Setting an Agenda

Results of a Consensus Process on Research Directions in Distance Simulation

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Background: The COVID-19 pandemic forced rapid implementation and refinement of distance simulation methodologies in which participants and/or facilitators are not physically colocated. A review of the distance simulation literature showed that heterogeneity in many areas (including nomenclature, methodology, and outcomes) limited the ability to identify best practice. In April 2020, the Healthcare Distance Simulation Collaboration was formed with the goal of addressing these issues. The aim of this study was to identify future research priorities in the field of distance simulation using data derived from this summit.
Methods: This study analyzed textual data gathered during the consensus process conducted at the inaugural Healthcare Distance Simulation Summit to explore participant perceptions of the most pressing research questions regarding distance simulation. Participants discussed education and patient safety standards, simulation facilitators and barriers, and research priorities. Data were qualitatively analyzed using an explicitly constructivist thematic analysis approach, resulting in the creation of a theoretical framework.
Results: Our sample included 302 participants who represented 29 countries. We identified 42 codes clustered within 4 themes concerning key areas in which further research into distance simulation is needed: (1) safety and acceptability, (2) educational/foundational considerations, (3) impact, and (4) areas of ongoing exploration. Within each theme, pertinent research questions were identified and categorized.
Conclusions: Distance simulation presents several challenges and opportunities. Research around best practices, including educational foundation and psychological safety, are especially important as is the need to determine outcomes and long-term effects of this emerging field.
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The advent of COVID-19 and "social distancing" forced a rapid shift within the simulation community toward "distanced" modalities of simulation-based education.[1] While the current nomenclature surrounding this mode of simulation is still being debated, for the purpose of this article, "distance simulations" are defined as those simulations in which some combination of participants, facilitators, operators, or equipment is in different physical locations while interacting synchronously (ie, no separation in time). Given the pressing need to maintain educational activities, there was little time to generate the rigorous research base needed to assure the effectiveness of distance simulation techniques. This constitutes a significant gap, as a proper theoretical and evidential foundation is needed for the optimal development, growth, and evaluation of distance simulation.

The number of different arrangements of distance simulation explored in the literature is limited when compared with the current proliferation of techniques,[2–6] and few relevant conceptual frameworks have been described.[7,8] A recent review of the literature revealed a wide variety of simulation modalities that have been adapted to a distance format, including procedural simulations, standardized patient-based encounters, and clinically immersive experiences.[9–14] Similarly, a number of different participant configurations have been represented, with some having a portion of participants "on-site" (in a simulation center or hospital setting), with other participants or facilitators remotely located[12,14]; in other studies, participants were clustered in 2 or more disparate geographic locations[15,16] (eg, 2 or more different states or countries), while in a third category, participants were entirely remote, each participating from a separate location.[17] Notably, many studies were primarily descriptive in nature,[5,11,15] or focused on attitudes toward, or acceptability of, the distance simulation activity.[5,18] The overall landscape of studies was lacking randomized controlled trials and studies comparing distance simulation delivery modes.

In response to this need, the Healthcare Distance Simulation Collaboration was founded and conducted an Inaugural Healthcare Distance Simulation Summit[19] supported by 4 leading pediatric simulation societies: the International Network for Simulation-based Pediatric Innovation, Research, and Education (INSPIRE),[20] the International Pediatric Simulation Society (IPSS),[21] the Pediatric Simulation Training and Research Society (PediSTARS, based in India),[22] and Netzwerk Kindersimulation (NKS, based in Germany).[23] This summit resulted in a rich array of textual and recorded data. In this article, we describe the conduct of the summit consensus process and the subsequent analysis of these data to generate a focused list of research priorities in distance simulation. It is our hope that these results can offer the simulation community a mutually agreeable framework to begin conducting this needed work.

METHODS

This prospective research used a 2-phase process: (1) a consensus summit focused on key questions in distance simulation research at the Inaugural Healthcare Distance Simulation Summit and (2) subsequent collation and analysis of the resulting textual data using a qualitative approach. This research was deemed exempt from continuing institutional review board review.

Phase 1: Consensus Summit

Summit Implementation

The core members of the Healthcare Distance Simulation Collaboration determined that the summit should address 2 basic areas: (1) development of a common nomenclature or taxonomy and (2) guidance as to the most critical areas for exploration and research for distance simulation. Planning team members included simulation experts from a wide array of simulation societies representing regions including Europe, North America, and India (Table 1).

The healthcare distance simulation summit was 3 hours in length and was scheduled at a time that allows participation across multiple time zones (Friday, August 21, 2020, from 10:00 to 13:00 EDT). The summit committee used a constructivist framework to engage participants in a process of validating existing knowledge and using the collective experiences of the contributors to build new knowledge.

The first hour was dedicated to updating participants on the current status of distance simulation nomenclature, reviewing relevant conceptual frameworks, and discussing the findings of our initial scoping review. Participants then spent 2 sequential hours in 1 of 10 small group virtual breakout rooms. There were 302 attendees from 29 countries (Table 2). Attendees self-identified as interested or expert in the area of distance simulation and anyone was welcomed to sign up for the summit. We advertised for the summit through social media channels of all 4 participating organizations and their annual meetings. The summit was free of charge for participants and administrative cost was covered through voluntary donations. The registration platform was open and available to anyone.

One discussion group was facilitated in German and was composed of attendees who had identified themselves as German speaking when they signed up for the summit. The remaining attendees were randomized to 9 group discussions that were

TABLE 1. Facilitator Demographics

Variable	N = 18 (%)
Country	
Austria	1 (5.6)
Canada	1 (5.6)
India	2 (11.1)
Sweden	1 (5.6)
United States	13 (57.2)
Occupation	
Physician	15 (83.3)
Educator	2 (11.1)
Other	1 (5.6)
Role in simulation center	
Director	8 (44.4)
Faculty	5 (27.8)
Fellow	1 (5.6)
Other	4 (22.2)
Sex	
Male	6 (33.3)
Female	12 (66.7)
Years of experience in simulation education, mean (SD)	12.1 (3.7)
Years of experience in simulation research, mean (SD)	9.6 (3.9)
Average no. distance simulations per month over the past year, mean (SD)	6.4 (11.5)

TABLE 2. Attendee Demographics (Participants Might Have Several Roles Within Simulation)

Variable	N = 302 (%)
Country	
Australia	7 (2.3)
Austria	7 (2.3)
Brazil	2 (0.7)
Canada	13 (4.3)
China	3 (1.0)
Germany	5 (1.7)
India	49 (16.2)
Nepal	2 (0.7)
Norway	3 (1.0)
Qatar	5 (1.7)
Switzerland	3 (1.0)
United Kingdom	16 (5.3)
United States	171 (56.6)
Unknown	16 (5.3)
Occupation	
Child life specialist	4 (1.3)
Educator	20 (6.6)
Industry	4 (1.3)
Nurse	31 (10.3)
Physician	194 (64.2)
Researcher	7 (2.3)
Resident or fellow	21 (7.0)
Simulationist	12 (4.0)
Other	9 (2.9)
Role within simulation	
Educator	258 (85.8)
Researcher	126 (41.7)
Technical support	11 (3.6)
Other	44 (14.6)
Network membership	
INSPIRE	94 (31.1)
IPSS	118 (39.1)
Netzwerk Kindersimulation	15 (5.0)
PediSTARS	25 (8.3)
Society for Simulation in Healthcare	113 (37.4)
None	107 (35.4)

facilitated simultaneously in English. During the first hour, participants discussed distance simulation nomenclature, and during the second hour, they addressed future directions and research questions in distance simulation. The focus of the remainder of this article is on the latter consensus exercise.

Group Implementation

Each discussion group was presented with the following 3 questions about distance simulation developed by the planning committee:

1) How do we ensure education and patient safety standards? (German/Deutsch: Wie können wir Ausbildungs- und Patientensicherheitsstandards sicherstellen?)
2) What are the facilitators/barriers that are impacting our future educational model? (German/Deutsch: Was sind unterstützende Faktoren/Hindernisse die sich auf unser zukünftiges Ausbildungsmodell auswirken?)
3) What research priorities are needed to achieve excellence in distance simulation innovation beyond the pandemic? (German/Deutsch: Welche Forschungs-Schwerpunkte sind notwendig um Exzellenz in Innovationen der Fern-Simulation über die Pandemie hinaus zu erreichen?)

The 3 questions were developed through iterative videoconference discussions until consensus was reached. Facilitators were oriented during 2 videoconference sessions and familiarized with our response documentation tool. Questions were posed sequentially to group participants, and responses were documented using Mural (Tactivos, Inc, San Francisco, CA).[24] This software effectively creates the digital equivalence of a "sticky note," allowing users to "paste" answers to the questions, and associated comments, in pictographic areas beneath the associated question (Fig. 1). Facilitators were also instructed to record observations and notes regarding key aspects of the discussions on the Mural board. All responses were deidentified. During the last half hour of the session, responses indicating the most pressing research questions and issues in distance simulation were aggregated in a collective area of the mural board and presented to all summit attendees at a summary large group session.

Phase 2: Qualitative Data Analysis

The collected Mural notes represent the primary data output of the consensus process and were used as the textual base for the qualitative process conducted in this phase. An explicitly constructivist open-coding, thematic analysis approach was adopted,[25] as it was the team's intent to create and present a useful theoretical framework synthesized from comments by session participants. Copious research notes were maintained during the analytic process to assure reflexivity by team members, and individual perspectives brought by those involved in the coding process were explicitly acknowledged and discussed during research meetings.

Qualitative Analysis of Data

Data analysis was conducted by a subgroup of the authors with expertise in pediatric simulation, distance simulation, qualitative research methodology, and scientific writing. Initial coding was conducted independently using raw data from Mural by 4 team members (A.A., M.W., E.S.D., B.W.). During the coding process, the researchers incorporated a reflexive thematic analysis approach,[26] whereby we maintained the questions that we used to prompt the participant discussions to identify relevant data while explicitly interpreting responses in light of potential future research questions that could be derived from them. As all researchers on the study had at least some experience with diverse distance simulation modalities, this expertise was also deliberately brought to bear when formulating codes and themes. These codes were then triangulated in a series of 8 iterative videoconference discussions, resulting in a final list of codes. There were substantial similarities between the coding schema developed by these individuals, and it was thus felt that a level of thematic sufficiency appropriate to the goals of the project had been obtained after 8 cycles.

After this exercise, 2 additional members of the author team experienced in qualitative analysis (A.C., T.C.C.) independently synthesized the final coding through thematic analysis. As highlighted by Creswell,[27] aggregated similar codes become categories, which are then compiled into themes. In qualitative research, themes are identified to help researchers understand central phenomenona. As in the previous coding process, these larger themes were deliberately constructed with reference to a potential future research agenda. The iterative process of generating and confirming the emerging codes and themes resulted in

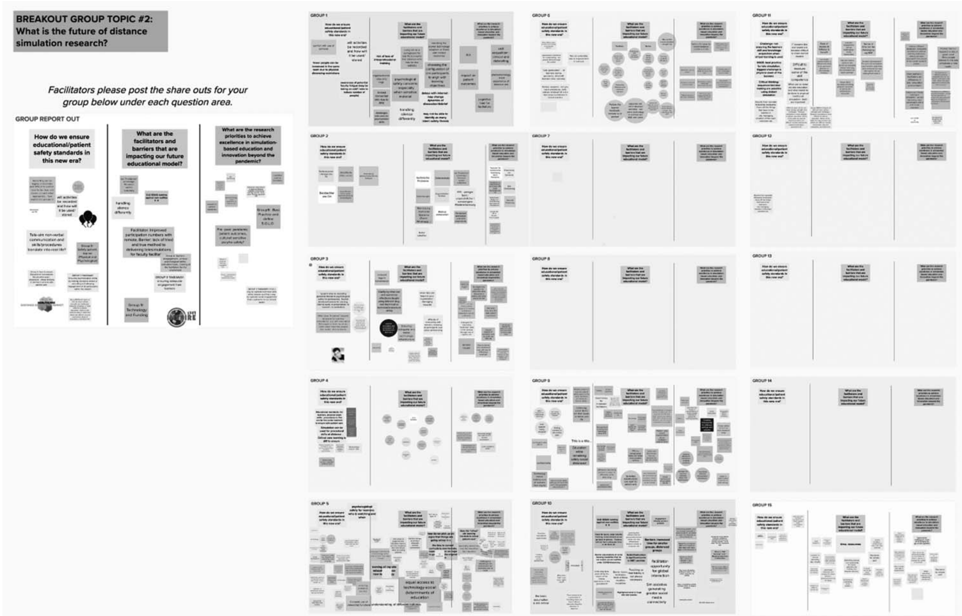

FIGURE 1. Mural (Tactivos, Inc) board digital "sticky note" allowing users to comment movable notes in pictographic areas beneath the associated question.

a common list of categories and themes. A final list was presented for review to the original consensus group for final triangulation and ensuring that the research questions were adequately addressed.

RESULTS

The coding process resulted in 42 codes nested within the original questions posed to participants in the summit. The final coding list is depicted in Table 3.

Exploration of Prominent Codes

Nine of these codes arose repeatedly during the coding process and were ultimately seen as potentially larger in scale and hence indictive of possible broader themes. These were psychological safety, procedural skills, realism/fidelity, learner participation/engagement, accessibility, and outcomes. We explore these codes below in greater detail and provide salient participant comments from the summit.

Psychological Safety

Concerns about psychological safety were pervasive and permeated many of the comments made by participants. Discussion included how to best assure (or define the limits of) psychological safety both as a discrete consideration for learners and as a factor impacting many of the other codes that emerged. Attendees discussed ground rules for recording video as this presents potential threats to psychological safety for participants. Considerations included "explicit permissions for use of the recordings," as well as clear declarations as to their potential use (eg, internal audit, presentation) and the need to clarify "who might be watching the videos if recorded and how they are being stored." The importance of informed consent was raised, as was the need for learners to understand the purpose of the recordings, as both were felt to impact the learners' engagement in the actual distance simulation as well as their participation in the debriefing. There were also many concerns regarding how chat and video functions affect confidentiality. However, the latter was felt to be similar on some level to the confidentiality issues raised by the video recording of standard in-person simulations.

Procedural/Psychomotor Skills

The overarching concern was how to best teach psychomotor skills. Whereas a few participants thought that "some psychomotor skills are easy to teach" and distance simulation "can be used to develop procedural skills," most participants voiced concern over how to develop appropriate muscle memory, physical evaluation skills, and procedural techniques if the interaction is solely screen based (eg, the learner is not in direct contact with the physical components of the procedure). For example, one group quote acknowledged a takeaway of distance simulation was "finding a way to replicate technical skills within telesim… that is authentic to the clinic space." Participants voiced concern as to whether skills and procedures learned "translate into real life" and cautioned about assuming equivalency between in-person and virtual learning. In addition, the feasibility of virtual assessment and measurement of procedural skills was questioned ("difficult to measure some of the skill competence") with concerns centering on whether and how standards for credentialing during evaluations such as Objective Structured Clinical Examinations could be established in the distance environment. Other questions raised included how to bridge the gap of skill acquisition without physical presence, how to replicate technical skills within distance simulation, and whether haptics or other technological developments cold profitably be used here.

Realism and Fidelity

Participants commented frequently about difficulties in assuring the realism of both case presentation and learner interaction during distance simulation. The question of what degree of realism/fidelity is necessary or appropriate was also raised. One group questioned the "representation of reality" (fidelity) necessary to achieve Sim learning objective, as this could vary widely between institutions. Another group asserted that similar

TABLE 3. Codes Identified Divided by Questions Posed to Group

Question 1: How Do We Ensure Education/Patient Safety Standards?	Question 2: What Are the Facilitators/Barriers That Are Impacting Our Future Education Model?	Question 3: What Research Priorities Are Needed to Achieve Excellence in Simulation Innovation Beyond the Pandemic?
Address psychological safety	**Missed responses, especially from silent learners**	**Factors affecting psychological safety**
Maintain realism	**Emotions, nonverbal cues,** gestures, body language not always evident	**Differences in learner engagement in the simulation activity**
Consider whether psychomotor skills can be adequately taught	**Access (may be enhanced for low resource areas)**	**Differences in how learners engage and interact with others**
Consider whether authenticity of teamwork, communication, **and leadership may be lost or reduced**	Time requirements may be increased	**Differences in learner outcomes, including long-term effects**
Address confidentiality	Technology causing lags in responses to questions	Tasks, skills, and procedures that can be taught effectively
Conduct prebriefs, emphasizing expectations	Increased no. participants	Impact on knowledge, experience, and decision making
Promote active engagement	Variable technology expertise	Value/return on investment
Require facilitator training for this modality	Variable technology quality	Tasks or subjects not ideal for distance simulation
Align checklists with objectives	Convenience	Impact on patient care
Provide performance feedback	Impingement by distractions	Time requirements and differences
	Time (eg, physiologic response development) may be unrealistic	Adequacy of existing assessment methods applied to distance simulation
	Decreased standardization	Cognitive load and stress levels
	Cultural differences	Best practices
	Limited view (bidirectional)	Differences in frequency of simulations
	Privacy/consent	Facilitator comfort and training
		Human factors and relationship with the technological environment
		Debriefing style differences
		Survivability of distance simulation beyond pandemic

Boldface type indicates the most commonly identified codes.

levels of fidelity can be reached across modalities within distance simulation. Discussion addressed the degree of fidelity that would be optimal for different types of distance simulation. Groups also discussed how the "suspension of disbelief" required for simulation may change when distance modalities are used.

Learner Participation and Engagement

The "difficulty of connecting with learners, involving all participants over video conferencing" emerged as a theme. It was noted that "learners' engagement can be challenging as they are easily distractible." Participants discussed the optimal way to assure that learners stayed engaged both cognitively and emotionally during distance simulation sessions. Several strategies were considered important to increase participation and engagement, such as having the moderator ask questions, use digital whiteboards (eg, Mural), and request that learners turn on their videos and perform specific tasks (eg, moderate, share the screen, write protocols, focus on specific discussion points). One idea from the group to enhance engagement was to develop deliberate mechanisms to involve "disengaged learners" and learners who do not actively participate, suggesting that "observers should be engaged, e.g., have a checklist etc. to give them a role." Participants noted that breaks are advisable for long sessions. Finally, there was concern regarding the "ability to connect with challenged learners/upset learners."

Accessibility

Concern was raised regarding accessibility, given distance simulation's dependence on adequate Internet bandwidth and appropriate telecommunication/computing equipment. Participants discussed the need for buy-in and sufficient equipment and infrastructure, particularly given that "tech/infrastructure is significant barrier in LMIC countries," as we need to support stable distance simulation on a consistent basis. Issues discussed included training faculty and students to use new technology, having technical support resources available in real time, baseline stability of the Internet connection, and "methods to access technological advances when funding might be available." Several topics were quite thoughtful: "access to technology is a social determinant of education," and "technology-related transmission delays may change the dynamics of discussion/debrief."

Outcomes

Participants questioned how to evaluate the comparability of both educational outcomes and outcome assessment processes between in-person and distance simulation in the context of both individual learners and teams. Participants asked whether checklists or other assessment tools that many educators use when evaluating trainees in person can be translated to the distance environment while still retaining validity: "evaluation tools currently used might not be relevant to new environment." Thus, tools might need to be updated or faculty may need to develop new tools specific for distance simulation. Furthermore, once new tools are potentially developed, "validation of assessment tools to new environment" will be the next step. Participants were concerned that psychomotor skills are more challenging to assess during distance simulation than knowledge and behaviors. Clarification about what can and cannot be assessed fairly using distance simulation has direct bearing on our ability to determine what can and cannot be taught effectively in this way, as without assessments that are effective in both environments it becomes difficult to compare outcomes in a meaningful way.

Participants also asked, "What is the clinical outcome and impact?" of distance simulation and can it improve actual patient care outcomes? One comment from the Mural board was: "what assumptions can we make about outcomes when translating a curriculum to a new format but otherwise not changing?" Several more topics bear mentioning, as they emerged as concepts of significant concern for all groups: (1) "extent of learning with these modalities," (2) "valuable learning happening or not happening," and (3) "how these modalities are outcome comparable."

Categories and Themes

Further synthesis of the Mural material led to 4 dominant themes encompassing 12 categories that summarize opportunities and concerns related to distance simulation now and in the future and hence can be used to define a comprehensive research agenda. These are presented in Table 4.

DISCUSSION

The COVID-19 pandemic has challenged educators across the world to adapt to distance teaching methods, including distance simulation. We describe the conduct of a consensus summit focused on research needs and a subsequent qualitative analysis process intended to synthesize the summit proceedings into a practical agenda. It is our hope that these results can offer the simulation community a mutually agreeable framework to begin conducting needed research about distance simulation.

In-person simulation-based education has been shown to be an effective tool for education in healthcare.[28] Evidence demonstrating the benefits of distance simulation compared with in-person simulation, however, is limited.[29,30] Distance simulation is heterogeneous, and there are different technical setups, platforms, and technological equipment that may be used. It is imperative for our simulation community to carefully study what works best and how we can best teach using simulation from a distance. We will need to leverage many simulation networks implementation modalities to tackle these broad and important concepts.[7]

In this study, we identified 4 main themes worthy of further research in distance simulation: safety and acceptability, foundational considerations, impact, and areas of ongoing exploration. We next explore each of these themes as they relate to potential future research.

TABLE 4. Distance Simulation Themes and Research Questions Listing Central Phenomena and Considerations Required of Techniques and Methods to Best Use Distance Simulation in the Present and Future

Themes	Categories
Safety and acceptability	Psychological safety
	Participant data security
	Sufficient realism and fidelity to meet standards and objectives
Educational/foundational considerations	Accessibility of technologies
	Learner and facilitator preparedness
	Effect on learning process
	Effectiveness of assessments
Impact	Economic impact
	Impact on patient and institutional outcomes
	Associated time and resources
	Ability to prepare large no. learners in convenient spaces
Areas for ongoing exploration	Foci for technological development
	Unique opportunities
	Utilization beyond the pandemic

Safety and acceptability concerns both the learner's own perception that the distance educational environment is a safe one in which to take interpersonal risks without fear of embarrassment, rejection, or punishment, as well as more practical considerations regarding data storage and security. It also embraces questions of fidelity and realism. Here, the common research thread is the rigorous determination of the conditions under which learners feel both comfortable and engaged in this new environment.

Efforts to create and maintain psychological safety often focus on defining the extent of confidentiality, explaining potential consequences based on performance, modulating adverse (simulated) patient outcomes, and considering ethical implications. These psychological risks are related not only to interactions between the immediate participants in the simulation but also to information obtained by others. When participants are in physical proximity, a "safe container"[31] can be created, but when participants are connected electronically, there are more opportunities for known or unknown persons to observe or record the simulation or review the overall results. Addressing research questions in this area will require a mixture of theoretical/conceptual work alongside practical evaluations of specific strategies that impact perceptions of security in this environment.

Foundational and educational considerations include a wide array of questions including how to translate widely accepted educational and debriefing frameworks into the distance environment, how to prepare faculty, and how to optimize access to appropriate technology.[8] The common thread is the groundwork needed to assure a well-constructed educational environment that addresses the needs of learners, facilitators, and operators and allows them an equivalent "playing field" in which to explore new knowledge and skills. Given that many practical aspects of faculty preparedness for simulation and debriefing stem from well-known theoretical concepts in adult learning, we can easily envision a series of research questions that begins with qualitative examination of how existing frameworks might be adapted to this new environment. This process may end with quantitative measurements of the comparative effectiveness of training and debriefing interventions based on these altered frameworks.

Access to technology presents a different challenge. In the previous studies, lack of access to a stable Internet connection, a fast processing computer, and good audio-capturing systems have been identified as some of the most important barriers.[29] It will be important to explore how to develop equity in access to appropriate technology as well as how to provide facilitators with the necessary skills to lead distance simulations.[6] Distance simulation allows facilitators to generate a shared experience while decreasing travel time and costs. Further technological advances may broaden access to and capabilities of distance simulation. Further studies are needed to optimize the distance simulation learning environment.

Impact represents the third category and includes outcomes at the patient, institutional, and economic levels. As the pandemic lessens in severity and many centers move to a more balanced "hybrid" mixture of in-person and distance simulation, the ability to conduct comparative studies between in-person and distance modalities will increase. Such efforts are needed and will enable us to better quantify how these new methods can best be used. Teams performing such studies should be encouraged, however, to look beyond simple knowledge transfer and attempt to gather higher-level outcomes data. How do distance simulation-based interventions affect, for example, medication errors? How do they impact rapid response rates and is this impact different from those generated by corresponding simulation center or in situ simulations addressing similar content?

It is also critical that financial and staffing impacts be considered. Does the use of distance simulation enable time-saving on the part of participants and can that be leveraged to provide greater access to and volume of education? Is distance simulation more cost-effective at an institutional level? These are complex questions, and a multitude of research strategies will be needed to address them. Distance simulation will have an impact on economics and outcomes beyond the current COVID-19 pandemic, and care must be taken to integrate this longer view.

Finally, areas for ongoing exploration represents a recognition by our team of both the rapid change and external pressures that have brought us to the current point and the fact that this process is far from complete. While we cannot predict what new telecommunication and telepresence technologies may be on the horizon, it is almost given that these will impact the development of distance simulation as a field. It is therefore incumbent upon us to closely follow technology developments so that their potential utility to simulation can be assessed in a timely manner.

Limitations

Our study has 3 main limitations. Our team used a virtual whiteboard tool for the recording of short phrases. While valuable as a means of furthering discussion, this process left a reasonable amount open to interpretation by coders. This was mitigated somewhat by both the presence of more detailed notes within the mural data and by the fact that each coder was also present at these discussions (giving them firsthand experience of their context on which to base their analyses). Furthermore, given the international nature of the summit, linguistic differences and interpretation between groups likely exist, as some words and thoughts simply do not translate between different languages in a one-to-one manner. Last, while we aimed for inclusivity and diversity in our conference attendees and in the data analysis team, most attendees and investigators were physicians and the predominant subspecialty was pediatrics. This was largely due to the fact that most of the members of the founding team were pediatrics oriented and that most of our summit advertising was executed through pediatric-oriented simulation societies. We acknowledge that a more deliberately interprofessional group may have organized the final framework differently.

CONCLUSIONS

Distance simulation presents both challenges and opportunities. By focusing initial research efforts on questions of safety and acceptability, foundational conceptual and training considerations, impact/outcome, and areas of ongoing exploration and development, it is our hope that a comprehensive and forward-thinking program of research surrounding distance simulation can be developed. Such a program is needed if distance simulation is to develop the broad scholarly base needed for its ongoing growth and success.

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