Development of a Rubric to Evaluate Implementation Quality of Simulation-Based Courses

A Consensus Study

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Introduction: Simulation-based education is a recognized way of developing medical competencies, and there is overwhelming scientific evidence to support its efficacy. However, it is still underused, which can often be related to poor implementation process. In addition, best practices for implementation of simulation-based courses based on implementation science are not widely known nor applied. The purpose of this study was to develop a rubric, the Implementation Quality Rubric for Simulation (IQR-SIM), to evaluate the implementation quality of simulation-based courses.

Methods: A 3-round, modified Delphi process involving international simulation and implementation experts was initiated to gather and converge opinions regarding criteria for evaluating the implementation quality of simulation-based courses. Candidate items for Round 1 were developed based on the Adapted Implementation Model for Simulation. Items were revised and expanded to include descriptive anchors for evaluation in Round 2. Criterion for inclusion was 70% of respondents selecting an importance rating of 4 or 5/5. Round 3 provided refinement and final approval of items and anchors.

Results: Thirty-three experts from 9 countries participated. The initial rubric of 32 items was reduced to 18 items after 3 Delphi rounds, resulting in the IQR-SIM: a 3-point rating scale, with nonscored options "Don't know/can't assess" and "Not applicable," and a comments section.

Conclusions: The IQR-SIM is an operational tool that can be used to evaluate the implementation quality of simulation-based courses and aid in the implementation process to identify gaps, monitor the process, and promote the achievement of desired implementation and learning outcomes.

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The value of simulation-based education in providing training opportunities for learners in a safe environment before patient care is well established, with abundant evidence supporting its effectiveness and its association to improved patient outcomes.[1,2] Simulation is a complex intervention that requires systematic, interactive processes to achieve the desired outcomes.[3,4] Evidence-based, stepwise approaches have been proposed to ensure that the development, delivery, and evaluation of simulation-based courses are well grounded,[4] with extensive focus on theory-based program development and rigorous evaluation of efficacy and effectiveness.[5] When a course fails, it is often not only because of the content or structure but also because the quality of the implementation process was deficient.[6–8]

There is ample evidence that the quality of implementation directly impacts program outcomes.[6–8] Simulation educators and program directors are now starting to pay increasingly more attention to the field of implementation science to identify factors that strengthen the implementation quality of new programs.[9,10] Thus, implementation science is gaining importance as the focus moves toward effectiveness, sustainable delivery, and widespread adoption of simulation in practice. The process of implementing simulation-based courses can be lengthy, complex, and dynamic.[10] Implementation science frameworks inform the design and development processes and identify possible implementation barriers and facilitators, prevent program drift, and facilitate the understanding of how simulation-based courses adapt and behave in new contexts.[4,10,11]

Systematic gathering of data along the spectrum of program conception, development, and testing informs the quality

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of the implementation process and can predict whether the intended program outcomes are reached. Implementation frameworks and models are available, and while they differ in terms of characteristics, assumptions, and implications for use, the main objectives are to guide implementation practice and to provide a better understanding of how and why implementation succeeds or fails.[12] To this end, Dubrowski et al[10] proposed a practical implementation framework that is specific to the simulation context: the Adapted Implementation Model for Simulation (AIM-SIM). The AIM-SIM was derived from existing implementation evidence by blending 3 complementary implementation models: the Consolidated Framework for Implementation Research,[13] the Quality Implementation Framework,[7] and the Implementation Outcomes framework.[14] It provides a substantive guide to the implementation process, emphasizing core activities such as engagement with key stakeholders, ensuring that the program fits into specific contexts, preimplementation planning, and ongoing monitoring and evaluation. The AIM-SIM identifies different phases throughout the implementation process in which tasks are performed and data gathered; however, it does not describe how to evaluate implementation quality. Successful implementation remains an unresolved issue in implementation research.[14] How do we conceptualize and evaluate success? Are there standards that should be met during each step of the process to promote the achievement of the desired outcomes of a program? As yet, there are no studies to systematically evaluate the implementation quality of simulation-based courses based on the AIM-SIM framework. There remains a gap in the literature regarding specific evidence-based best practices to evaluate the implementation of simulation-based education.

The purpose of this study was to develop a rubric, based on the AIM-SIM framework, to evaluate the implementation quality of simulation-based courses in health professions education.

METHODOLOGY

Study Design

A modified 3-round Delphi method was performed to gather and converge expert opinion regarding different criteria or items that should be considered when evaluating implementation quality of simulation-based courses (Fig. 1). The Delphi method is a structured group communication process that seeks to gather information and achieve consensus from a panel of experts using iterative survey questionnaires.[15–17] This method is used widely in medical education, being applied in needs assessment processes,[18] to define content for assessment instruments,[19] and to identify research priorities in medical education.[20,21]

In this study, the Delphi rounds were conducted through online survey questionnaires (Qualtrics, London, UK) sent individually through email. We decided to conduct a maximum of 3 rounds, and 2 reminder mails were sent for each round. Nonresponders in previous rounds remained as members of the panel and were invited to participate in the succeeding rounds. The Delphi process is described in the attached online supplement (see Text, Supplemental Digital Content 1, http://links.lww.com/SIH/A884, which further describes the Delphi method).

This study was granted exemption by the institutional review board of the University of Illinois in Chicago (protocol number 2021-0137).

Steering Group

A steering group was established with extensive collective experience in implementation science, medical education, and simulation. L.J.N. as the primary Delphi investigator, supported by other authors (R.Y., A.D., C.P., L.K.), conducted all tasks including mail correspondences, design and piloting of survey questionnaires, data organization, and analyses of each round. The steering committee retained the right to reinstate any items despite elimination via the Delphi process if they were deemed critical in some way after collective consideration by the committee.

Selection of the Delphi Expert Panel

We used representative sampling to identify national and international leaders engaged in simulation-based education and implementation processes to compose our Delphi expert panel. The eligibility criteria were:

1. Simulation center directors who have held their position for more than 2 years.
2. Simulation operations officers who assume the responsibility for the day-to-day management of the center's operations and have held the position for more than 2 years.
3. Simulation education experts who have been actively involved in the development and implementation of simulation-based courses at their home institutions.
4. Implementation experts with experience in simulation settings.

The identified experts were purposely invited for panel membership to represent opinions from both simulation and implementation experts across different geographical locations. To increase the number of participants and extend representation, we used the snowballing technique[22] by asking the identified experts to nominate 1 to 3 individuals from other institutions who fit the eligibility criteria to participate in the Delphi process. An invitation email was sent to the identified experts to participate in the Delphi process, detailing the purpose of the study, a description of the different rounds of the Delphi process, and the importance of active participation.

Initial Candidate Items Based on the AIM-SIM

In a modified Delphi method, an initial list of candidate items is generated before the initial round. Candidate items were proposed by the steering group using 2 sources: the AIM-SIM framework[10] and the Hexagon, an exploration tool proposed by the National Implementation Research Network.[23] These sources provided the IQR-SIM blueprint and generated 32 candidate items that were mapped onto 3 phases of the implementation process: Phase 1, stakeholder engagement and context exploration; Phase 2, implementation planning; and Phase 3, implementation monitoring and evaluation.[10]

Delphi Round 1

In this initial round, the experts were asked demographic questions to establish participant characteristics. They were then asked to provide feedback and build on the IQR-SIM draft by reviewing the candidate items and rating each item on a 5-point rating scale regarding importance for inclusion

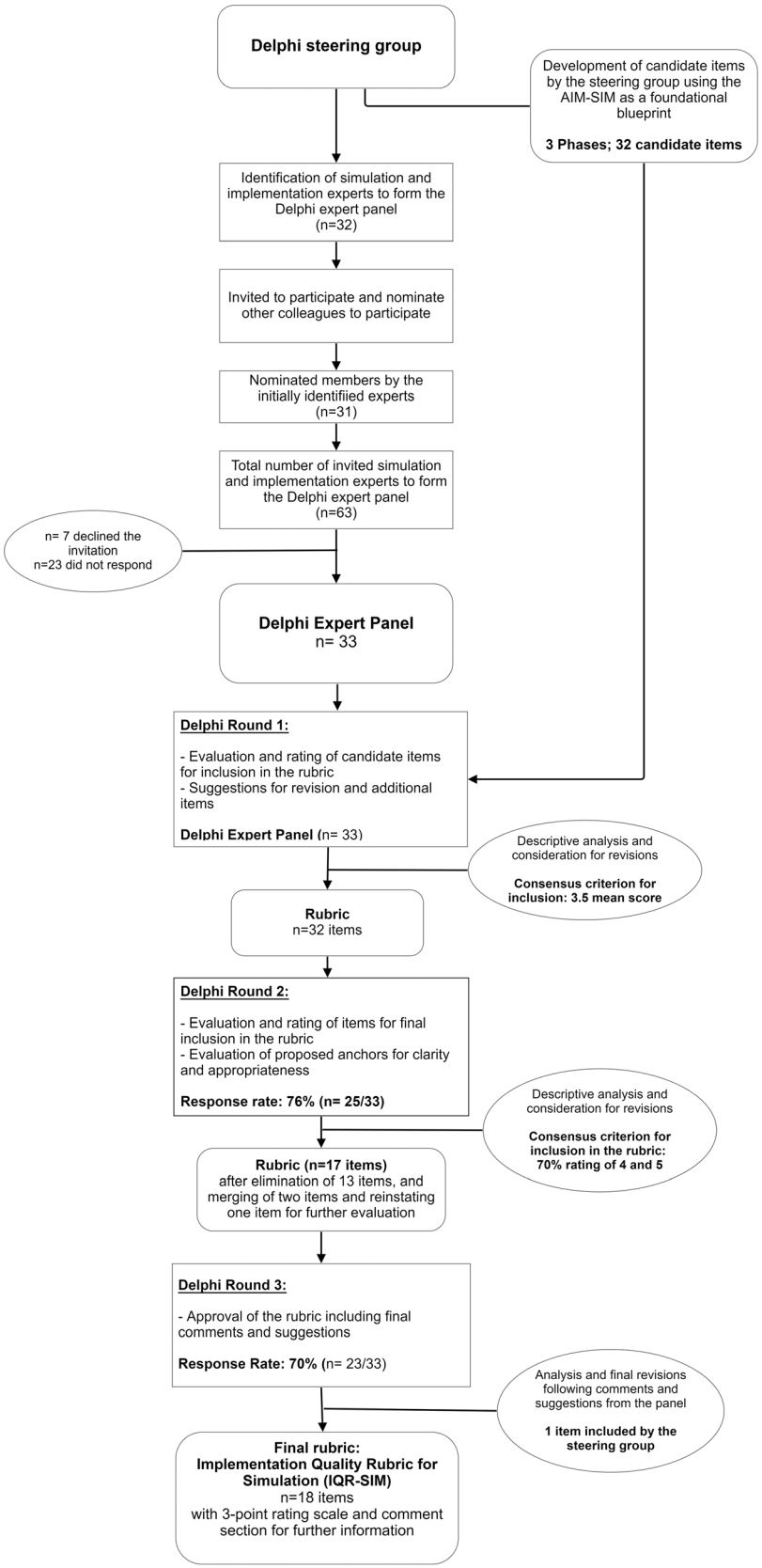

FIGURE 1. The IQR-SIM Delphi process.

in the rubric where (1) definitely do not include, (2) probably do not include, (3) acceptable to include, (4) important to include, and (5) essential to include. Commenting and proposing additional items or revisions were encouraged.

The suggestions and ratings from the expert panel were gathered and reviewed by the steering group. Items with a mean score of 3.5/5 and less were eliminated. Comments and suggestions for revisions of the candidate items were

considered and applied accordingly. Before sending the new version of the IQR-SIM to the panel, it was expanded by the steering group to include a 3-point rating scale with descriptive anchors. The rubric was developed into a survey questionnaire for the expert panel to review and re-evaluate in the next round.

Delphi Round 2

In the second round, the expanded IQR-SIM was sent to the expert panel along with a copy of results of Round 1 to provide transparency and an opportunity to review how the items were scored by the entire group. The panel was asked to re-evaluate the revised items and to evaluate the anchors for clarity and/or appropriateness on a 5-point scale. They were also given the opportunity to clarify their answers and provide comments and suggestions for revisions.

The required level of agreement was defined as 70%; items that did not receive a rating of 4 or 5 from more than 70% of the expert panelists were eliminated.

Delphi Round 3

The third round was a final review and approval of the rubric. The expert panel was presented with the IQR-SIM, which had been revised based on the ratings and comments gathered in the previous round and was asked to carefully review the items and anchors. Approval signified agreement to the content of the IQR-SIM notwithstanding minor revisions (eg, changes in wording), while disapproval of the IQR-SIM suggested disagreement with the rubric indicating that major revisions were required (ie, another Delphi round was required). The panel was also asked to provide final comments and suggestions. Consensus agreement was defined as 70% of the expert panel approving the IQR-SIM.

STATISTICAL ANALYSIS

Descriptive statistics were calculated in all survey rounds. The mean scores and standard deviation were calculated for each item in Round 1. While a Shapiro-Wilk test determined that the rating distribution departed significantly from normality ($P < 0.001$ to $P = 0.002$), the goal was to describe agreement among the expert panel rather than hypothesis testing; therefore, the mean and standard deviation are reported as being more informative than the median and range. Frequency analysis was used in Rounds 2 and 3. All statistical analyses were performed using SPSS software version 25 (IBM SPSS, Chicago, IL).

RESULTS

Thirty-two international simulation and implementation experts were identified and invited to participate in the Delphi. The invited members nominated 31 additional colleagues to participate in the process, totaling 63 invited participants.

A total of 33 experts from nine countries agreed to participate in the Delphi expert panel. Demographic characteristics of the participants are presented in Table 1.

TABLE 1. Demographic Characteristics of the Expert Panel

	Round 1	Round 2	Round 3
	n	n	n
Country			
Australia	3	2	1
Belgium	1	1	1
Canada	3	1	2
Denmark	3	3	3
Germany	2	2	2
Ireland	2	0	0
Sweden	4	4	4
Netherlands	1	1	0
United States of America	14	11	10
Profession			
Medical doctor	16	13	12
Nurse	4	3	4
Others (ie, educator, psychologist, paramedic, scientist, sociologist, training and education director, PhD educator with doctorate in human communication and master of fine arts in theater)	13	9	7
Expertise			
Simulation	12	10	11
Implementation	3	2	2
Both	18	13	10
Years of experience			
Years of experiences as simulation expert/ specialist (median years)	20	17.5	17.5
Years of experiences as implementation expert/ specialist (median years)	11.5	11.5	13
Role in simulation			
Simulation center director	18	14	12
Simulation operations manager/officer	3	3	3
Simulation education expert	5	3	3
Others (ie, educational unit leader, research director, simulation program director—100% in situ program with no center)	3	3	2
Type of simulation center			
University-based center	13	7	8
Hospital-based center	9	9	8
Others (ie, both university and hospital-based center)	8	7	5
Experience with healthcare simulation			
No experience	1	0	0
Some experience	1	1	1
Extensive experience	19	14	11

Round 1

The 33 members of the Delphi expert panel responded to Round 1. All 32 candidate items were rated highly with mean scores greater than 3.5; therefore, no items were eliminated in this round (Table 2). The steering group reviewed the comments and suggestions and revised the items accordingly. Based on the comments, 2 items were found redundant and were reinforced in other items. These include "Established availability of expertise in the intervention" under phase 1 and "Identified all activities related to implementation (eg, frontline staff recruitment and training, procurement of equipment and infrastructure etc.)" under phase 2.

Round 2

Twenty five of the 33 experts (76%) responded. Seventeen items were retained, having received importance ratings of 4 or 5 by more than 70% of the expert panel. Thirteen items did not meet this criterion and were eliminated. Four of 5 items in the section about stakeholders' involvement were eliminated; after deliberation by the steering group, a more general item regarding stakeholder engagement was proposed called "Identified and engaged relevant stakeholders (eg, trainees, directors, deans, etc.)." Two items were found redundant and therefore merged to form one item under the subcategory "The *When* of implementation" in Phase 2 (Table 2). The

majority of the panel rated the anchors as clear and appropriate, with constructive suggestions for improvement. Additional comments and suggestions were considered, and revisions were applied. The resulting rubric was sent to the panel to approve in the final round.

Round 3

Twenty three of 33 initial expert panel (70%) responded. Twenty (87%) approved of the rubric, with 6 suggesting additional minor changes, while 3 did not approve of the rubric and provided constructive comments and suggestions for improvement. Based on the predefined consensus criterion of 70%, the decision was to proceed with approval of the rubric, after addressing minor and major comments.

Final Rubric

During analysis, the steering group found that an essential item regarding evaluation of implementation process and outcomes had been eliminated in Round 2—"Assessed adherence to implementation process (eg, Was the program implemented as planned? Was everything done in a timely manner?)," and after deliberation decided to revise and return the item to capture this important step. After final revision, the rubric consisted of 18 items and is called the Implementation Quality Rubric for Simulation in health professions education (IQR-SIM). The items fall under the 3 implementation phases and are evaluated using a 3-point rating scale using descriptive anchors as well as nonscored options "Don't know/can't assess" and "Not applicable." Based on the suggestions from the panel, a comment section was added under each phase to allow evaluators to include notes and other relevant information. The IQR-SIM is presented as a supplemental table (see Table, Supplemental Digital Content 3, http://links.lww.com/SIH/A886, which presents the IQR-SIM). A guide on how to use the IQR-SIM is available (see Text, Supplemental Digital Content 2, http://links.lww.com/SIH/A885, which outlines how to use the IQR-SIM).

DISCUSSION

The purpose of this inductive, mixed methods, survey-based research study was to use a modified 3-round Delphi method with an international expert panel to develop a rubric to evaluate the implementation quality of simulation-based courses in health professions education. This process involved rigorous evaluation of candidate items that were derived and guided by the AIM-SIM framework and formulated into a 3-point rating scale with descriptive anchors. This resulted in an 18-item rubric referred to as the IQR-SIM (see Table, Supplemental Digital Content 3, http://links.lww.com/SIH/A886). The IQR-SIM is an operational tool that is intended for use by educators, program directors, managers, and operations staff to evaluate the quality of implementation of simulation-based courses in their institutions. The rubric aims to aid in the implementation process to identify gaps, monitor the process in real time, and promote the achievement of desired outcomes.

Structure of the IQR-SIM

The IQR-SIM is divided into 3 phases,[10] starting from the formation of the implementation team, engagement of stakeholders and context definition, to implementation planning, and lastly monitoring and evaluation. The items under each phase represent action steps that need to be accomplished to ensure implementation quality. The IQR-SIM was designed as a 3-point rating scale where "1" indicates a task that is not accomplished, "2" describes a task that is partially accomplished, and "3" represents a task that is fully accomplished and completed. The IQR-SIM is intended to be used as a formative tool to evaluate the implementation process, either retrospectively or prospectively; thus, the rubric uses a rating scale to identify work in progress rather than a dichotomous scale that limits the options to yes or no. Scoring of the different items allows for nuances and for evaluators to identify and assess the status of the implementation process and what tasks are yet to be accomplished. In contrast to the Quality Implementation Tool (QIT) proposed by Meyer et al,[24] which requires narrative assessment of all action steps in terms of planning, real-time monitoring, and evaluation, a descriptive scale is relatively easy for evaluators to fill out, and they can provide more information in the comments section when needed.

Scoring

The IQR-SIM includes nonscored options "Don't know/Can't assess" and "Not applicable" to indicate indeterminate decisions or when an item is not applicable for the program or context, respectively. Information provided in the comments sections could be used to jumpstart conversations among the team members regarding capacities and other resources needed to ensure successful implementation.[7,23,24] A user guide including definition of terms is provided as supplementary file to the IQR-SIM. The user guide recognizes that implementation is a complex undertaking that requires substantial knowledge of the process as well as specific considerations that are relevant to the local context for it to be used effectively.[24] The user guide can also be used as a rater training tool to improve rater performance and promote accuracy.[25]

Content

The IQR-SIM used the AIM-SIM as a foundational framework, ensuring that included items are aligned to core implementation components, such as content, context, implementation process, and outcomes.[7,10,13,14] These important items influence the effectiveness and quality of implementation, and the IQR-SIM can be used to appraise these items.

The formation of an implementation team with well-defined roles was highly rated and included as the first step in preimplementation planning. An implementation initiator should be identified and assigned, and the roles and responsibilities should be well defined and communicated. Throughout the rubric, we assumed that "definition of different tasks" (eg, roles and responsibilities) includes documentation. Emphasis on careful and systematic documentation is a useful strategy for shaping the overall direction of the implementation process and serves as an institutional memory that can be retrieved when planning similar initiatives.[26]

Two activities deemed critical by implementation science were initially eliminated during the Delphi process. The items regarding stakeholder engagement were eliminated by the panel in Round 2, in which the importance of 4 of the 5 items was rated 4 and 5 by less than 70% of the panel. Upon careful consideration and recognizing the importance of stakeholder buy-in, the steering group proposed a more general statement regarding stakeholder engagement to be evaluated further by

TABLE 2. Ratings of the Candidate Items in Round 1 and Round 2

	Round 1 (Mean Scores)*	Round 1 (SD)*	Round 2 (% Agreement for Ratings 4 and 5)*
Phase 1: Stakeholder engagement and context exploration			
I. Identification of implementation team and relevant stakeholders			
1 Identified implementation initiator who will lead the implementation team	4.76	0.61	96
2 Identified other members of the implementation team (ie, directors of simulation center, educators, learners, administrative and IT staff)	4.39	0.56	88
3 Identified implementation champions who will inspire and lead others to implement the program	4.12	0.70	64†
4 Identified other relevant stakeholders (eg, heads of clinical departments, other healthcare workers, specific patient groups, funding agencies)	3.73	0.76	68†
II. Obtaining buy-in from relevant stakeholders			
5 Organized meetings to introduce the simulation-based training program to the local implementation stakeholders	4.52	0.83	68†
6 Sought explicit buy-in from organization leadership (ie, simulation center, university, or hospital). This might include a verbal agreement, letter of support, a memorandum of understanding (MOU), commitment of funding etc.	4.21	0.89	68†
7 Sought explicit buy-in and commitment from core users of the program (eg, verbal agreement or letter of support, MOU etc.)	4.06	0.84	56†
8 Assigned specific roles to internal implementation champions who will inspire and lead others to implement the program	4.00	0.87	68†
9 Assigned formal roles to, and foster relationships with the members of the implementation team	3.97	0.92	72
III. Determining the degree of fit between the simulation-based program			
10 Assessed specific educational needs through data collection	4.69	0.59	80
11 Assessed if the intervention fitted with current initiatives, structures and values	4.41	0.56	72
12 Identified and ensured availability of resources (human, equipment, financial)	4.59	0.80	92
13 Assessed the evidence (literature) in relation to the program- what works, within what contexts, and with whom	4.06	0.80	68†
14 Assessed the evidence in relation to implementation (outcomes and fidelity) and cost effectiveness	3.84	0.88	60†
15 Examined if the program is clearly defined (eg, what is it, and for whom is the program intended?)	4.27	0.69	96
16 Established availability of expertise in the intervention	4.09	0.82	Round 1 analysis showed it to be redundant and was therefore eliminated
17 Identified if the setting has the capacity to sustain the program (eg, qualified staff, leadership, finance, and structure)	4.56	0.67	68†
Phase 2: Implementation planning			
I. The "WHAT" of implementation			
18 Identified all activities related to implementation (eg, frontline staff recruitment and training, procurement of equipment and infrastructure etc.)	4.45	0.56	Round 1 analysis showed it to be redundant and was therefore eliminated
19 Developed a plan for evaluating implementation processes and outcomes (eg, barriers and facilitators)	4.36	0.65	92
20 Developed a plan for evaluating educational outcomes of the simulation program	4.33	0.65	92
21 Planned for personnel sustainability (eg, faculty development and staff turn-over)	3.85	0.87	80
22 Planned for simulation space and equipment sustainability (eg, maintenance of rooms, consumables, equipment replacement, warranty)	3.91	0.84	68†
II. The "WHO" of implementation			
23 Recruited and trained faculty (eg, clinician educators)	4.42	0.61	96
24 Recruited and trained support team members (eg, administrative support, technicians)	4.09	0.72	80
25 Defined roles, processes, and responsibilities of entire implementation team	4.52	0.70	88
III. The "WHEN" of implementation			
26 Created a plan that includes specific tasks and timelines to enhance accountability during implementation process	4.39	0.70	92
27 Created a plan to measure adherence to the implementation schedule	3.82	0.85	44†
Phase 3: Implementation monitoring and evaluation			
I. Implementation process evaluation			
28 Assessed adherence to implementation process (eg, Was the program implemented as planned? Was everything done in a timely manner?)	4.09	0.77	64†
29 Shared process data with those involved in the program (eg, stakeholders, administrators, implementation support etc.)	3.88	0.78	53†
30 Revised implementation process as needed	4.27	0.63	76
31 Communicated lessons learned to improve future implementation efforts	4.48	0.67	80
II. Simulation program outcomes evaluation			
32 Collected relevant data about outcomes of the simulation program	4.64	0.55	96

*Five-point rating scale used to rate the anchors: 1, definitely do not include in rubric; 2, probably do not include in rubric; 3, acceptable to include in rubric; 4, important to include in rubric; 5, essential to include in rubric.
†Eliminated in Round 2 based on 70% consensus agreement.

the expert panel in the final round. Stakeholder involvement is one of the very first steps in implementation and achieving buy-in is of extreme importance.[7,10,13,23] It has been shown that engagement with a broad group of stakeholders encourages buy-in and collaboration, which consequently leads to leveraging resources and optimization of the implementation process.[27] Dubrowski et al[10] described stakeholders in simulation to include directors and/or managers of the simulation center, educators, clinician-educators, learners, information and technology support staff, and human resources staff. These stakeholder groups are also represented in other items in the rubric with better specified tasks such as recruitment and training of the faculty (eg, clinical educators) and the support team members (eg, administrative staff).

The second item eliminated by Delphi concerned gathering data to evaluate the actual implementation of the program. Quality implementation is defined as putting an innovation or intervention into practice in a way that meets the necessary standards to achieve the desired outcomes.[6] Several studies have suggested that the outcome of implementation depends on achieving a quality process of implementation.[6,8,14] In simulation, there is much focus on measuring educational outcomes, with emphasis on development and implementation of assessment to ensure that the goals and objectives of the educational program are met. The emphasis on evaluation of educational outcomes was evident in this study, being highly rated by the expert panel in Round 2, while evaluation of implementation process and outcomes was limited by the Delphi process to revision of the implementation process and communicating the lessons learned. Implementation outcomes include the effects of the activities that are undertaken during the entire process including adoption, acceptability, appropriateness, fidelity, feasibility, cost, penetration, and sustainability.[14] Focusing on and measuring implementation outcomes allow users to identify successfully implemented programs, identify gaps that need to be addressed and make decisions about future implementation efforts.

The IQR-SIM is intended for use by simulation center leaders, curriculum developers, and operations staff to plan, evaluate, and augment the implementation quality of their courses. If desired, external evaluators can provide an independent perspective regarding the implementation process. All evaluators should undergo rater training in using the IQR-SIM to ensure accuracy of rating.[25]

Strengths of This Study

The strengths of this research are 3-fold: the methodology used; composition of the expert panel; and the use of the blueprint. Specifically, the modified Delphi method allowed for administering the survey questionnaires electronically, facilitating the inclusion of experts from different countries. The anonymous nature of the process allowed the participants to contribute without the influence of dominant individuals who could potentially disproportionately impact the outcomes.[15,16] The engagement of participants in the process with provision of comments and suggestions in all rounds was constructive and helpful in the design and definition of the rubric. An important lesson of this study was the need for clear and specific instructions to avoid participant misunderstanding. In Round 3, we revised the instructions to include examples of minimal and maximal changes, which resulted in more concrete answers. Piloting the questionnaire is an essential step in ensuring clarity of instructions, estimating the time required to complete the survey and strengthening validity for its use.[28,29]

Another strength is the involvement of key experts from simulation-based education who are highly experienced and are involved in the implementation of simulation-based courses in different health professions. The selection of individuals to partake in Delphi processes should rely on not only knowledgeable participants but also those who will use the results of the Delphi and who will promote its use.[16,30] The panel represented a group who will potentially use the IQR-SIM to evaluate the quality of implementation of their own programs. The selection of the panel and the Delph process ensured that IQR-SIM is highly contextualized to simulation-based education in health care.

An additional strength of the study is the use of an initial blueprint in Round 1 as a foundation for the rubric, encompassing all the essential and critical components that need to be considered when planning for implementation. This made it convenient for the expert panel to evaluate the items and provide feedback in the comment section, which was later integrated in the succeeding rounds.

Limitations

There are a few noteworthy limitations. The expert panel represented nine countries only from North America, Australia, and Europe. Almost half of the experts (n = 16/33) were medical doctors; we suspect that the same implementation challenges would be apparent across different professional groups, but this should be established. The nonphysician group (n = 17) consisted of varied professions, which is a strength as we become more cognizant of the importance of diversity, representation, and inclusivity.

Some of the IQR-SIM items may be less relevant or applicable in other cultures and contexts, especially more resource-limited settings. Within this limitation, we believe that the opportunity to nominate colleagues from other institutions extended representation. A recommended way to increase the number of participants is to solicit nominations from a target group of well-known and respected experts, as was done here. This ensures the inclusion of a well-dispersed participant group who is able to provide qualified input regarding the topic.[16] The finding that items critical in practice were eliminated by the Delphi suggests the limitations of the Delphi procedure. The iterative, time-consuming nature of the Delphi process, combined with the isolated context of an online survey, may have limited the panel's in-depth analysis of what each statement and anchor entailed. The steering group's decision, after reflection and consideration, to revise and return an eliminated item demonstrates the "double-edged sword" nature of the Delphi process, in which investigators tend to influence the results.[16] The steering group, relying on their own experience and expertise in implementation of simulation-based courses, aimed to arrive at a final rubric that would be logical and practical to use.

Future Directions

The development and modeling of the IQR-SIM is only the first step of a long-term research program. To further explore

the IQR-SIM's applicability, feasibility, utility, and sustainability, we plan to pilot the IQR-SIM in simulation centers representing different expertise and resources, training modalities, and learner groups. Our Delphi process for instrument development provides initial content evidence supporting the validity of the IQR-SIM. We plan to collect additional validity evidence from various sources, as suggested by the contemporary validity framework of Messick, to ensure that interpretations and decisions based on IQR-SIM scores are valid and defensible.[29] We encourage future users of the IQR-SIM to publish their experience to further strengthen validity evidence for its use.

CONCLUSIONS

The IQR-SIM is a promising operational rubric developed with input from key experts in simulation and implementation of simulation-based courses. Simulation center directors, educators, curriculum developers, and operations staff can use this tool collaboratively to plan, evaluate, and enhance the implementation of their simulation-based courses, toward the goal of improved patient care for all.

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