Methods for scaling simulation-based teamwork training

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Effective teamwork and communication is now recognised as a critical component of safe and high-quality patient care. Researchers, policymakers and frontline providers are in search of strategies to improve teamwork in healthcare. The most frequently used strategy is teamwork training.[1] Teamwork training involves a systematic process in which a team is guided (often by facilitators) to improve and master different skills for working together effectively. Single-centre teamwork training initiatives have demonstrated improvements in patient care, but these results have been challenging to reproduce at scale.[2]

In this issue of *BMJ Quality and Safety*, Lenguerrand *et al* report the results of a stepped-wedge randomised controlled trial in which PRactical Obstetric Multi-Professional Training (PROMPT), an interprofessional intrapartum training package, was implemented across 12 maternity units in Scotland.[3] Each participating unit identified an in-house training team to travel to attend a 2-day PROMPT Train the Trainers programme conducted in one simulation centre; two units were unable to send training teams. Training teams were subsequently responsible for coordinating the delivery of in-house PROMPT courses to all maternity staff within 12 months. The courses were intended to cover core obstetrical emergencies, such as postpartum haemorrhage, sepsis, shoulder dystocia, teamwork and fetal monitoring. In addition to clinical outcomes, each maternity unit collected process data about their local PROMPT courses, including the total number of staff trained and courses delivered and the actual course content. The authors found a significant amount of variability in the implementation across units. For example, all courses included elements of teamwork whereas fetal monitoring and shoulder dystocia training were not universally included. Despite the previously demonstrated benefits of PROMPT in single-centre studies, the final results did not demonstrate a reduction of term babies with a low Apgar score. The authors postulate this null finding may be in part related to barriers in implementation rather than the effectiveness of the PROMPT training package itself. This highlights the need to understand the real-world barriers to implementation of available teamwork training interventions in order to design solutions to overcome them. Herein, we identify common challenges associated with scaling current teamwork training programmes and suggest methods for spreading teamwork training more broadly.

BARRIERS TO SCALING TEAMWORK TRAINING IN HEALTHCARE

Similar to most existing teamwork training programmes, PROMPT uses a combination of didactic instruction and healthcare simulation. Didactic instruction involves the passive transmission of knowledge in a unidirectional flow from the educator to the learner whereas healthcare simulation is 'a technique that creates a situation or environment to allow learners to experience a representation of a real event for the purpose of practice, learning and evaluation'.[4] Each of these approaches has important limitations. For adult learners, the didactic approach is demonstrably inferior to the experiential learning of simulation.[5] Simulation training encourages participants to experience events in both a cognitive and emotional fashion in ways that didactic education does not. This is believed to help enhance the natural transfer and application of knowledge to real-life situations. However, significant barriers preclude the scaling of simulation-based teamwork training.

Immersive simulation-based teamwork training often requires specialised technological equipment to recreate the clinical environment. For these reasons, these types of teamwork training programmes are most commonly available in simulation centres. Simulation centres with the technology required to provide this type of simulation training are relatively few in number, have limited capacity, are expensive to launch, operate and maintain and require staff time commitments in conflict with production demands of healthcare systems. For example, in the USA, there are currently 493 simulation centres listed in the Society for Simulation in Healthcare's Sim Center Directory. This represents 71% of all simulation centres globally. The American Hospital Association estimates there are 6210 hospitals and 5260 ambulatory surgical centres in the USA. On average, each simulation centre would need to serve roughly 24 healthcare facilities to deliver their programming at scale. We predict this ratio is even higher in most other countries with fewer simulation centres. Thus, while immersive simulation-based teamwork training addresses the needs of adult learners, it is too often inaccessible.

Simulation-based teamwork training can also be delivered with minimal resources through role-play or in situ simulation. This method can circumvent the resource, time and infrastructure barriers to opening and maintaining a simulation centre. However, even this approach has challenges. Even when specialised equipment is not required for the simulation, successful simulation-based teamwork training requires the contribution of trained facilitators to design and deliver curricula and guide the participants' learning. Reflection on personal experience through debriefing is responsible for most of the important learning in simulation. This is true not only in simulation training but also in allowing clinical teams to learn from real clinical events, especially adverse outcomes.[2] However, managing a debriefing exercise is an unfamiliar task for most clinical educators. This can lead to limited uptake of this role due to a well-recognised phenomenon where educators resist engagement for fear of looking foolish in front of trainees and colleagues.[6]

In the following sections, we review some of the emerging options for delivering simulation-based teamwork training at scale that have the potential to overcome challenges related to availability of specialised equipment and trained facilitators often required for immersive simulation (table 1).

APPROACHES TO SCALE: OVERCOMING TECHNOLOGICAL LIMITATIONS

Technological barriers to simulation-based teamwork training can arise due to limitations in the resources required to deliver effective training to clinical teams not just once, but in a sustained fashion to combat decay of learning. Several approaches have been proposed to overcome the technological resources required for immersive simulation-based teamwork training.

With each successive modification described in table 1, the technological requirements to produce and deliver the training are reduced. For example, telesimulation and screen-based simulation are both alternatives to immersive simulation. The important difference between screen-based simulation and telesimulation is that telesimulation does not use virtual reality. Rather, it uses remote, real-time expert facilitation to provide training to off-site locations. This modification significantly reduces the expertise and costs required to produce the virtual environment used in screen-based simulation that may otherwise create barriers for development, validation and maintenance of this high technology platform.

With the expansion of internet access, there is now widespread availability of telecommunication, even in low-resource settings.[7] However, telesimulation requires high-speed internet for real-time live streaming, which is commonly cited as a challenge and a barrier to its successful implementation globally.[8–10] Furthermore, telesimulation can put additional strain on qualified facilitators that are already stretched

Table 1 Approaches for scaling simulation-based teamwork training

Method	Definition
Overcoming technological limitations	
Screen-based simulation	A type of simulation 'presented on a computer screen using graphical images and text, similar to popular gaming format, where the operator interacts with the interface using keyboard, mouse, joystick or other input device'.[4] Technology is used 'to provide feedback to, and track actions of learners for assessment, eliminating the need for an instructor'.[4]
Telesimulation	'A process by which telecommunication and simulation resources are utilised to provide education, training and/or assessment to learners at an off-site location, where an off-site location is considered a distant site that would preclude education, training and/or assessment without the use of telecommunication resources'.[25]
Observed simulation	Observing live or prerecorded video interactions of real people without the use of telecommunication.[14]
Overcoming limited access to trained facilitators	
Scripted facilitation	'A cognitive aid that may promote faculty development efforts and augment debriefing skills particularly in those educators who are still solidifying their debriefing expertise'.[26]
Within-team debriefing	'A debriefing led by the team itself rather than an external instructor'.[19]

thin, particularly when used across time zones.[11] For example, the University of Toronto provides teaching and evaluation of laparoscopic skills to low-resource contexts using telesimulation.[9] Instructors for this course are required to commit to an 8-week to 10-week course where they provide four to six 1-hour to 2-hour telesimulation teaching sessions. Cultural differences in communication, leadership and decision-making may create limitations for the effectiveness of this approach for the global spread of non-technical skills training.[12] For these reasons, the sustainability of telesimulation as a viable solution for scaling simulation-based teamwork training is unclear and it may represent an exchange of one set of barriers for another.

Observed simulation can further reduce the technical barriers to simulation-based teamwork training. Observation is an accepted form of adult learning; it 'informs us about the roles of other people in our environment and allows us to make predictions which will guide our own behavioural output'.[13] It is different from didactic education as it is problem centred and meaningful to participants' life situations, and it can elicit emotional and psychological engagement similar to participatory simulation. Our recent systematic review and meta-analysis demonstrated that observation was comparable to active participation in simulation-based training when observation and debriefing activities are directed towards specific learning.[14] A variant of observed simulation, involving a recorded video scenario portraying clinicians other than the learners' colleagues, may also help limit the psychological risk of debriefing. Although observed simulation dramatically lowers the technology barrier, it does little on its own to improve access to trained facilitators needed to deliver the critical reflection component of simulation-based training.

APPROACHES TO SCALE: OVERCOMING LIMITED ACCESS TO TRAINED FACILITATORS

In addition to overcoming technical barriers to participating in simulation-based teamwork training, we also recognise the need to minimise the reliance on trained facilitators, given their scarcity and the barriers to training them. Simulation facilitators play a variety of roles depending on the needs of their local context. They can be responsible for implementing, designing and conducting simulations in addition to debriefing participants. Healthcare providers interested in becoming simulation facilitators currently acquire the necessary skills through a variety of courses and workshops, most of which require one or more days and have associated educational and travel costs. For example, in the study by Lenguerrand *et al*, two midwives, one obstetrician and one anaesthetist were required to travel from their local institution to attend a 2-day Train the Trainer programme at The Scottish Clinical Simulation Centre. Because of similar time demands, relatively few educators have the opportunity to obtain formalised training.[15 16]

The lack of facilitator development in simulation has consequences; several qualitative studies describe facilitators' low comfort level with the simulation technology and with designing and running scenarios.[6 17] Master trainers often return to their local institutions with limited support to deliver trainings making it challenging to sustain high-volume delivery. This may be one explanation for the large variation in number of PROMPT training sessions delivered by the master trainers at each participating unit (ie, between 0 and 20). The authors state that even the highest performing sites did not exceed the 90% training threshold needed to demonstrate improvements associated with PROMPT training in previous studies. This has also been observed with other large-scale teamwork training initiatives, such as TeamSTEPPS where only 50% of master trainers report sustaining implementation after a few months.[18] There is a need for methods of delivering teamwork training that can be employed with a reasonable and accessible level of investment of time, effort and resources for facilitators, recognising competing demands in healthcare.

A number of recent randomised controlled trials have demonstrated the effectiveness of using debriefing scripts for new facilitators without formal facilitation training to manage simulation exercises.[19 20] However, our experience suggests that new facilitators may feel intimidated or uncomfortable to step into this role even with a script. Often, prior studies on scripted debriefings do not acknowledge the challenge of *engaging* new facilitators. In most studies, the facilitators are already committed to the role. Thus, an important gap in the evidence on scripted debriefing is that it does not address this recruitment challenge.

An approach that minimises the burden on both new and experienced facilitators is within-team debriefing.[19] In this model, the team guides itself through a debriefing without an instructor using an expertly designed discussion outline to prompt reflection on their actions and the specific learning objectives of the exercise. Use of a prerecorded, video-based observed simulation may allow experts to curate discussion guides that are even higher quality given the predictability of the scenario compared with active participatory simulation. This combination of techniques also supports potentially much larger groups of participants: the video simulation is a large group activity and the debriefing occurs in small group breakouts, of which there can be many in a single session.

While using scripted facilitation or within-team debriefing may be effective ways to spread simulation-based teamwork training, no studies have assessed psychological safety in these models. Some learners have previously experienced psychological harm that may be stirred up by simulation training, and seasoned facilitators have a variety of skills to help mitigate these challenging situations. Use of prerecorded, video-based

observed simulation may help reduce these risks when a video scenario that does not depict the learners' colleagues or self is employed and, thus, may help lower the threshold level of skills required to manage psychological safety among participants. Improving teamwork at scale through simulation will be one step closer if there is an accessible approach to facilitation and debriefing, but prior to spreading, new methods must be thoroughly investigated for their effectiveness and potential harm.

LOOKING TO THE FUTURE: SCALING SIMULATION-BASED TEAMWORK TRAINING

We have reviewed several strategies described in the literature that have the potential to overcome the technological and facilitator-related resource barriers of simulation-based education. By using a combination of these methods, facilities with varying capacities and capabilities will be better able to access these valuable patient safety interventions in the context of their local resources. For example, a facility equipped with a simulation centre but limited access to trained facilitators may opt for the combination of immersive simulation and within-team debriefing. On the other hand, a facility with few intermediate-level facilitators with limited time for curriculum design and no simulation centre may opt for prerecorded, video-based observed simulation with scripted facilitation or within-group debriefing. The combinations and permutations of the major components of the simulation and debriefing experience can be tailored to meet the needs of the local context.

Lenguerrand *et al*'s attempt at scaling PROMPT across Scotland provides a prototypical example of the challenges faced by many of today's teamwork training initiatives. These include resource-heavy initiatives with limited implementation support to adapt the training to the local context. The optimal approach to simulation-based teamwork training depends on the local context, but a low-resource method of delivery that minimises the need for expert facilitation skills and specialised equipment is likely to have the farthest reach. In the future, large-scale teamwork training trials should aim to understand and address barriers to scale through detailed and cyclic study of implementation experience with redesign of the implementation strategy (and potentially the intervention itself) in the model of plan-do-study-act and similar quality improvement frameworks.[21–24] This will accelerate the pace of discovery of interventions that have been designed and tested with respect to the varying levels of resources and readiness that exist in the real-world settings. This offers the best hope for improving patient outcomes at scale.

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REFERENCES

1 Buljac-Samardzic M, Dekker-van Doorn CM, van Wijngaarden JDH, *et al*. Interventions to improve team effectiveness: a systematic review. *Health Policy* 2010;94:183–95.
2 Hughes AM, Gregory ME, Joseph DL, *et al*. Saving lives: a meta-analysis of team training in healthcare. *J Appl Psychol* 2016;101:1266–304.
3 Lenguerrand E, Winter C, Siassakos D, *et al*. Effect of hands-on interprofessional simulation training for local emergencies in Scotland: the thistle stepped-wedge design randomised controlled trial. *BMJ Qual Saf* 2020;29:122–34.
4 Society for Simulation in Healthcare. *Healthcare simulation dictionary*, 2016.
5 Lo L. Teamwork and communication in healthcare a literature review. Canadian patient safety Institute, 2011. Available: https://www.patientsafetyinstitute.ca/en/toolsResources/teamworkCommunication/Documents/Canadian%20Framework%20for%20Teamwork%20and%20Communications%20Lit%20Review.pdf [Accessed 1 Mar 2019].
6 Blazeck A. Simulation anxiety syndrome: presentation and treatment. *Clin Simul Nurs* 2011;7:e57–60.
7 ITU. World Telecommunication/ICT Development Report 2010 - MONITORING THE WSIS TARGETS. Available: http://www.itu.int/ITU-D/ict/publications/wtdr_10/index.html [Accessed 11 Feb 2019].
8 Mikrogianakis A, Kam A, Silver S, *et al*. Telesimulation: an innovative and effective tool for teaching novel Intraosseous insertion techniques in developing countries. *Acad Emerg Med* 2011;18:420–7.
9 Okrainec A, Henao O, Azzie G. Telesimulation: an effective method for teaching the fundamentals of laparoscopic surgery in resource-restricted countries. *Surg Endosc* 2010;24:417–22.
10 Ahmed RA, Atkinson SS, Gable B, *et al*. Coaching from the sidelines: examining the impact of Teledebriefing in simulation-based training. *Simul Healthc* 2016;11:334–9.
11 Acton RD, Chipman JG, Lunden M, *et al*. Unanticipated teaching demands rise with simulation training: strategies for managing faculty workload. *J Surg Educ* 2015;72:522–9.
12 Wondimagegn Gebreamlak D, Pain C. The dangers of assuming the generalisability of non-technical skills. *Med Educ* 2016;50:391–3.
13 Zentgraf K, Munzert J, Bischoff M, *et al*. Simulation during observation of human actions – theories, empirical studies, applications. *Vision Res* 2011;51:827–35.
14 Delisle ME, Ward MAR, Pradarelli JC, *et al*. Comparing the learning effectiveness of healthcare simulation in the observer versus active role: systematic review and meta analysis. *Simul Healthc*. In press.

15 Qayumi K, Badiei S, Zheng B, *et al*. Status of simulation in health care education: an international survey. *Adv Med Educ Pract* 2014;5:457–67.
16 Adamson K. Integrating human patient simulation into associate degree nursing curricula. *Clinical Simulation in Nursing* 2010;6:e75–81.
17 Jones AL, Hegge M. Faculty comfort levels with simulation. *Clinical Simulation in Nursing* 2007;3:e15–19.
18 Health Research and Educational Trust. *Agency for healthcare research and quality contract No. HHSP233201500016I/ HHSP23337004T implementation of the TeamSTEPPS® program*, 2017.
19 Boet S, Bould MD, Sharma B, *et al*. Within-team debriefing versus instructor-led debriefing for simulation-based education: a randomized controlled trial. *Ann Surg* 2013;258:53–8.
20 Cheng A, Hunt EA, Donoghue A, *et al*. Examining pediatric resuscitation education using simulation and scripted debriefing: a multicenter randomized trial. *JAMA Pediatr* 2013;167:528–36.
21 Leis JA, Shojania KG. A primer on PDSA: executing plan–do–study–act cycles in practice, not just in name. *BMJ Qual Saf* 2017;26:572–7.
22 McNicholas C, Lennox L, Woodcock T, *et al*. Evolving quality improvement support strategies to improve Plan-Do-Study-Act cycle fidelity: a retrospective mixed-methods study. *BMJ Qual Saf* 2019;28:356–65.
23 Taylor MJ, McNicholas C, Nicolay C, *et al*. Systematic review of the application of the plan–do–study–act method to improve quality in healthcare. *BMJ Qual Saf* 2014;23:290–8.
24 Reed JE, McNicholas C, Woodcock T, *et al*. Designing quality improvement initiatives: the action effect method, a structured approach to identifying and articulating programme theory. *BMJ Qual Saf* 2014;23:1040–8.
25 McCoy CE, Sayegh J, Alrabah R, *et al*. Telesimulation: an innovative tool for health professions education. *AEM Education and Training* 2017;1:132–6.
26 Eppich W, Cheng A. Promoting excellence and reflective learning in simulation (pearls): development and rationale for a blended approach to health care simulation debriefing. *Simul Healthc* 2015;10:106–15.