How to agree on what is fundamental to optimal teamwork performance in a situation of postpartum hemorrhage? A multidisciplinary Delphi French study to develop the Obstetric Team Performance Assessment Scale (OTPA Scale)

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How to agree on what is fundamental to optimal teamwork performance in a situation of postpartum hemorrhage? A Multidisciplinary Delphi French Study to develop the Obstetric Team Performance Assessment Scale (OTPA Scale).

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Abstract (323 words)

Introduction: The objective of this study was to develop a new interdisciplinary teamwork scale, the Obstetric Team Performance Assessment (OTPA), for the management of the post-partum hemorrhage, through consensus agreement of obstetric caregivers. The goal is to provide a reliable tool for teaching and evaluating teams in high-fidelity simulation.

Methods: This prospective study is based on an expert consensus, using a Delphi method. The authors developed the "OTPA» specifically related to the management of post-partum hemorrhage, using existing recommendations. For the Delphi survey, the scale was distributed to a selected group of experts. After each round of Delphi, authors quantitatively analyzed each element of the scale, based on the percentages of agreement received, and reviewed each comment. This blind examination then led to the modification of the scale. The rounds were continued until 80–100% agreement with a median overall response score equal to or greater than 8 was obtained for at least 60% of items. Repeated 3 times, the process led to consensus and to a final version of the OTPA scale.

Results: From February to October 2018, 16 of the 33 invited experts participated in four Delphi cycles. Of the 37 items selected in the first round, only 19 (51.3%) had an agreement of 80-100% with a median overall response score equal to or greater than 8 in the second round, and a third round was conducted. During this third round, 24 of the 37 items were validated (64.9%) and 82 of the 88 sub-items obtained 80%-100% agreement (93.2%). The fourth round consisted of proposing a weighting of the different items.

Conclusion: Using a structured Delphi method, we provided a new interdisciplinary teamwork scale (OTPA), for the management of the post-partum hemorrhage. Thus, this scale will be able to be used during high-fidelity scenarii to assess performances of various teams facing a scenari of PPH. Moreover, this scale, focusing some crucial aspects of interdisciplinary teamwork will be useful for teaching purpose.

Abbreviations

CNGOF : Collège National des Gynécologues et Obstétriciens Français

NTS: Non-Technical Skills

OTPA: Obstetric Team Performance Assessment Scale

PPH: Postpartum Hemorrhage

TS: Technical Skills

Key Message

OTPA scale is a promising new tool that highlights the assessment of non-technical skills and teamwork in the management of postpartum hemorrhage.

INTRODUCTION

Risk management and patient safety in emergency situations is one of the highest public health priorities (1)(2). Obstetric hemorrhage remains the leading and most preventable cause of maternal death worldwide with an incidence between 5% and 10% (3) (4–8) According to the 2014 report of the "Collège National des Gynécologues et Obstétriciens Français " (CNGOF), maternal mortality due to obstetric hemorrhage has decreased in France. However, according to this report, two thirds of these deaths were preventable. Poor quality factors, such as processing times, are often reported (9)(10). The use of evidence-based guidelines such as the clinical practice recommendations of the CNGOF or of the World Health Organization (WHO), promote the improvement of so-called technical skills. These defined as the general procedural and professional skills that promote the optimization of clinical care and the reduction of maternal mortality and morbidity (11–16)(17). In addition to the technical skills of the medical team, patient safety in emergency situations is highly dependent on the coordination of multidisciplinary teams. Recent research on clinical risk management has shown a growing consensus on the relevance of non-technical skills (NTS) (18–22). NTS are defined as the cognitive and social skills necessary to perform the technical task in a given situation. These are teamwork behaviours, but also interpersonal behaviours (communication, leadership) and cognitive skills (decision-making, planning, situational awareness)(19). WHO published a report highlighting the crucial role of human factors relevant to patient safety (23). It is now recognized that non-technical errors are a major cause of increased morbidity and mortality in obstetric health care (24,25). Research results on safety in high-risk organizations, such as the ENEIS report (Adverse Events in Health Care Facilities), have shown that these cognitive and social skills play a central role in maintaining safety in critical care areas (26) (15,27–32).

The high-fidelity simulation learning method is effective in improving both technical skills acquisition and teamwork (24,25,33,34). In addition to conducting simulation sessions to confront teams with the acquisition of these NTS, the evaluation of these skills is necessary to assess both the effectiveness of the group and the impact of training interventions (35–37). An assessment of these NTS should be conducted using an assessment tool already established, providing objective feedback and consisting of psychometric characteristics.

The objective of our study is to design a new multidisciplinary teamwork assessment scale for the management of PPH with observable behaviours that establish clear criteria for better reproducibility of the tool.

MATERIALS & METHODS

Delphi method

The Delphi method is a structured interactive technique for developing consensus or near-consensus among experts on what to include in a study or tool (38). The experts fill out an anonymous questionnaire and then receive feedback on all the answers from the entire panel of experts. The questionnaire is revised based on these responses and then administered back to the panel. This process is repeated until the range of expert responses narrows sufficiently to build consensus or near-consensus on all or some of the points. In each round, the experts can send comments and suggestions. A Delphi study is conducted with a group of people considered to have expertise (both professional and experience-based) in the field studied (39)(40).

Identification of participants in the Delphi process

An email invitation was sent to the members of the CNGOF 2014 Clinical Practice Guidelines Drafting and Review Committee. When one of these members was unable to respond to this survey, they were asked to put us in touch with someone on his team who might be interested in the survey.

This person had to have more than five years of clinical experience and must have been actively practicing in the field with additional simulation skills.

The experts had to practice their profession independently and were blind to each other, they all had to work in university hospitals.

Those who responded to this invitation and agreed to participate in all rounds of the Delphi process gave their written and informed consent and were included in the committee.

Development of the questionnaire and First Delphi cycle

Before beginning the consensus process, the authors established a list of key competencies expected of obstetrician gynecologists in the management of a PPH, reviewing the guidelines of the recommendations CNGOF. In order to better integrate the items related to difficult to evaluate NTS, we imagined a PPH scenario that would guide the team towards deciding and organizing an embolization transfer. An overview of this scenario (Appendix 1), as well as a list of 43 items from these recommendations, were provided to the participants as a basis for a response.

The scenario was invented jointly with the anaesthetists and obstetricians of the simulation centre of the Grenoble Alps university.

This scenario was tested in high-fidelity simulation sessions by 6 multidisciplinary teams in the year preceding the creation of the OTPA Scale. These teams were composed of an obstetrician, an anesthetist, an obstetrical gynecology resident, an anesthesia resident and a midwife.

Delphi Process

The panelists were instructed to list what they considered to be the key technical and non-technical competencies for managing a PPH situation and to approve (or not approve) each of the 43 items proposed. The resulting list of items was reviewed (MC) and any redundancy was eliminated.

The items suggested by at least two experts were added in the second round. The items considered similar as defined in the first round were grouped into a single item in the second round. In this second round, the experts were asked to rate each element on a 10-point Likert scale, on which 1 indicated that the element was unnecessary and 10 that it was crucial. They were also asked to provide a binary opinion (approve or disapprove) on the quality of the proposed sub-items representing the detail and perfect realization characteristic of the item in a simulation scenario. For each item, the experts received the median score assigned by the entire panel and their individual score. The consensus to keep the item was recognized if the median score was greater than or equal to 8 and at least 80% of the experts had given a score in between 8-10. Consensus to delete the item was reached when the median score was less

than or equal to 4 and at least 80% of the experts had given a score in the interval 1-4. A median score between 5 and 7 was considered an equivocal response. The experts then had to use the same 10-point Likert scale again to re-evaluate the item and could keep their previous score or modify it. If once again, there was disagreement about the item (median score between 5 and 7) the item was definitely excluded. This collection and reassessment process were repeated until consensus was reached on at least 60% of the items. For sub-items, elements with at least 80% agreement were included in the evaluation scale. The experts could also propose other sub-items and a general opinion was requested from the other members of the group in the next round. This process of collecting and re-evaluating sub-items was repeated until a consensus was reached.

Scale weighting

Once the general items were validated, the experts were asked, in a fourth round, to allocate a total of 70 points among all the items selected according to the relative importance they attributed to each for the evaluation of teamwork. Each item had to be weighted between 1 and 4 points. At the end of this last step, median of the 16 weights was calculated for each item, in order to reach at a final weighting.

Ethical approval

The study was designed as a prospective, cross-cutting consensus based on the Delphi technique. Following the opinion of the Regional Committee for the Protection of Persons, this study falls outside the scope of the provisions governing biomedical research and routine care because it does not involve the human person.

The experts who responded to the invitation and agreed to participate in all stages of the Delphi process gave their written and informed consent and were included in the committee.

RESULTS

List of experts

Thirty-three experts were invited to participate in the Delphi process. Sixteen participated in the entire process. Ten participants did not respond despite several reminders, and seven of them refused to participate. Most of the participating experts came from France, two from Canada and one from Switzerland. Ten experts were obstetricians, two midwives who were members of the 2014 Clinical Practice Guidelines review committee and four were anesthesiologists and intensivists. The mean age (standard deviation) of the Delphi panel participants was 44 (± 10,3) years, with 18.4 (± 9.7) years of practice in their own specialty and 12.4 (± 11) years of teaching experience.

Delphi process flowchart is summarized in Figure 1.

First Round

Of the 43 items proposed, 18 items were approved by 80% of the experts. Concerning the remaining 25 items, the majority of the experts requested that they be grouped together in seven items.

After removing the points suggested by a single expert and grouping together the similar points proposed by the expert panel, 12 new items were selected for inclusion in the different steps of the scenario (step 1 (1): persistent bleeding in the post-partum; step 2 (2): severe bleeding in the post-partum; step 3 (3): hemodynamic instability). In the end, a list of 37 items was proposed for the second round, including again accepted and controversial items. (Table 1)

Second Round

The scores assigned by the experts to the 37 items proposed in the second round are shown in Table 2. A consensus was reached for 19 items (51.3%) and 59 sub-items (64.1%).

The different ratings assigned to the sub-items are shown in Table 2.

Third Round

A consensus was reached for 24 items (64.9%) presented in Table 1 and 82 sub-items (93.2%) presented in Table 2.

Fourth Round

The final grid including the weighting of each item is presented in Figure 2.

DISCUSSION

Effective management of obstetric emergencies requires a quick coordination of a large multidisciplinary team, a simultaneous execution of multiple complex tasks and an efficient decision-making. Such advanced obstetric care requires excellent teamwork and communication, which can be difficult to teach and evaluate. Given the paucity of reliable and valid tools for assessing teamwork in obstetrics, this study has led us to develop a new interdisciplinary teamwork assessment scale for the management of PPH.

Using a structured Delphi method with a large number of experts, the OTPA scale consists of 24 items including 14 NTS. The experts needed 4 rounds to reach a consensus allowing a detailed description of each item. We created the first scale, with a significant number of NTS to assess teamwork in a situation of PPH.

The technical skills elements selected by our panel of experts are consistent with CNGOF and global recommendations (17).

The real challenge in creating a simulation evaluation scale is to address specific aspects and observable behaviours that establish clear. For this reason, each skill must be described in terms of a specific behavioral marker representing what can be observed in a simulated scenario or in real life. Very few assessment tools are available to assess obstetric teamwork performance in a simulated setting (30,37,41–45) and when they are, they assess teamwork performance overall in different obstetric emergency situations, so they are generally the same tool used for different obstetric emergency scenarios, resulting in a lack of clarity of the items and greater inter-observer variability (37). All characteristics of the different assessment tools and their construction methodology are presented in table 3. In the literature, we have been able to identify a single tool that evaluates teamwork performance in a postpartum hemorrhage (PPH) situation (46). However, the items used lack clarity and precision, which affects the psychometric accuracy of the test and the reproductibility of the tool.

Therefore, we need additional tools that assess teamwork performance as objectively as possible. In addition to the educational impact, the use of these tools will be useful for assessing the quality of care and benchmarking the performance over time of teams in an emergency situation. In addition, in research, it may help us define effective teams and discover the key to their success.

We imagined a PPH scenario that would guide the team towards deciding and organizing an embolization transfer because, in our experience in the field, this is a situation that is often conducive to a breakdown in communication between the team carrying out the transfer and the team receiving the patient. Inter-team and inter-hospital communication in an emergency situation can be a source of confusion and misunderstanding. It would be beneficial to improve communication between staff immediately present at the time of PPH, and the staff who will receive the patient. Many teams receiving a critically ill patient complain of a discrepancy between the patient's clinical condition and the previous phone description of the situation. Then it seemed essential to us to integrate a patient transfer situation into our scenario. The OTPA scale evaluates a very specific scenario with several clinical severity thresholds of a PPH situation, in our opinion, it is precisely in situations where the patient's clinical condition worsens progressively or abruptly that teamwork must be irreproachable. It is fundamental to train teams to maintain the acquisition of these skills throughout a situation and even more so when it deteriorates, hence the importance of team evaluation throughout the proposed scenario. In other obstetrical emergencies such as eclampsia, the OTPA scale will effectively be invalidated due to the specificity of the cited skills specific to the PPH situation. However, we believe that training a team using this tool, even if it is a PPH situation, can only reinforce the rigorous integration of fundamental psychometric and behavioral skills in any obstetric emergency situation.

The OTPA scale is precise, and offer many details on the general skills specific to the management of PPH. We believe the OPTA scale will have a potential value in teaching, debriefing, and evaluating NTS required for team dynamics in a PPH situation.

A recent systematic literature review by Fransen and al (37) has identified 6 tools for evaluating teamwork performance in obstetrics in simulated settings, but the evidence supporting their psychometric properties remains very limited.
All these scales assess teamwork in any emergency obstetric situation, with the same evaluation grid for different scenarios. There is then a lack of clarity of the different items, often compensated by a significant amount of training time provided to evaluators, which significantly affects its practical application.
The most applicable tools in terms of reliability and validity measures are "The Clinical Teamwork Scale (CTS)" by Guise et al (41),"The Global Rating Scale Of performance (GRS)" and "The Global Assessment of Obstetric Team Performance (GAOTP)" by Morgan and al (42,43). However, the pedagogical impact of these scales has never been assessed. The

CTS demonstrated the good validity and reliability of the measurements, but unfortunately, anesthesiologists were not part of the scenarios. GAOTP and GRS involved anesthetists in the scenarios, but no validity measurement were performed. The GAOTP is a reliable tool, provided that at least eight evaluators, after an in-depth 8-hour workshop training, are used for the evaluation of teamwork in order to ensure a sufficiently stable score. The limitation of the GRS is that, in addition to not containing a validity measure, requires nine external evaluators for the evaluation, which limits its ease of use and makes the tool expensive.

The TeamOBS-PPH tool (46) developed by Brogaard et al, is to our knowledge, the only tool for evaluating clinical performance in the management of PPH developed according to a Delphi process and tested in simulated and real situations with acceptable validity. However, of the 19 items on the scale, only 7 assessed the so-called NTS and the description of all items is brief and not thorough. Indeed, each item is very general, and the resulting low inter-observer variability is surprising. A group of four evaluators was formed during a one-hour session during which they were introduced to the tool and had to discuss each item to agree on the individual actions that would obtain the different proposed weights. This made it possible to overcome the lack of precision of the items and explains the good validity between assessors while considerably altering the psychometric fidelity of the test. Indeed, 2 teams of different evaluators can then have dissimilar intergroup weightings, and the reproducibility of the tool is then altered.

Our OTPA scale allows an analysis of the performance of the team as a whole and focuses on objective elements essential for effective team management in obstetrics. The scale is designed to be evaluated by external evaluators and evaluators of different specialties, in order to provide global and domain-specific feedback. The precision of the criteria composing the evaluation grid should allow for objective analysis and low inter-observer variability. We believe that our scale incorporates all the psychometric and behavioral markers essential to the assessment of NTS during a PPH management, by highlighting sub-items describing the characteristics of the perfect performance.

The OTPA scale will include an objective score weighted by the entire panel of experts, which will be a strength of our study. Indeed, it seems essential to us to integrate into this teamwork evaluation scale, an objective evaluation for educational purposes. Only the TEAM-Obst scale contains an evaluation score, but this was arbitrarily performed by the authors. Our OTPA scale contains a score determined by all experts who participated in the survey in order to ensure the validity of the tool. The rating of each item is done in a binary way (yes/no) unlike the other tools where each item is evaluated with a Likert scale, which in our opinion will

promote consistency between the evaluators and thus the feasibility and reproducibility of the tool.

To our knowledge, no scale assessing technical and NTS in an equal way was found in literature.

Indeed, the above-mentioned scales only assess NTS of the teams, which represents a weakness. In our opinion, for an optimal pedagogical impact, NTS are inseparable from technical skills. Only the TEAM-Obst scale includes the evaluation of the two types of skills but includes a smaller number of NTS (seven NTS, 12 technical skills).

Moreover, the Delphi method (38) was chosen specifically for the study because it has been shown to reliably translate into an increase in the percentage of agreements between participants and shows a convergence of opinions as consecutive cycles progress (47), which indicates consensus and stability. Other advantages of the Delphi method include the ability to participate via electronic communication and the anonymous response format, which allows different participants to express opinions without being influenced or guided by other experts. Consensus on a subject is reached by having about 70% to 80% of the votes in a described range (48). Another strength is that the tool was developed through a Delphi process with a large number of experts from three French-speaking countries, which considerably increases the power of the study and could be associated with a good intercultural validity of the tool.

The main weakness of our study is that the validity, feasibility and pedagogical impact have not yet been assessed. A good evaluation tool must demonstrate excellent validity and feasibility combined with a positive pedagogical impact and we will not remedy the evaluation of these fundamental elements. Our objective is to evaluate these elements of the OTPA scale using video recording of high-fidelity simulation sessions offered to our multidisciplinary teams.

The reliability of a tool describes how reproducible it is and can refer to test-release reliability or to the agreement between evaluators. The agreement between evaluators depends on the training the evaluators have received. It may also depend on the clarity of the scale definition and its ease of use.

OTPA currently has a large number of items, which could be considered long and could limit its use in current practice. However, from our point of view, it is preferable to involve more elements than necessary to ensure optimal patient safety, and to ensure an appropriate initial pedagogical impact while keeping the possibility of a refinement of our scale in the future.

One possible limitation of our Delphi process is that we have chosen expert evaluators with similar views, which can lead to a high rate of convergence of responses. Indeed, all our participants had a high level of expertise in the studied field, and all worked in university hospitals. We could have produced more generalizable results if we had chosen evaluators from a broader range of clinicians, including non-academic physicians.

CONCLUSION

Using a structured Delphi method, we provided a new interdisciplinary teamwork scale (OTPA), for the management of the post-partum hemorrhage. Thus, this scale will be able to be used during high-fidelity scenarii to assess performances (NTS and technical skills) of various teams facing a scenario of PPH. Moreover, this scale, focusing some crucial aspects of interdisciplinary teamwork will be useful for teaching purpose. Finally, further studies assessing validity, reliability and pedagogical impact of the OPTA Scale during high-fidelity simulation sessions offered to our multidisciplinary teams are mandatory.

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Figure 1 : The Delphi Process

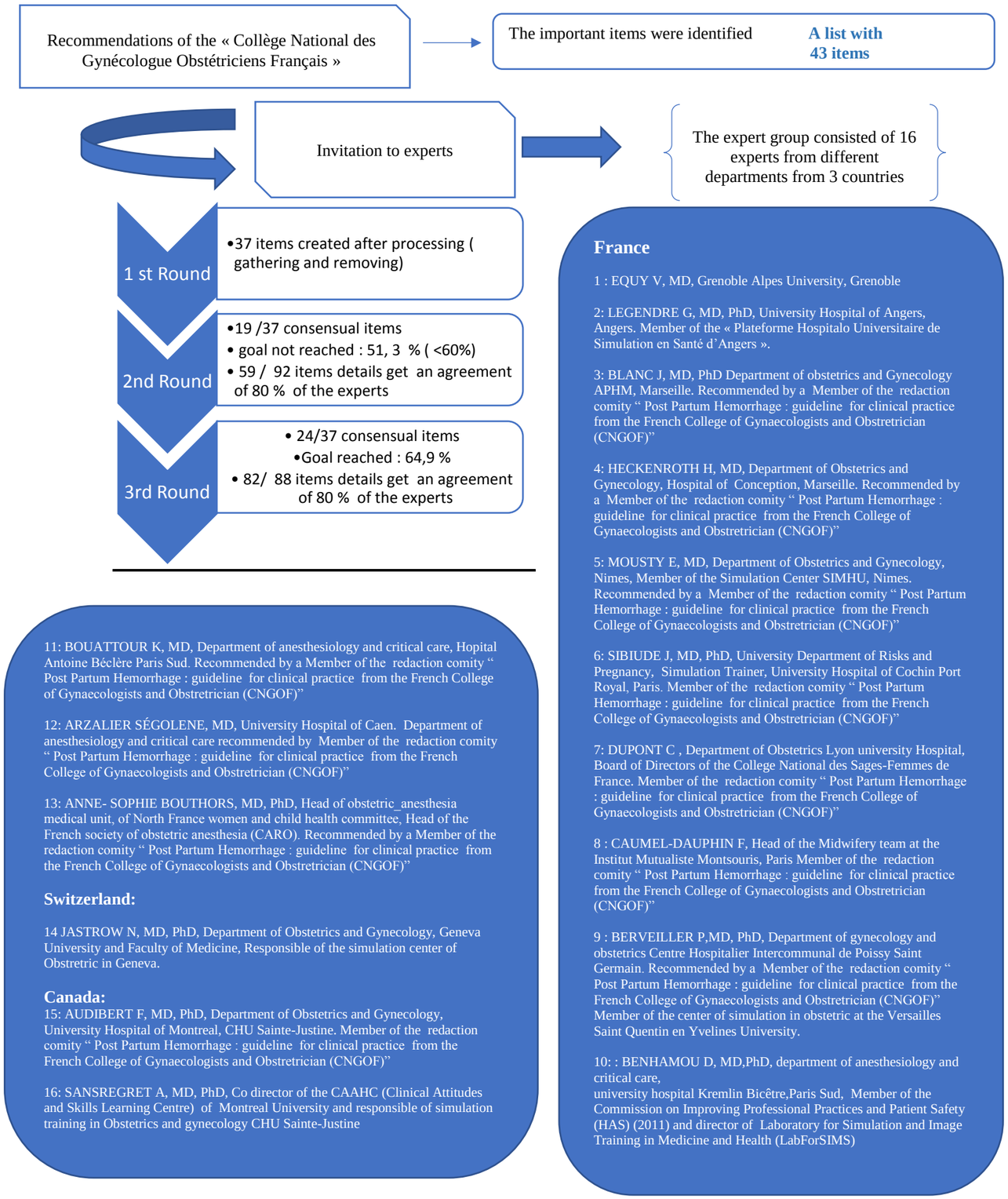

Table 1: Results of the Delphi Survey (items)

	Items		Round 2			Round 3		
			Median	% agreement 8-10	Status	Median	% agreement 8-10	Status
Technical Skills: PPH Persistence (1)	1	*Continue uterine massage*	8	81	VALIDATED			
	2	*Placement of an indwelling bladder catheter*	10	93,75	VALIDATED			
	3	*Continuation of vascular filling with crystalloid*	10	100	VALIDATED			
	4	*Insertion of a 2nd peripheral venous route and carrying out a haemostasis check-up*	10	100	VALIDATED			
	5	*Oxygen therapy*	8,5	81,25	VALIDATED			
	6	*Intravenous administration of sulprostone*	10	100	VALIDATED			
	7	*Fight against hypothermia*	8	81,25	VALIDATED			
	8	*Pain assessment and management*	4	18,73	_	5	38	DELETED
	9	Administration of tranexamic acid	9	88	VALIDATED			
Technical skills : Serious PPH (2)	10	*Transfusion of 2 blood pellets and 2 fresh frozen plasma*	9	93,75	VALIDATED			
	11	*Order fresh frozen blood and plasma pellets*	8	69	_	8	75	DELETED
	12	*Administration of fibrinogen*	8	56,26	_	8	93,25	VALIDATED
	13	*Platelet*	2	12,5	DELETED			

		administration						
	14	*Calcium Administration*	2,5	18,74	_	3,5	12,5	DELETED
General non-technical skills	15	*Completion of the chronological statement sheet*	10	100	VALIDATED			
	16	*Highlighting the cognitive help sheet "PPH Protocol"*	6	43,75	_	8	56,25	DELETED
	17	*Situational Awareness*	8	56,25	_	8	87,5	VALIDATED
	18	*Call for help: strengthening the team*	10	100	VALIDATED			
	19	*Situation monitoring*	10	100	VALIDATED			
	20	*Leaders' discussion and decision-making*	10	100	VALIDATED			
	21	*Action plan presented to the team: Call out*	9	93,75	VALIDATED			
	22	*Loop communication*	7,5	50	_	8	87,5	VALIDATED
	23	*Well-identified co-leadership*	8	74	_	8,5	81,25	VALIDATED
	24	*Communication to the patient and her companion*	9	87,5	VALIDATED			
	25	*Quality of verbalization: precise and clear*	2	12,5	DELETED			
	26	*Efficient gestures, savings in gestures and movement, no task interruption*	2,5	12,5	DELETED			
	27	*Efficiency of words: calm voice, no excessive elevation of the voice, clear and coherent*	2,5	12,5	DELETED			

		communication						
Non-technical skills : Persistent PPH (1)	28	*Ensure the safety and availability of blood products*	10	100	VALIDATED			
	29	*Using the telephone book*	1	6,23	DELETED			
	30	*Call the embolization center*	9,5	81,25	VALIDATED			
	31	*Request from the radiologist present*	1,5	6,35	DELETED			
	32	*Call for Mobile Emergency and Revival Service*	9,5	81,25	VALIDATED			
	33	*Communication adapted according to the SBAR structure*	9,5	81,25	VALIDATED			
	34	*Ensure that a place is available on site in an appropriate hospital facility (intensive care.)*	2,5	12,5	DELETED			
	35	*Ensure a short-estimated transport time to the host structure*	2,5	12,5	DELETED			
Non-technical skills: Serious PPH (2)	36	*Confirm the transfer with the embolization center and the Mobile Emergency and Revival Service*	6,5	31,25	_	8	62,5	DELETED
	37	*Anticipation: programming of a plan B and organization of the surgery*	9	62,5	_	9	93,75	VALIDATED

SBAR: « Situation, Background, Assessment Recommendation »
PPH: Post-Partum Hemorrhage

Table 2: Results of the Delphi Survey (items details)

	Items	Items details	Round 2		Round 3	
			% agreement 8-10	Status	% agreement 8-10	Status
Technical Skills: PPH Persistence (1)	1	Verbalization of the execution of the gesture	87,5	VALIDATED		
		Information validated by the leader	87,5	VALIDATED		
	2	Verbalization of the execution of the gesture	93,75	VALIDATED		
		Information validated by the leader	93,75	VALIDATED		
	3	Inspection of the solute bag and flow regulator	81,25	VALIDATED		
		Verbalization type "the infusion of... is well adjusted speed" "	75	_	81,25	VALIDATED
		Verbalization of the functionality of the 2 peripheral venous pathways	Proposed by 2 experts	_	43,75	DELETED
		Information validated by the leader	81,25	VALIDATED		
	4	Verbalization of peripheral venous line placement and hemostasis test	87,5	VALIDATED		
		Verbalization of the balance sheet content: Blood Formula Count, Prothrombin Ratio, Activated Cephalin Time, fibrinogen	87,5	VALIDATED		
		Information validated by the leader	87,5	VALIDATED		
		Actions carried out within the first 3 minutes of learners taking up their duties	87,5	VALIDATED		
	5	Verbalization of the performance of the gesture "oxygen therapy is well applied with a mask / glasses" by specifying the speed 3L/min or the saturation objective	75	_	81,25	VALIDATED
		Information validated by the leader	87,5	VALIDATED		
	6	Verbalization of oxytocin discontinuation	Proposed by 2 experts	_	43,75	DELETED
		Verbalization of the initiation of Sulprostone treatment	81,25	VALIDATED		
		Verbalization of drug name, dose and rate: "1 ampoule of 500 micrograms per hour"	81,25	VALIDATED		
		Verbalization of the "T1" administration time	81,25	VALIDATED		
		Information validated by the leader	81,25	VALIDATED		
	7	Taking of temperature and verbalization of the result	81,25	VALIDATED		
		Placing a heating blanket on the patient and verbalizing the gesture	81,25	VALIDATED		
	9	Verbalization of the introduction of tranexamic acid treatment	75	_	93,75	VALIDATED
		Verbalization of the dose	75	_	93,75	VALIDATED
		Verbalization of the administration speed	Proposed by 2 experts	_	12,5	DELETED
		Verification of the administration time	75	_	81,25	VALIDATED
		Information validated by the leader	75	_	81,25	VALIDATED
Technical skills : Serious PPH (2)	10	Task explicitly delegated to a team member	75	_	100	VALIDATED
		Call the laboratory to specify the degree of urgency of the supply	75	_	100	VALIDATED
		Verbalization of the completion of the task	75	_	100	VALIDATED

		(transfusion)		
		Information validated by the Leader	75 _	100 VALIDATED
	12	Verbalization of the execution of the gesture	75 _	87,5 VALIDATED
		Verbalization of the dose: 2g	75 _	87,5 VALIDATED
		Verification of the administration time	75 _	87,5 VALIDATED
		Information validated by the Leader	75 _	87,5 VALIDATED
General non-technical skills	15	Task explicitly delegated to a team member	87,5 VALIDATED	
		Delegated task within the first 2 minutes of taking office of the positions	87,5 VALIDATED	
		Task clearly stated with request to specify the T1 (Nalador administration time) on the tracking sheet	87,5 VALIDATED	
	17	Leaders verbalize aloud:		
		As soon as the positions take up their duties	75 _	81,25 VALIDATED
		Information about: the patient's history, time and manner of delivery	75 _	81,25 VALIDATED
		Actions already performed: Uterine revision/ valve revision/ 10 IU syntocinon administered	75 _	81,25 VALIDATED
	18	Verbalization aloud of the request of a member of the anesthesia team as a reinforcement	87,5 VALIDATED	
		Task performed within the first 3 minutes of the start of the shift	87,5 VALIDATED	
		Check Back of the arrival of the help	87,5 VALIDATED	
	19	Leaders verbalize aloud:		
		the persistence of active bleeding and flow (specifying whether normal or above normal)	87,5 VALIDATED	
		Blood pressure and heart rate	87,5 VALIDATED	
		the quality of the uterine globe	87,5 VALIDATED	
		at each step of the scenario T1 /T2 /T3	87,5 VALIDATED	
		disruption of the hemostasis test for step 2	87,5 VALIDATED	
	20	Leaders at each stage of the scenario make the decision to:		
		T1 : initiation of Sulprostone treatment	81,25 VALIDATED	
		T2 : embolization programming	87,5 VALIDATED	
		T3 : validation of the transfer	87,5 VALIDATED	
		T4: cancellation of the embolization transfer	87,5 VALIDATED	

	21	Leaders verbalize aloud, at each step of the scenario:				
		T1: initiation of Sulprostone treatment	93,75	VALIDATED		
		T2: programming of embolization with transfer if bleeding persists within 25 minutes	93,75	VALIDATED		
		T3: validation of the transfer	93,75	VALIDATED		
		T4: cancellation of the embolization transfer	93,75	VALIDATED		
	22	Followers validate the receipt of information received by the leaders of:				
		T1: the introduction of sulprostone treatment	68,75	_	81,25	VALIDATED
		T2 : embolization programming	68,75	_	81,25	VALIDATED
		T3: validation of the transfer	68,75	_	81,25	VALIDATED
		T4: cancellation of the embolization transfer	93,75	VALIDATED		
	23	Have assigned tasks in a precise and clear manner	93,75	VALIDATED		
		Balanced the workload within the team	93,75	VALIDATED		
		Were if possible outside the technical gestures	93,75	VALIDATED		
	24	Introduce yourself and explain to the patient the arrival of a team that she does not know but that will be responsible for stopping PPH	Proposé par 2 experts	_	62,5	DELETED
		Information given at each stage of care T1/T2/T2/T3	93,75	VALIDATED		
		Quiet communication	93,75	VALIDATED		
		Reassuring communication	93,75	VALIDATED		
		« Verbal asepsis »	68,75	_	68,75	SUPPRIME
Non-technical skills : Persistent PPH (1)	28	Task explicitly delegated to a team member	87,5	VALIDATED		
		Laboratory call: warn of the arrival of a haemostasis test to be performed urgently	93,75	VALIDATED		
		Call from the blood-delivering establishment: request for urgent storage of *blood pellets and fresh frozen plasma*	100	VALIDATED		
		Verbalization of the task completion	87,5	VALIDATED		
		Information validated by the leader	93,75	VALIDATED		
	30	Task explicitly delegated to a team member	87,5	VALIDATED		
		Call the number indicated on the "PPH Protocol" cognitive aid form	87,5	VALIDATED		
		Verbalization of the execution of the gesture	87,5	VALIDATED		
		Information validated by the leader	87,5	VALIDATED		
	32	Task explicitly delegated to a team member	87,5	VALIDATED		
		Call the number indicated on the "PPH Protocol" cognitive aid form	87,5	VALIDATED		

		Verbalization of the execution of the gesture	87,5	VALIDATED		
		Information validated by the leader	87,5	VALIDATED		
	33	Information on the situation: precise and clear	81,25	VALIDATED		
		Information on processing already undertaken	81,25	VALIDATED		
		Information on the patient's clinical condition (Blood pressure, Heart Rate, blood loss)	81,25	VALIDATED		
		Information transmitted to the on-call radiologist / anesthesiologist of the embolization tray / Mobile Emergency and Revival Service	81,25	VALIDATED		
	37	The Obstetrical Leader inquiries about which operating room is available in emergency	68,75	_	93,75	VALIDATED
		He's asking about which surgeon is available for backup.	75	_	93,75	VALIDATED

Table 3. Characteristics of the different assessment tools and their construction methodology.

	OTPA Scale	Team OBST-PPH tool	Clinical Teamwork Scale (CTS)	Global Assessment of Obstetric Team Performance (GAOTP)	Global Rating Scale (GRS)
Year of development of the tool	2019	2018	2008	2007-2012	2007-2012
Items	24	19	15	6 6	1
Number of non-technical items	14	7	15	12	1
Number of technical items	10	12	0	0	0
Obstetrical emergency scenario evaluated	PPH Situation scenario orienting the team work towards the decision of a transfer in embolization	PPH Situation The scenario is not detailed	All obstetric emergency situations	All obstetric emergency situations	All obstetric emergency situations
Type of item response	Yes/No item	5 point Likert-scale	0-10 rating scale (and 1 Yes/No item)	5 point Likert-scale 5 point Likert-scale	5 point Likert-scale
Medical specialities involved in teams	Obstetrics, midwives anaesthesiology	Obstetrics, anaesthesiology	Obstetrics	Obstetrics, anaesthesiology Obstetrics, anaesthesiology, family medicine	Obstetrics, anaesthesiology
Methodology of grid construction	Delphi method with 16 experts 4 rounds	Delphi method with 12 experts 4 rounds	Without Expert Consensus	Without Expert Consensus	Without Expert Consensus
scoring of items	score weighted by the entire panel of experts	arbitrarily performed by the authors	No	No	No
Setting for validation	The scenario was tested in high-fidelity simulation sessions by 6 multidisciplinary teams.	4 selected video-recordings	3 scripted simulated scenarios (with different predefined levels of performance)	12 simulated scenarios for usefulness (4 clinical situations) of which 3 were used for reliability measures 136 simulated scenarios (4 clinical situations)	12 simulated scenarios (4 clinical situations