Rapid deployment of a virtual simulation curriculum to prepare for critical care triage during the COVID-19 pandemic

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Abstract

Background During the COVID-19 pandemic in Ontario, Canada, an *Emergency Standard of Care for Major Surge* was created to establish a uniform process for the "triage" of finite critical care resources. This proposed departure from usual clinical care highlighted the need for an educational tool to prepare physicians for making and communicating difficult triage decisions. We created a just-in-time, virtual, simulation-based curriculum and evaluated its impact for our group of academic Emergency Physicians.

Methods Our curriculum was developed and evaluated following Stufflebeam's Context-Input-Process–Product model. Our virtual simulation sessions, delivered online using Microsoft Teams, addressed a range of clinical scenarios involving decisions about critical care prioritization (i.e., Triage). Simulation participants completed a pre-course multiple-choice knowledge test and rating scales pertaining to their attitudes about using the *Emergency Standard of Care* protocol before and 2–4 weeks after participating. Qualitative feedback about the curriculum was solicited through surveys.

Results Nine virtual simulation sessions were delivered over 3 weeks, reaching a total of 47 attending emergency physicians (74% of our active department members). Overall, our intervention led to a 36% (95% CI 22.9–48.3%) improvement in participants' self-rated comfort and attitudes in navigating triage decisions and communicating with patients at the end of life. Scores on the knowledge test improved by 13% (95% CI 0.4–25.6%). 95% of participants provided highly favorable ratings of the course content and similarly indicated that the session was likely or very likely to change their practice. The curriculum has since been adopted at multiple sites around the province.

Conclusion Our novel virtual simulation curriculum facilitated rapid dissemination of the Emergency Standard of Care for Major Surge to our group of Emergency Physicians despite COVID-19-related constraints on gathering. The active learning afforded by this method improved physician confidence and knowledge with these difficult protocols.

Keywords Simulation · Critical care · Triage · COVID-19

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Résumé

Contexte Au cours de la pandémie de COVID-19 en Ontario, au Canada, une norme de soins d'urgence pour les poussées majeures a été créée afin d'établir un processus uniforme pour le " triage " des ressources limitées en soins intensifs. Cette proposition d'écart par rapport aux soins cliniques habituels a mis en évidence la nécessité d'un outil éducatif pour préparer les médecins à prendre et à communiquer des décisions de triage difficiles. Nous avons créé un programme d'études virtuel, juste à temps, basé sur la simulation et avons évalué son impact sur notre groupe de médecins urgentistes universitaires.

Méthodes Notre programme d'études a été développé et évalué selon le modèle Contexte-Intrant-Processus-Produit de Stufflebeam. Nos sessions de simulation virtuelle, réalisées en ligne à l'aide de Microsoft Teams, ont abordé une série de scénarios cliniques impliquant des décisions sur la priorisation des soins intensifs (c.-à-d. le triage). Les participants à la simulation ont rempli un test de connaissances à choix multiples avant le cours et des échelles d'évaluation concernant leurs attitudes à l'égard de l'utilisation du protocole de soins d'urgence standard avant et deux à quatre semaines après leur participation. Des commentaires qualitatifs sur le programme ont été sollicités par le biais d'enquêtes.

Résultats Neuf sessions de simulation virtuelle ont été dispensées sur trois semaines, touchant au total 47 médecins urgentistes titulaires (74 % des membres actifs de notre service). Dans l'ensemble, notre intervention a conduit à une amélioration de 36 % (IC 95 % 22,9-48,3 %) de l'auto-évaluation du confort et des attitudes des participants en matière de décisions de triage et de communication avec les patients en fin de vie. Les scores au test de connaissances se sont améliorés de 13% (IC 95% 0,4-25,6%). 95 % des participants ont donné une évaluation très favorable du contenu du cours et ont également indiqué que la session était susceptible ou très susceptible de modifier leur pratique. Le programme d'études a depuis été adopté à plusieurs endroits dans la province.

Conclusion Notre nouveau programme de simulation virtuelle a facilité la diffusion rapide des normes de soins d'urgence en cas de crise majeure à notre groupe d'urgentistes, malgré les contraintes de rassemblement liées au COVID-19. L'apprentissage actif que permet cette méthode a amélioré la confiance et les connaissances des médecins concernant ces protocoles difficiles.

Clinician's capsule

What is known about the topic?
The spectre of rationing critical care resources during the COVID-19 pandemic was a new and unfamiliar concept for Emergency Physicians.

What did this study ask?
We evaluated the impact of a simulation-facilitated dissemination of Triage protocols on Emergency Physicians' knowledge and comfort with the process.

What did this study find?
Virtual simulation resulted in improvement in knowledge of the protocol and physician comfort with the making triage decisions.

Why does this study matter to clinicians?
Simulation can be useful in disseminating and socializing new clinical protocols, particularly in the distressing case of COVID-19 triage.

Background

The impending second and third wave of the COVID-19 pandemic in Ontario, Canada elevated the possibility that the needs of critically ill patients could soon outstrip available resources. Anticipating this scenario, the Ontario Bioethics Table developed and circulated an *Emergency Standard of Care for Major Surge (ESC)*. This protocol was created to establish a uniform process for the rationing of critical care resources. Though not yet implemented, this unprecedented shift in usual clinical practice could represent a major departure from the training, experience, moral and legal obligations of healthcare professionals. Throughout the province, this possibility represents a source of considerable stress and anxiety among acute care physicians.

ESC background materials, scoring tools, and the decision algorithm itself had been circulated through hospitals and departments typically by email or brief presentations. Several versions were disseminated over the course of the pandemic and promoted in an online webinar hosted by Critical Care Services Ontario in January 2021. However, uptake by healthcare professionals was not formally measured. Furthermore, no formal process existed to ensure familiarity among health care professionals with its use, normalize the cultural and attitudinal shifts required, or provide the skills for effective communication of triage decisions to other healthcare professionals and families. There was therefore a clear need for an educational initiative to assist in the effective dissemination of the ESC and prepare clinicians to deliver a consistent and high standard of care to patients during extraordinary circumstances.

Simulation is an effective modality for health professions education [1] and in recent years has emerged as an important tool in Emergency Medicine for

knowledge dissemination [2, 3], system design [4–6], quality improvement [7, 8], and continuing professional development [9–11]. Simulation offers, through deliberate practice, coaching, and feedback, an opportunity for healthcare professionals to undertake mastery learning, improving downstream outcomes that contribute to safer patient care [12, 13]. Amidst the COVID-19 pandemic, the necessary limits on social gatherings have further revealed that the use of virtual methods (e.g., Zoom) for the conduct of simulation-based education can also be effective [14]. Leveraging virtual simulation, we thus proposed a just-in-time interactive, simulation-based ESC curriculum, and delivered it to our group of academic emergency physicians at the University Health Network (UHN) hospitals in Toronto, Ontario over a 3-week period. The objective of this study was to develop and evaluate the virtual simulation curriculum for triage of critical care resources according to the ESC protocols.

Methods

We followed Stufflebeam's Context-Input-Process–Product model [15], a program development technique that allows for curriculum evaluation at each stage of the process with a greater focus on "how and why the programme worked and what else happened" [16]. Recognizing that this would be a small, rapid, and dynamic initiative with limited opportunity for outcomes-based program evaluation and subsequent revision, this technique was expected to better inform design and gauge impact [17]. A waiver of formal Research Ethics Board review was obtained on the basis of a Quality Improvement exemption (UHN Quality Improvement Review Committee ID# 21-0169).

Context evaluation

Planning proceeded from the understanding that Triage was novel in our academic, tertiary care hospital setting. It was assumed that a knowledge gap existed in the group with respect to the skills needed for effective prioritization of patients for critical care during a major surge. Multi-source input from interprofessional clinical leaders identified that, in addition to the need for rapid translation of the new protocols, pre-existing deficiencies existed in skills required for end-of-life care planning and goals of care decision-making within the target learner group (emergency physicians at UHN).

An expert group of institutional clinical leaders in Emergency Medicine, Critical Care, Ethics, and Palliative Care was convened to identify the following key objectives for the intervention:

1. To improve clinicians' knowledge on "best practices" in leading goals of care conversations in the setting of an acute health crisis;
2. To develop skill and fluency in applying clinical decision instruments included in the ESC Triage protocol;
3. To foster confidence among clinicians in navigating the patient/family discussions about triage decisions, as dictated by the standard.

Given the desire for an active learning process, simulation was considered the ideal educational modality, as it offers the opportunity to rapidly cycle through clinical scenarios and engage in deliberate practice, coaching, and debriefing discussions. The opportunity to engage in psychologically safe rehearsal with time to debrief was also felt to be essential, considering the sensitive nature of ESC Triage. To support participant safety and physical distancing, as well as the unique scheduling considerations of Emergency Physicians, virtual delivery of the simulations was prioritized.

Participants were recruited through emails, announcements at recurring weekly departmental "COVID Huddles", and through individual encouragement. Simulation sessions were limited to a minimum of four, and maximum of eight participants, as this was felt to represent the optimal group size for engagement. To promote enrollment, accreditation with the institutional Continuing Professional Development office was obtained to provide credits for participants.

Input evaluation

A set of illustrative cases (Appendix A) was developed to span a range of possible patient Triage scenarios. Review of existing ESC documents and a recorded lecture [18] on the Triage process was recommended to participants as pre-course preparatory work, allowing simulations to focus on application, communication, and debriefing. Of note, versions of these resources had previously been disseminated to our physician group through email, though uptake had not been measured. The structure of simulation cases, based on a template created by one of the authors (AD), focused on goals of care discussion and presentation of the Triage decision to the patient and/or substitute decision-makers. Cases involved participants taking turns acting in the roles of "most responsible physician" (MRP), "patient/family member(s)", and "second physician", with the remainder observing. A clinical vignette was presented to the MRP and role cards were provided to participants acting in supporting roles to ensure uniformity of case progression between sessions. Participants were then set into a mock clinical encounter with instructions that the initial resuscitation stages were complete, and it was time to engage in a crucial conversation. Simulation sessions were conducted in a

virtual environment via Microsoft Teams [Microsoft Corp., Redmond, WA, 2021].

Process evaluation

Cases were first piloted internally within the simulation educator group to ensure they followed the intended learning trajectories, then externally reviewed by peers with expertise in simulation education from other centres. Sessions were delivered by institutional experts in simulation-based education and debriefing and co-facilitated by experts in ethics and palliative care to ensure adequate content expertise was available. Different pairs of faculty from the planning group delivered the sessions with one or two others observing, and the group communicated regularly throughout the implementation period to ensure consistency in the curriculum delivery. A standardized pre-briefing was presented highlighting the "basic assumption" in simulation [19], importance of confidentiality, suspension of disbelief, and psychological safety. Cases were debriefed following the PEARLS model [20].

Product evaluation

We focused on Kirkpatrick level 1 and 2 outcomes (reactions and knowledge acquisition) [21] as it remains unknown whether the training will ever be operationalized through a formal invoking of the ESC. Participants completed a multiple-choice test and rating scales (Appendix B), before- and within 4 weeks after participating (Appendix C), both administered via SurveyMonkey [SVMK Inc., San Matteo, CA, 2021]. The pre- and post-tests presented five identical scenarios and participants were asked to respond with their proposed management plans. Rating scales asked participants to rate (on a 5-point Likert) their level of comfort and self-assessed aptitude with end-of-life care, use of the ESC tools, and comfort applying the Triage decision algorithms in clinical practice. Individual participant responses were linked with an anonymized unique identifier to allow per-participant analysis. A post-course survey invited participants to reflect on the session, key learning points, and overall comments (positive or negative) about the strengths and targets for improvement of the course.

Our main educational outcomes of interest were self-reported level of comfort with using the ESC protocol and with communicating triage decisions, before and after the course, as rated on the 5-point Likert scales. Secondarily, we sought to determine if the session would improve performance on the 5-question multiple-choice test about the ESC. We calculated that for a moderate effect size (Cohen's $d = 0.5$) we would require a sample size of 55 participants to detect a 1-point change in Likert scale ratings and/or a 20% improvement in quiz results at 80% power.

Results

A total of nine virtual ESC simulation sessions were delivered over a period of 3 weeks. 53 unique participants enrolled and completed the pre-course materials, and 47 attended the course (Table 1). This represents 74% of all active physicians within our academic emergency department (ED).

Baseline and post-course participant attitudes regarding end-of-life care and the ESC are presented in Fig. 1. Overall, we found that our intervention resulted in a combined 36% improvement in participants' self-perceived comfort and attitudes on navigating Triage decisions and communicating with patients at the end of life, increasing most Likert ratings by an average of nearly two points out of five (1.78; 95% CI 1.15–2.42, Cohen's $d = 1.50$) (Table 2). This strong effect size was sustained even when the analysis was restricted to paired data for participants who completed both the pre- and post-course surveys.

Among participants who completed both the pre- and post-course knowledge test, mean test scores improved from 2.6 to 3.3 out of 5 (95% CI 0.4–25.6%, Cohen's $d = 0.56$).

Overall participant feedback regarding the course was overwhelmingly positive (Fig. 2), with 95% of respondents agreeing or strongly agreeing with the statements "The learning objectives were met", "The quality of the session was acceptable", "The content was relevant to my practice", "Recommendations were based on appropriate research findings and/or evidence", and "This program content enhanced my knowledge". Equally, 95% of respondents indicated that the session was likely or very likely to change their practice.

Table 1 Baseline participant characteristics

Total number of participants	41
Age (median, IQR)	41 (37–52)
Sex	
Female	17
Male	24
Certification	
FRCPC-EM	15
CCFP-EM	23
CCFP	1
Other	2
Years in practice (median, IQR)	12 (7–22)
Concurrent practice (outside academic ED)	
Community ED	13
Other	2

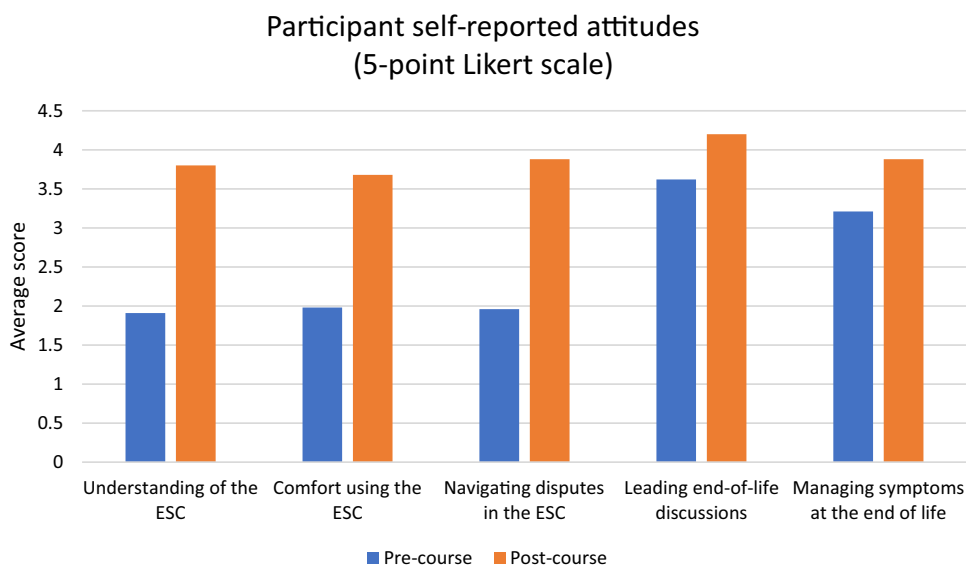**Fig. 1** Attitudes towards the Emergency Standard of Care before and after the course

Participant self-reported attitudes (5-point Likert scale)

Table 2 Overall curriculum effects on self-perceived comfort and knowledge test

	Pre-course		Post-course		Difference	95% CI	p
Unpaired *t* test for all survey responses	Mean	N	Mean	N			
I have a good understanding of how to use the Triage Standard of Care	1.9	53	3.8	25	**1.9**	1.5–2.3	**< 0.001**
I feel comfortable applying the Triage Standard of Care to clinical scenarios in the Emergency Department	2.0	53	3.7	25	**1.7**	1.2–2.2	**< 0.001**
I understand how to navigate clinical uncertainties and disagreements when applying the Triage Standard of Care to clinical scenarios in the Emergency Department	2.0	53	3.9	25	**1.9**	1.4–2.4	**< 0.001**
I feel confident leading discussions around end-of-life decision making (i.e., "Goals of Care" conversations)	3.6	53	4.2	25	**0.6**	− 0.7–1.9	0.38
I am proficient in managing symptoms in critically ill patients at the end of life	1.1	53	3.9	25	**2.8**	2.3–3.3	**< 0.001**
	Pre-course		Post-course		Difference	95% CI	p
Paired t-tests for per-participant analysis	Mean	N	Mean	N			
I have a good understanding of how to use the Triage Standard of Care	2.0	20	3.9	20	**1.8**	1.3–2.4	**< 0.001**
I feel comfortable applying the Triage Standard of Care to clinical scenarios in the Emergency Department	2.1	20	3.8	20	**1.7**	1.1–2.3	**< 0.001**
I understand how to navigate clinical uncertainties and disagreements when applying the Triage Standard of Care to clinical scenarios in the Emergency Department	2.1	20	4.0	20	**1.9**	1.4–2.4	**< 0.001**
I feel confident leading discussions around end-of-life decision making (i.e., "Goals of Care" conversations)	3.8	20	4.2	20	**0.4**	0.0–0.7	**p = 0.049**
I am proficient in managing symptoms in critically ill patients at the end of life	3.2	20	4.0	20	**0.8**	0.5–1.2	**< 0.001**
Knowledge Test results (5 total marks)	2.6	20	3.2	20	**0.6**	0.02–1.3	**p = 0.044**

Discussion

Interpretation of findings

The Emergency Standard of Care circulated in Ontario to manage a major surge of critically ill patients is an unfamiliar and genuinely unsettling prospect for physicians practicing in Emergency Medicine. This study illustrates two key findings: first, our curriculum fostered Emergency Physician proficiency with a novel and radical treatment protocol during a pandemic surge. Second, the curriculum had a positive impact on physician comfort level with Triage decisions and related discussions, and was well-received by our group of physicians. Participants expressed gratitude for the opportunity to practice with the

Fig. 2 Participant ratings of course quality

Participant feedback ratings (5-point Likert scale)

Comparison to previous studies
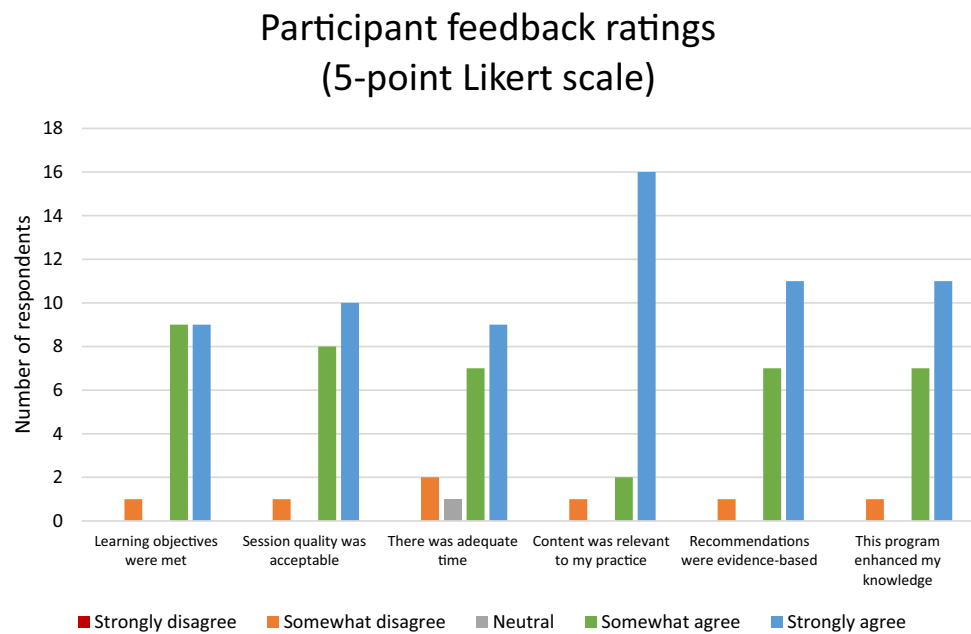
decision instruments, consider the context in which these decisions might need to be made, and rehearse strategies for communicating with patients and substitute decision-makers with feedback from colleagues.

Leveraging simulation as a tool for the rapid dissemination and evaluation of new clinical processes is highly relevant in the realm of knowledge translation, as the mastery achieved by participants translates to improved patient outcomes [1, 11]. Simulation-facilitated implementations such as ours offer a chance to work with new concepts in a deliberate way, receiving coaching and feedback from experts and peers to gain comfort and proficiency [2, 3, 8]. This study also illustrates that simulation can be pragmatically implemented even when stripped of technology, mannequins, and training environments. Despite presenting these cases over a simple Microsoft Teams conference, our simulation educators were able to establish an environment of suspended disbelief among participants that was sufficient to evoke visceral responses and meaningful learning. For simulation educators, this finding illustrates that engagement and suspension of disbelief is better achieved through a consideration of alignment between training objectives and case design, rather than the fidelity of the training space, consistent with work from Chaplin, Hanel, Petrosoniak, Hamstra and others [3, 11, 13, 14]. Taken altogether, our paper illustrates the success that comes from effective collaboration between quality improvement and simulation-based education experts on new care initiatives.

Strengths and limitations

The main strength of our study is the pragmatic application of virtual technologies and simulation-based educational methods to deliver a novel clinical protocol rapidly to a large group of physicians. As a particularly evocative protocol, focused on critical care triage, this was successful in both conveying and socializing the concepts. Moreover, the interventions and methods have good generalizability to emergency medicine and other acute care disciplines across the country and the international community for educational and knowledge translation applications.

The first and foremost limitation of our work is that, due to the nature of the pandemic, we were only able to evaluate low Kirkpatrick-level outcomes. The ESC protocol is one that all authors and participants hope will never be needed in practice, and evaluating how our curriculum translates to clinical practice has thus far been impossible. Second, our outcomes assessment was limited to a small number of measures due to concerns for practicality. While acknowledging the importance of evaluating our intervention, there was a balance that needed to be struck between motivating and discouraging factors, to ensure maximal participation rates. Further to this, the pre-post test included only a small number of cases, which could bias the effect size found if participants were academically dishonest in answering the quiz. Third, while the study sample size fell short of our target, it was practically limited by the total number of available participants in the physician group and incomplete uptake of the simulation session. However, it is noteworthy that we were still able to enroll three quarters of our group on short notice. Finally, as participation was voluntary, it is possible that the general positivity towards

simulation-based education is an artifact of self-selection. We have not yet had an opportunity to clarify non-participation in any formal manner.

Clinical implications

Our use of simulation allowed participants to discuss, dissect, and experience the significance of the triage concept and the particular application of the ESC decision instruments, while developing the skills to convey this to patients in an empathetic and respectful way. Skill acquisition is illustrated in participants' improved self-assessments of confidence and their improved scores on the knowledge test. Indeed, our pre-course data alone show that the notion of simply circulating a protocol and expecting team members to be prepared to understand and use it is extremely flawed. We believe this study illustrates that simulations can and should be used to better convey major changes to clinical practices and processes.

Research implications

Unfortunately, the urgency of uptake precluded extending the program evaluation to other centres. However, future work may include an evaluation of the curricular impact on clinicians if the ESC is ever formally implemented, which could include further tests and questionnaires, as well as qualitative analysis (e.g., via focus groups) contrasting the experience of those who had received simulation-based training in the ESC and those who hadn't.

Conclusion

We developed and delivered a novel virtual simulation curriculum for triage of critical care resources during a pandemic, and were able to rapidly deliver this curriculum to the majority of our physicians in a short time frame. Participant confidence and knowledge improved as a result of this innovation. Other centres could learn from our experience and apply it to their context.

Declarations

Conflict of interest Dr. Mastoras holds a leadership position and shares in Rocket Doctor Inc., a Canadian telemedicine company. The authors have no other conflicts of interest to declare. Rapid deployment of a virtual simulation curriculum to prepare for critical care triage during the COVID-19 pandemic.

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