Education Article

INTERNATIONAL JOURNAL OF SURGERY: GLOBAL HEALTH

OPEN

Vital Anaesthesia Simulation Training (VAST); immersive simulation designed for diverse settings

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Abstract

Simulation-based education (SBE) of health care providers is ubiquitous in well-resourced locations and has been used successfully to teach clinical and nontechnical skills. Numerous barriers prevent this important educational tool from widespread use in resource-limited and remote settings. Vital Anaesthesia Simulation Training (VAST) was founded with the aim of promoting the use of vivid, experiential simulation-based learning regardless of location. As an organization, VAST now offers a range of training opportunities. The 3-day VAST Course is a highly portable program that uses low-cost materials to teach core perioperative practices and non-technical skills for health care practitioners in diverse settings. The VAST Course is paired with the VAST Facilitator Course to build skills for SBE among local educators. The VAST Design Course equips simulation facilitators with tools for developing their own simulation scenarios. The VAST Foundation Year is a 48-week curriculum of active learning sessions for early anesthesia trainees, made available to VAST facilitators. This manuscript describes many of the challenges faced when delivering SBE in varied environments and indicates VAST's strategies to help overcome potential barriers. An overview of the VAST scenario template and stepwise approach to scenario design is included (Supplemental Digital Content 1, http://links.lww.com/IJSGH/A14). While challenges facing SBE in resource-limited settings are significant, its potential value in this context is immense. VAST offers a viable platform for expanding SBE beyond the traditional simulation center.

Keywords: Simulation, Resource limited, Faculty development, Simulation design

Background

Simulation has a long and varied history in medical education. Simulation-based education (SBE) can provide immersive, experiential learning that allows participants to develop knowledge, skills, and attitudes without harm to patients[1]. From ancient carvings and clay anatomic models to 18th century birth simulators teaching midwives and surgeons skills to assist with childbirth, simulation has often played a central role in medical training[2]. The first half of the 20th century was a "dark-age" for simulation, with students and trainees learning skills on patients[3]. SBE re-emerged in the 1960s with the full body simulator, SimOne, with features akin to current "high-fidelity" mannikins[4]. Over time, SBE has been integrated into health care provider training and professional development[1].

Despite SBE for health care being widespread in well-resourced locations, there are many obstacles preventing its ubiquitous dissemination in resource-limited and remote settings. A simulation center typically includes a dedicate space, skilled staff, sufficient equipment, and technical support[4], all of which require substantial funding. Successful examples exist where simulation centers have been established in resource-limited settings[5–7]; however, cost and logistical constraints usually preclude widespread delivery of SBE in this manner[8]. Furthermore, reliance on a dedicated center impedes delivery of SBE in rural and remote settings.

The challenges facing health care provision in resource-limited settings are extensive. Personnel and resource shortages contribute to avoidable death and disability in surgery and anaesthesia[9,10]. Of the 234 million major operative procedures performed annually, only 3.5% occur in low-income countries, despite their accounting for one-third of the global population and the majority of the global burden of disease[11]. SBE is arguably of greater imperative in resource-limited settings compared with well-resourced systems[12]. Educational initiatives are a viable way to train leaders and teachers

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This manuscript has been peer reviewed.

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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International Journal of Surgery: Global Health (2021) 4:e64

Received 31 August 2021; Accepted 14 September 2021

Published online 6 October 2021

Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website, www.ijsglobalhealth.com.

http://dx.doi.org/10.1097/GH9.0000000000000064

who can build skills among diverse cadres of health care providers[13]. Low-cost simulation has demonstrated capacity for improvement of both clinical and behavioral skills of participants in resource-limited settings[5,14,15].

Vital Anaesthesia Simulation Training (VAST) was founded in 2017 with the goal of providing effective SBE regardless of context. Based on a longstanding partnership between Dalhousie University and the University of Rwanda[6,15,16], VAST evolved as a collaboration among educators in high- and low-income countries. These partners were central in content development and in ensuring that resources are authentic, reflecting clinical care across a broad range of settings. The Scottish Centre for Simulation and Clinical Human Factors has been a collaborator since inception. VAST works with the World Federation of Societies of Anaesthesiologists and anesthesia societies from high- and low/middle-income countries to deliver its programs. Key programs offered by VAST include the VAST Course, VAST Facilitator Course, VAST Design Course, and VAST Foundation Year.

The VAST Course is a 3-day immersive, interdisciplinary simulation-based program designed to teach core perioperative practices and nontechnical skills. Using simple, low-cost materials and thoughtful design, the course is highly portable and deliverable across diverse settings. Driven by the need to increase access to safe essential surgery and anesthesia, the clinical content centers on essential surgical procedures commonly performed in district hospitals. These surgeries are hallmarks of a health care system's ability to conduct other primary care procedures[17,18]. The VAST Course has a demonstrated ability to improve participants' nontechnical skills, with skill retention at 4 months postcourse[19].

The VAST Facilitator Course (VAST FC) trains health providers and educators to ultimately function as VAST Course simulation faculty. Following the VAST FC, trainee-facilitators are mentored in applying new simulation skills during subsequent VAST Courses. The VAST Design Course equips simulation facilitators with tools for developing their own simulation scenarios suitable for their unique working environments and learners. The VAST Foundation Year is a 48-week curriculum of active learning sessions for early anesthesia trainees, made available to VAST facilitators.

Since 2018, VAST's courses have been offered in varied locations, from remote district hospitals in Rwanda to tertiary care hospitals in Canada. Delivering simulation-based education in resource-limited environments poses unique challenges. VAST's simulation materials and pedagogy are tailored with this in mind. Scenarios have been pilot tested in the "field" and continue to undergo iterative refinement. The following description highlights many of the challenges faced when delivering SBE in varied environments and indicates VAST's strategies to help overcome potential barriers. A central tenant of VAST's teaching materials is consistency and ease of use; **Table 1** outlines the features of VAST's Scenario Template. Blank templates can be found on the VAST website, http://www.vastcourse.org.

Resource limitations

The need for expensive, fragile, high-cost simulation technology limits widespread access to SBE[8]. VAST embraces the concept of "functional task alignment" or the correspondence between what the simulator does and real-life tasks where new learning will be applied[21]. Expensive high-fidelity simulators are not necessarily better than low-cost simulators for teaching communication and behavioral skills[15,22]. Maran and Glavin[23] argue that psychological fidelity, or emotional buy-in, is more important than physical fidelity, or the look of the simulator. Vivid, experiential learning in VAST is created with simple props and course participants who are briefed to function as simulated patients according to prescripted roles. Courses aim to include a realistic interdisciplinary team, with participants functioning in their own clinical roles, thus building sociological fidelity[24]. Blank walls are transformed with large posters reinforcing key clinical frameworks and treatment algorithms covered during the VAST Course. Essential equipment and empty labelled drug syringes are systematically organized into 3 open containers: (1) airway, (2) breathing, (3) circulation + drugs. This simple arrangement of equipment allows for rapid participant orientation and ease of use during scenarios.

Realistic, yet economical, remotely controlled patient monitoring is created by using the SimMon app (available at https://apps.apple.com/au/app/simmon/id364731597). Refurbished tablets are pair over Bluetooth. Scenario participants see and hear changes to the vital signs in real time. Each scenario includes relevant clinical documentation (eg, patient observation chart, photographs of pathology, x-rays) to further build realism. Wherever possible, course participants are integrated into the scenario as simulated patients, obviating the need for expensive simulation mannikins. Task trainers are only used when an invasive clinical procedure is required.

To compensate for the lack of a control room and ability to unobtrusively watch the scenario unfold, the boundaries of the simulation space are demarcated with tape on the floor. Facilitators and scenario observers remain behind the line or "outside" of the scenario. A co-facilitator supports the scenario from within, always playing a central supportive role, such as a ward nurse providing initial patient handover. Lacking headsets, communication between the facilitator and scenario confederates is by briefing cards with prescripted prompts. If required, the facilitator initiates the use of a prompt by tapping the shoulder or giving a hand gesture to the appropriate person in the scenario. In a simulation center with headsets and a control room, briefing cards are less essential but prescripted prompts may still be useful adjuncts to support scenario progression.

Experience with simulation

For many, a VAST Course is the first exposure to simulation training[19]. It is essential that participants receive adequate prebriefing and orientation to the simulation space[25] and have an opportunity to develop prerequisite knowledge and skills for meaningful engagement in the scenarios[26]. The spiral curriculum[27] of the VAST Course begins with precourse reading and preparation. During the course, case-based discussions and skills workshops are strategically timed to precede simulation scenarios, priming participants with core clinical content and skills for performance. Facilitators can scale the difficulty of individual scenarios in real time, tailoring the scenario to optimally challenge an individual/group, in keeping with best practices for SBE[28–30]. As the course progresses, scenarios increase in complexity, moving from specific clinical tasks to team-based care of complex problems. Deliberate practice, whereby

Table 1
Overview of VAST's scenario template.

Page	Overview	Content and Function
1	Scenario overview	Covers the core topic, learning objectives, and scenario summary
	Scenario setup	Details the required equipment and organization of the simulation space
		Allows for rapid orientation to the scenario
2	Briefing instructions	Lists the roles within the scenario, who is present at the start and who needs to be isolated
		Individual briefing cards and group briefing instructions are detailed for those "in" the scenario
3	Copy of briefing cards	The facilitator has a copy of the briefing cards given to individual roles in the scenario
		Cards include pertinent details of the role and prescripted prompts that the facilitator may use to progress the scenario forwards through the Transition Triggers, where required
4	Scenario sequence	A one-page run sheet for facilitating the scenario after entry of the lead participant/s that includes:
		Scenario *stages*, *each* linked to an individual learning objective
		Parameters for the patient's clinical condition at each *stage*
		Predetermined *Transition Triggers*, a key action that signifies enough material for debriefing has been attained to allow scenario progression to the next stage
		Prompts for use by the facilitator, if required, to support participants' progress in order to attain the *Transition Triggers*
		Additional notes, including useful clinical information or resources that may be incorporated into the debrief
		Faculty keep the scenario on track while simultaneously running hardware and cueing prompts, where required
5	Debriefing guide	Contains 3 adjacent elements:
		A streamlined version of VAST's debriefing framework
		Scenario learning objectives mapped to key nontechnical skill elements[20]
		Space for facilitator notes; key observations to base the debriefing discussion
		Supports debriefing by providing structure, a focus on predetermined learning objectives and specific observations from the scenario

participants apply learning from reflective debriefing to future scenarios, is promoted. This consolidates behavior change from SBE[31]. Deliberate practice is supported by consistent themes interwoven across scenarios. Examples include using structured and repeated approaches to patient assessment and handover, teamwork, and communication skills. The VAST Course culminates with a commitment-to-change workshop, encouraging learners to reflect on practice changes they are would like to make following the course and to consider potential barriers and supports for making those changes.

Simulation faculty

Simulation facilitation, particularly debriefing, involves complex and nuanced skills that require significant practice to develop expertise[32]. For emerging faculty in resource-limited environments, the ability to acquire confidence and expertise is challenging. At a minimum, there are high clinical demands, little time for professional development and few mentors to guide refinement of new skills[8]. In addition, contextual factors, such as language and culture, potentially impact faculty development and subsequent delivery of SBE[33,34].

VAST's FC aims to efficiently orientate trainee-facilitators to the core roles of simulation facilitation and to provide a structured, accessible means for delivering and debriefing scenarios. As with the VAST Course, concepts are introduced in a spiral manner[27]. The facilitator role is initially divided into component parts. Trainee-facilitators first master individual elements, cushioning the steep learning curve for new skills[35]. Prerecorded simulation scenarios and role-play allow trainee-facilitators to become familiar with the core elements of debriefing and establish a strong framework upon which more advanced debriefing techniques are based. Debriefing practice initially focuses on familiar clinical content before incorporating more nuanced discussions on behavioral and communication skills. This structured model for debriefing stems from the Scottish Centre for Simulation and Clinical Human Factors and follows 4 distinct phases, *Reactions*, *Agenda, Analysis*, and *Take Home Messages*[36]. The framework is guided by central principles and techniques that support effective debriefing[37–39], while not being overly prescriptive in phrasing. As the VAST Course unfolds, facilitators debrief on themes relating to welfare, consent, complex decision making and conflict resolution.

The learning environment for VAST supports novice debriefers. Trainee-facilitators are mentored by experienced faculty and have a co-debriefer[40] present for assistance and redirection, where required. Comprehensive facilitator resources include key clinical information and cognitive aides for debriefing (**Fig. 1**). VAST FCs usually precede a VAST Course, allowing trainee-facilitators to immediately apply new skills. To foster an interprofessional team-based learning environment, VAST encourages the development of faculty from a range of clinical backgrounds. Facilitators may go on to teach the VAST Foundation Year, a 48-week curriculum that allows introduction of SBE in their own academic programs. **Tables 2** and **3** provide reflections on VAST from facilitators in Rwanda and Sudan.

Simulation support staff

Many settings lack access to dedicated simulation support staff. VAST makes a concerted effort to up-skill local, nonclinical personnel to the simulation support role. Potential candidates are identified by local VAST leads and communication begins with the VAST team precourse. This involves sharing of equipment checklists and a review of available in-country resources. Local simulation support trainees are encouraged to be available 2 days before VAST to work with the visiting team on preparing the

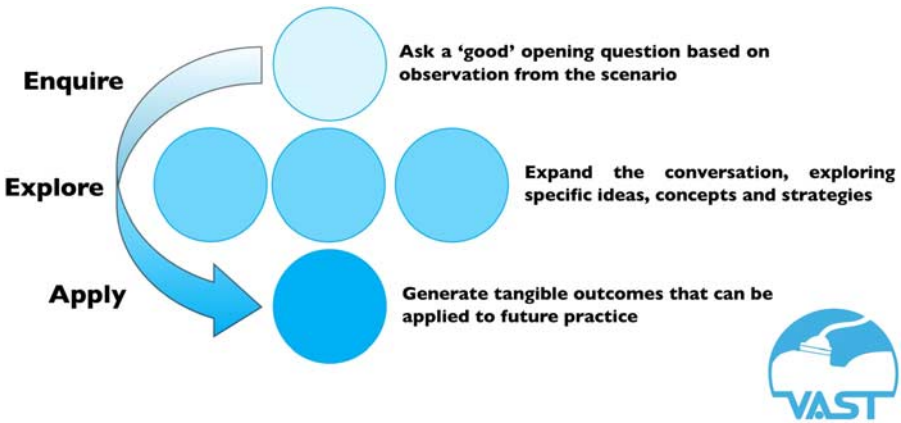

Figure 1. Distilling the conversation. This cognitive aid encourages facilitators to conceptualize how they will progress the discussion of each discrete topic during the analysis phase of debriefing. Pairing this approach with different conversational techniques helps participants to develop learning readily applicable to their future practice. VAST indicates Vital Anaesthesia Simulation Training.

equipment and space. Having local staff engaged in this supportive role is advantageous for assisting with logistics and building familiarity with the local context. During the course, experienced support staff mentor the local trainee staff so they are able to function independently. New support staff are encouraged to assist in delivery of future VAST Courses and to mentor others in this role. Centers are asked to designate a local custodian who can securely store VAST simulation materials for use during subsequent courses.

Teaching materials

SBE in resource-limited and remote locations requires dedicated, contextually appropriate, user-friendly teaching materials[7]. VAST's clinical content and available equipment is intentionally drawn from a case-mix reflective of care at the district hospital level. When delivering VAST in well-resourced locations, there is flexibility to scale-up the equipment and simulation environment. The VAST Course Manual provides facilitators with comprehensive teaching materials that are user-friendly and do not require extensive prior preparation.

VAST's Scenario Template is inspired by the Scottish Centre for Simulation and Clinical Human Factors storyboarding tool (https://scschf.org/faculty-development/). It incorporates best practice principles[41–43] and follows a consistent layout for easy use by both simulation novices and experienced faculty (**Table 1**). The template provides facilitators with an intuitive process for delivering and debriefing scenarios to help participants meet predetermined learning objectives.

Table 2

Reflections on Vital Anaesthesia Simulation Training (VAST) by Dr Christian Mukwesi, from Rwanda.

Simulation-based education is new in Rwanda, especially in the anesthesia postgraduate program. VAST Course represented a milestone for the Rwanda Anesthesia Society as it provided an opportunity to teach about communication skills such as gathering information, anticipation and calling for help. VAST also helped fix gaps in routine, knowledge, and communication for nonphysician anesthetists (NPA) who work in isolation and who have little access to anesthesia refresher courses. Bringing together NPAs, midwives, theater nurses and doctors in VAST helped build team capacity for the primary response to urgent cases. Having the perioperative team all together for simulation helped them reflect not only on what went well and what was challenging during scenarios but also on critical cases they had managed in the past and how to improve going forward
From performance in simulation and from conversations with course participants, facilitators could sense improvements in team communication skills and safety practices by the end of the course. For example, one trainee noticed the advantages of applying WHO Surgical Safety Checklist and promised she would work to implement this and to change practice and culture in her home hospital. The next great challenge is to demonstrate to funders and stakeholders a clear return on investment that participants and facilitators intuitively feel to exist with the VAST Course and its associated facilitator training
VAST is user-friendly for facilitators who have not had extensive training in SBE as the course materials are clear. Little preparation is needed in order to be able to moderate discussions or facilitate sessions. The VAST Course is comprehensive, it widely captures scenarios that healthcare providers face on a regular basis

Table 3

Reflections on Vital Anaesthesia Simulation Training (VAST) by Dr Mohamed Elaibaid, from Sudan.

In Sudan, nontechnical skills are rarely included in medical education. International courses, usually developed for high-income settings, tend to emphasize technical skills. VAST address this gap by focusing on non-technical skills like communication and team working with the aim of improving patient safety
Medical educators are familiar with the statement "simulation is a technique not a technology," VAST truly represents this because there is no need for expensive manikins or complex technology. Rather, the course uses basic equipment and simple affordable manikins or simulated patients, while still achieving a high level of emotional realism. This makes it possible to run the course in low-resource settings and rural areas, without needing a simulation center. The scenarios reflect day-to-day problems that affect patient safety, which builds great buy-in as course participants consider the training relevant for their setting. Collaboration of multidisciplinary teams is important for good patient outcomes. VAST is one of the few courses that address this issue by inviting participants from different disciplines to foster effective team function
Sustainability of medical education initiatives is a major issue in Sudan. We have received many great training courses but, lacking postcourse follow-up, training eventually stopped. After the VAST course, the faculty continues to provide support, communicates and even explores new training models to ensure continuity
In summary, the VAST Course has the potential to dramatically change perioperative team practice in low-income countries by overcoming many barriers to SBE and addressing nontechnical skills issues in an innovative way

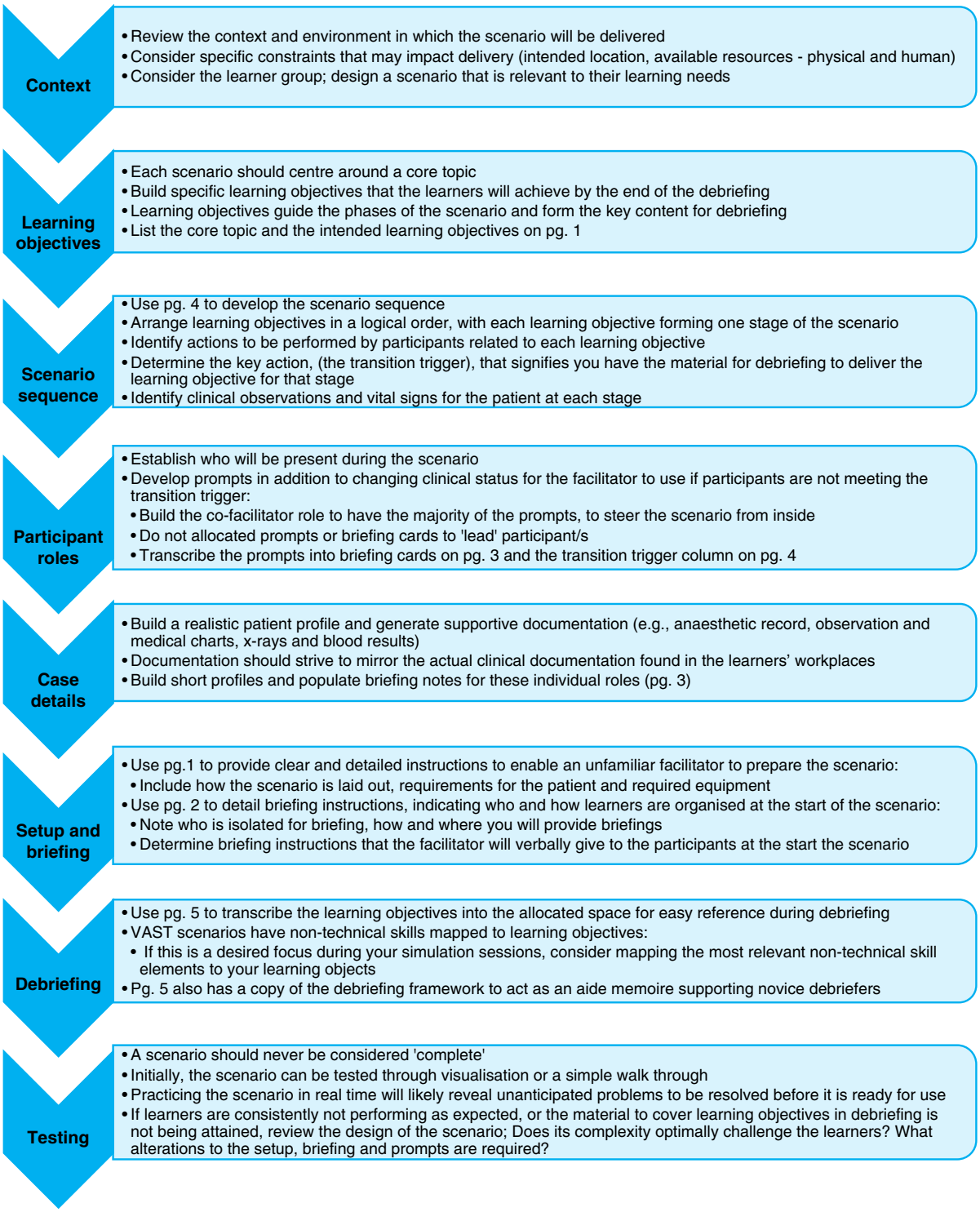

Figure 2. VAST's stepwise approach to scenario design. This details VAST's 8-step guide to scenario design. This guide is intended to be used in combination with VAST's Scenario Template. VAST indicates Vital Anaesthesia Simulation Training.

It is challenging to develop simulation scenarios that both help participants meet intended learning objectives and are accessible for faculty[44]. VAST's emerging faculty have expressed a strong desire to design their own novel scenarios, tailored to local needs. The VAST Design Course takes facilitators through the process of developing immersive simulation scenarios. **Figure 2** summarizes the stepwise approach taken during VAST scenario design. This incorporates key pedagogical theory[43–45] and provides a practical approach to designing scenarios. As progressive VAST Design Courses are

Table 4

Illustrative quotes from VAST course participants.

Simulation is helpful and we need more time because what we are doing in simulation is what happens in real life. (Kigali, Rwanda)
[We valued the] ability to make mistakes without fear. (Suva, Fiji)
Excellent points on how leaders should act in a crisis. The scenarios choices are what we actually encounter in our practice. (Addis Abba, Ethiopia)
Everyone has an important role in patient care. Stay calm, call for help, involve people around you in a crisis. (Dar es Salaam, Tanzania)
The fact that this course came to our location meant that we could work as our usual OR team which is very valuable for improving team function and dynamics. (Whitehorse, Yukon, Canada)
It is new and very informative in understanding the relevance and importance of non-technical skills and other important aspects like checklists, planning and executing the plan. (Hyderabad, India)
I really enjoyed this course and feel honored to be part of the first group of Canadians to have the opportunity to take this course. I think that healthcare teams across Canada could benefit from the non-technical skills developed in this course and I really hope to see VAST continue to grow both nationally and internationally. (Prince George, Canada)

run, and with the permission of scenario authors, new scenarios are being added to an expanding open-access VAST Scenario Bank.

Delivery to date

As of March 2020, when courses stopped due to the global pandemic, the VAST Course had been delivered 17 times in 6 countries (Rwanda, Tanzania, Ethiopia, India, Fiji, Canada) with the VAST FC always accompanying role out in new locations. Feedback from these courses has been overwhelmingly positive (**Table 4**). Venues have ranged from designated simulation centers to hotels to hospitals, with an outdoor hospital veranda used at one course. This highlights the flexible, portable nature of VAST. A mixed methods study[19] demonstrated statistically significant improvements in VAST Course participants' non-technical skills using the Anaesthetist Non-Technical Skills Framework[20]. The study found that cognitive aids and clinical algorithms, repeated and reinforced across simulated scenarios, encouraged a systematic approach to patient care. Participants reported improved problem-solving skills and confidence, particularly during emergencies.

Discussion

VAST's scenario design and debriefing are inspired by constructivist learning theory; learners construct knowledge from their experiences by coding and categorising information, a process driven by their own learning needs with personal meaning created by participants, rather than facilitators[46]. The VAST methodology is influenced by the sociocultural branch of constructivism and as such, social interaction between interdisciplinary learners is key to its success. Constructivist learning is encouraged by reflective debriefing that examines and reframes perspectives[47]. VAST facilitators are asked to be respectful and curious about the viewpoints of others. They refrain from making specific comparisons between "standard" practice and observed performance, particularly important in the cross-cultural and diverse background where VAST is taught. SBE is new for many and psychological safety is paramount[48]. VAST facilitators are encouraged to recognise and explore unconscious biases, potential hierarchies, and complex social interplay that may impact performance during simulation scenarios and debriefing. Effective VAST facilitators[36] may also be driving an equally important informal curriculum[49], modelling behaviors of respect and inclusivity among multidisciplinary health care teams. Fostering this collaborative and open social and interpersonal environment may directly translate to improved safety outcomes[50].

Future directions for VAST include iterative refinement of teaching materials and strengthening the "VAST Facilitator Pathway," methods for helping novice facilitators progress to expert. This will include design of a VAST Facilitator Assessment Matrix to outline competencies of excellent VAST facilitation. The tool has potential value in both education and assessment of simulation facilitation in diverse settings.

Conclusion

The challenges facing SBE in resource-limited settings are significant[7], yet its potential value in this context is immense[51,52]. VAST's pedagogy is designed to reduce barriers to widespread application of SBE in resource-limited and remote locations and to encourage vivid, experiential learning[53,54]. The VAST Course is contextually appropriate, portable, adaptable and low-cost, overcoming barriers to delivery of SBE in these settings. Local educators are supported in acquiring simulation facilitation skills through VAST's facilitator training. Emerging faculty develop facilitation and debriefing skills, broadly expanding the capacity for simulation delivery. Opportunity is provided to access additional simulation teaching resources and scenario design workshops. Future work will strengthen the processes of mentorship and skill development along the VAST Facilitator Pathway. VAST offers a viable platform for expanding SBE in health care beyond the traditional simulation center.

Ethical approval

None.

Sources of funding

None.

Author contribution

A.I.M. and P.L.L. contributed to article conception, design and drafting of the manuscript as well as review and approval of the final version of the manuscript. C.M., M.E., J.D., A.M., and M.M. contributed to design of the article and critical revisions of the manuscript as well as review and approval of the final version of the manuscript.

Conflicts of interest disclosure

Other than the authors (A.I.M., C.M., M.M., P.L.L.) affiliation with VAST, the authors declare that they have no financial conflict of interest with regard to the content of this report.

Research registration unique identifying number (UIN)

None.

Guarantor

None.

Acknowledgments

The authors thank the Dalhousie University's Department of Anesthesia, Pain Management and Perioperative Medicine for their ongoing support of VAST. They thank all of the volunteers and partners associated with VAST's development and ongoing delivery. Likewise, they thank Dr Michael Moneypenny for his contribution toward this paper.

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