk of death in the absence of an appropriate rapid response. All but one of the themes (malignant hyperthermia) were situations with a high probability of being encountered (cardiac arrest, local anesthetic system toxicity, hemorrhagic shock).

We also collected data on senior (e.g., attending anesthesiologist-level) programs and they are presented in Supplemental Digital Content 6.

Discussion

Given the growing chorus of advocates for simulation as part of the clinical competence assessment portfolio describing the starting baseline of such programs is a crucial first step. We have been able to do this by describing what is currently feasible for simulation in AIC. Simulation is a necessary innovation needed for trustworthy assessment of competence. In Rogers'

Table 3. Sixteen most commonly taught procedural skills and full-scale simulation; and the four simulated patient themes according to years of training: number of centers (percentage) providing themes per anesthesia and intensive care residency year from the most to the less commonly taught.

Procedural skills (among 29 centers)	Year 1	Year 2	Year 3	Year 4	Year 5	NT*
Difficult intubation	12 (41)	16 (55)	12 (41)	12 (41)	6 (21)	1 (3)
Tracheal intubation	28 (97)	5 (17)	3 (10)	1 (3)	1 (3)	2 (7)
External chest compressions	27 (93)	14 (48)	11 (38)	6 (21)	6 (21)	2 (7)
Management of intraosseous access	16 (55)	7 (24)	4 (14)	7 (24)	4 (14)	3 (10)
Use of defibrillators	22 (76)	12 (41)	7 (24)	3 (10)	4 (14)	4 (14)
Cricothyroidotomy	8 (28)	7 (24)	8 (28)	10 (34)	8 (28)	5 (17)
Ventilation with face mask	25 (86)	2 (7)	–	1 (3)	1 (3)	5 (17)
Supraglottic device	20 (69)	9 (31)	5 (17)	3 (10)	3 (10)	5 (17)
Management of central venous access (ultrasound guided)	20 (69)	8 (28)	1 (3)	–	–	6 (21)
Fiberoptic intubation	5 (17)	10 (34)	9 (31)	8 (28)	5 (17)	6 (21)
Epidural anesthesia	17 (59)	4 (14)	2 (7)	1 (3)	1 (3)	8 (28)
Chest tube insertion	13 (45)	6 (21)	7 (24)	5 (17)	4 (14)	8 (28)
Mechanical / Invasive Ventilation	16 (55)	10 (34)	4 (14)	1 (3)	1 (3)	8 (28)
Spinal anesthesia	16 (55)	4 (14)	2 (7)	1 (3)	1 (3)	9 (31)
Transtracheal oxygenation	6 (21)	6 (21)	7 (24)	8 (28)	6 (21)	9 (31)
Ultrasound guidance for peripheral nerve blocks	8 (28)	10 (34)	9 (31)	2 (7)	1 (3)	10 (34)
Management of peripheral venous access	18 (62)	–	–	–	–	11 (38)
e-Fast ultrasound assessment	5 (17)	10 (34)	8 (28)	8 (28)	4 (14)	11 (38)
Full-scale simulation themes (among 31 centers)	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**NT***
Cardiac arrest – adult patient	27 (87)	13 (42)	12 (39)	8 (26)	8 (26)	1 (3)
Anaphylactic shock	15 (48)	19 (61)	14 (45)	8 (26)	5 (16)	2 (6)
Difficult tracheal intubation	12 (39)	14 (45)	14 (45)	13 (42)	10 (32)	2 (6)
Management of a trauma patient	6 (19)	13 (42)	15 (48)	15 (48)	9 (29)	3 (10)
Malignant hyperthermia	8 (26)	14 (45)	15 (48)	11 (35)	9 (29)	4 (13)
Local anesthetic systemic toxicity	8 (26)	17 (55)	16 (52)	14 (45)	8 (26)	4 (13)
Hypotension	17 (55)	19 (61)	13 (42)	8 (26)	3 (10)	5 (16)
Hemorrhagic shock	14 (45)	13 (42)	16 (52)	8 (26)	6 (19)	5 (16)
Hypoxemia	16 (52)	16 (52)	14 (45)	10 (32)	4 (13)	6 (19)
Bronchospasm	8 (26)	12 (39)	9 (29)	12 (39)	6 (19)	6 (19)
Septic shock	2 (6)	15 (48)	15 (48)	6 (19)	4 (13)	8 (26)
Obstetric hemorrhage	3 (10)	7 (23)	11 (35)	11 (35)	6 (19)	9 (29)
Cardiac arrest – pediatric patient	4 (13)	8 (26)	9 (29)	9 (29)	5 (16)	9 (29)
Laryngospasm	6 (19)	9 (29)	10 (32)	11 (35)	4 (13)	10 (32)
Cardiogenic shock	8 (26)	13 (42)	13 (42)	6 (19)	4 (13)	11 (35)
Emergency cesarean delivery	2 (6)	6 (19)	11 (35)	11 (35)	3 (10)	11 (35)
Simulated patient simulation themes (among 19 centers)	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**NT***
Anesthesia consultation	15 (79)	6 (32)	4 (21)	3 (16)	3 (16)	2 (11)
Breaking bad news	6 (32)	3 (16)	7 (37)	7 (37)	8 (42)	3 (16)
Announcement of care-related damage	3 (16)	6 (32)	6 (32)	7 (37)	8 (42)	5 (26)
Announcement of a death	3 (16)	2 (11)	6 (32)	4 (21)	7 (37)	8 (42)

*NT: Not Taught.

concept of "diffusion of innovation," adopters are educational and scientific societies, institutions, programs directors, education teams, and to a certain degree, the learners.[33] For adopters to support and promote innovation, it should provide advantages, be compatible with existing systems and be efficient. We attempt to address these three elements by excavating existing commonalities between programs.

Establishing baseline knowledge and practices is essential to building effective assessment programs these are present in the French context. For simulation in AIC, effectiveness is judged by whether the learners acquire the skills and includes factors such as what are their instructors' training (which we collected) and what pedagogical principles are applied (which we have not yet fully assessed). Both must be present, and future work must aim to capture these more completely to form the most accurate baseline. Baseline knowledge presents the advantages of providing a starting point to build an ideal simulation program, and helping to match guidelines with field practices. As demonstrated by our survey of French simulation centers, these baseline measures help to (i) set realistic goals and measure progress toward them; (ii) maintain accountability and inform others of what differences the project is making; and (iii) inform and motivate stakeholders to focus on certain issues and increase their engagement in the process.

With a high response rate (100%), our results are comprehensive and reliable, and demonstrate that a baseline assessment is achievable and valuable at a national level for a given healthcare discipline. Our conclusions, though derived from the French AIC simulation community, could be generalized to guide needed program baseline evaluations in other countries. We believe this approach may be reproduced for other disciplines and can determine the common ground upon which to build coordinated simulation programs. In France we found high homogeneity between programs (Figure 3 and Table 2), suggesting that there is room for a common simulation program. This criterion of homogeneity could be applied to baseline assessments in other countries.

To assess competence rigorously, it is crucial to have a constellation of approaches to assessment and a variety of skills able to be assessed. This study demonstrated that, at least in the French context, this diversity of approaches is already in place: In situ simulation (that supports interprofessional collaboration skill development); simulated patients; and training for procedures. In addition, the level of learner becomes an area of interest, as it relates to various competency-based assessment initiatives through all stages of training from undergraduate to continuing medical education. Finally, we have early evidence of more centers using advanced pedagogical techniques (mastery learning and peer-to-peer teaching) aimed at more efficient learning.

If we analyze the data concerning different simulation modalities, we observe an important rate of full-scale in situ simulation (Supplemental Digital Content 1 and Figure 3) requiring complex organization and resources.[34] In situ simulation may offer simpler access to interprofessional training since different professions are on site and it is not necessary to organize to bring them together in a simulation center.[34–36] This suggests that at baseline there is already an important awareness and training objectives of human factor and non-technical skills. Since the in-situ environment provides opportunities to uncover or test latent problems that would not emerge in a completely simulated environments,[37–39] threats to the validity of summative assessment – environmental barriers to excellent performance can be detected and eliminated. On another note, simulated patients are moderately used and there is a large heterogeneity in their background (Figure 1). Questions on simulated patients' training deserve further development because of the important possible issues with training outcomes, efficiency, and participants' psychological consequences.

Procedural training is widely used but few centers reach the objective of "never a first procedure on a patient without prior training in simulation."[40] (Figure 2a) Ideally, this objective would strive for mastery beforehand. Organizational and AIC instructor human resources seem to be the main limitations hindering this goal. With a large dispersion in the number of instructors, identifying a minimum number and ratio of instructors to trainees may help to develop and apply programs. Generalizing procedural training prior to caring directly for patients is certainly a priority development area for ethical, safety, quality, and efficiency reasons in healthcare.[21] This would be true for every discipline, and reveals there is opportunity for common and standardized training programs across areas sharing the same requirements.

As a side observation, the significant level of senior (e.g., attending/consultant anesthesiologist) training signals the perceived importance and engagement with continuing education with simulation. (Supplemental Digital Content 3) This is promising for needed follow-up after graduation. Simulation is a concrete, close to real life training that is likely well adapted for practicing healthcare staff training and future recertification.[41] Knowing that healthcare faces a skyrocketing rate of new knowledge,[42] simulation may be a perfect match for some needs in continuing education.

In terms of pedagogical concepts, innovative pedagogical approaches such as mastery learning and peer-to-peer teaching are known and partially used.[27–32] (Supplemental Digital Content 2) That can be seen as a proof of feasibility for these techniques. However, there is room for larger implementation and research into knowing how these newer innovative teaching techniques may help with achieving competency. Having a baseline assessment makes it possible to map the simulation modalities used in a discipline and for a type of learner (initial or continue medical education), making it possible to customize education and eventually fill in the gaps.

Finally, as reported in a similar survey in the US,[43] there was interest and readiness expressed for a national program, calling for its development and foretelling a potential easy adoption. Experience from Canada proved that a national simulation program in AIC can be feasible.[13] These are promising data in light of our objective to prove the feasibility of a baseline description of simulation use in AIC as a first step toward the development and application of a common program. We think that strategy is reproducible for other disciplines and for different training levels.

Limitations

Our work has some limits that must be underlined. First, our survey was self-declarative (not externally observed and validated) and there was no control on data reported. However, the anonymity, the support from national societies and institutions, and the credentials of the responders led us to believe they responded honestly. Second, we attempt to prove the concept of doing a baseline assessment for simulation in a discipline as a first step for developing a large common program. It appeared to work for AIC but it remains to be confirmed for other disciplines, as specific effects for AIC could not be excluded. Third, simulation modalities are evolving quickly in France, as the OSCEs (objectives structured clinical examinations) are promoted as mandatory for the 2023 national medical exam. Therefore, one might guess that relational simulation and procedural simulation that are often used during OSCEs will soon have increasing application in France. Fourth, we did not explore at which extent centers were networking and supporting each other through exchanging educational resources (e.g., personnel, equipment, curricula), the basis for developing a common curriculum.

Conclusion

This work illustrates a decentralized approach in which 31 individual institutions or regional consortia conducted simulation for a discipline in a relatively homogeneous way, suggesting the feasibility for national guidelines. These institutions were supportive of a national program and expressed willingness to use it. Nationally networked resources might be a suitable response to difficulties related to limited resources and would promote homogenized practices and implementing a unified program. This is a promising foundation for developing trustworthy skill assessments needed for transitioning from undergraduate medical education to graduate medical education. A national program lowers the hurdles that are highlighted as principal limits to development.[6] Common guidelines for a ready-to-use simulation program may allow educators to focus on the teaching. Such a program may help to reach the essential patient safety objective "*Never for the first time on a patient* without prior (simulation) training," [40] and to generalize and homogenize precious human factor training resources.

This AIC illustration proves that the lofty goal of a common, comprehensive blueprint for simulation training for a large network of programs is within reach. With our robust baseline assessment, a common blueprint seems valuable, feasible, sustainable, and desirable; all necessary for its adoption. Our observations of AIC simulation in France could reasonably be reproduced in other disciplines and countries to efficiently and relevantly integrate simulation in Graduate Medical Education and Continuing Medical Education.

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Authors' contributions

CB helped with study conception and design, data contribution, data analysis, data interpretation, writing, visualization, and review and editing. RDM helped with study design refinement, data contribution, data interpretation, writing, and review and editing. JWR and DB helped with data interpretation, writing, and review and editing. AB, ML and JP helped with study conception and design, data and review and editing BP, and JP helped with review and editing. All authors read and approved the final manuscript.

Availability of data and materials

All data generated or analyzed during this study are included in this published article [and its supplementary information files] or available on reasonable request.

Declaration of interest statement

The authors declare that they have no competing interests.

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Appendix.

Centers' characteristics regarding their physical layout, affiliations and national certification.[44]