Adapting to Major Disruptions to the Learning Environment: Strategies and Lessons Learnt During a Global Pandemic

Matthew Spond1 · Veronica Ussery1 · Andrew Warr2 · Karen J. Dickinson2,3,4

Abstract
Dealing with rapid, unanticipated disruptions to established learning environments are challenging. There are a number of situations that may require this including natural disasters such as weather disturbance, viral pandemics, or political unrest and violence. For example, the COVID-19 pandemic provided medical educators with this challenge and enabled valuable lessons to be learnt. These can be utilized to prepare for other occurrences in which disruptions must be faced and high-quality education delivered. Focus should be placed both on successful transition of learning events to a new modality appropriate to the emerging climate and on reliably assessing efficacy of these new educational strategies with identification of those best suited to the new environment. We present a framework, based on local lessons learnt, by which the challenges faced during an educational disruption can be addressed, and describe methods to determine which changes are most effective and should be durable.

Keywords Educational technology · Change · Simulation · Distance simulation · Telesimulation · Pandemic

Introduction
In many parts of the world, access to education is taken for granted. The question of if and how to engage with education is not a challenge faced by many in high income countries [1]. In contrast, many areas affected by conflict and natural disaster have this daily struggle. Through resources such as those provided by UNICEF [2] and the US Department of Education Disaster Recovery Unit [3], efforts are made to provide consistency in education for learners those areas. This is a significant undertaking, but a subject matter in which these agencies have huge experience. The same cannot be said for the majority of educators teaching undergraduate and postgraduate learners as the COVID-19 pandemic took hold, necessitating a shift in delivery of medical education to virtual or hybrid platforms [4–6]. This was largely unchartered territory with medical educators being forced to navigate virtual learning event planning or curricular development in synchrony with delivery of these events [7, 8]. Unanticipated disruptions in the educational environment can negatively affect quality. Lessons learnt during the COVID-19 pandemic regarding rapid pedagogical shifts can be employed to strategize for durable change and to prepare for future disruptive events.

This work describes challenges faced from the disruption of education due to the COVID-19 pandemic and provides a practical guide for dealing with and optimizing the process of continuing to provide education. We have structured the approach to management of educational disruption in three stages: Assessment, Meeting Needs, and Evaluation and draw upon the work of Kern [9], Kotter [10, 11], and Kirkpatrick to guide educators through this process. Kern’s work provides a six step outline for the development of medical educational curricula, Kotter describes an eight step process for leading change, and Kirkpatrick provides a level specific evaluation process to assess efficacy of learning events [12, 13] Tables 1–3.

Virtual education, including telesimulation, has been utilized before the COVID-19 pandemic, but not with the frequency seen since the virus arrived [14]. The disruption caused to in-person learning events from dynamic isolation...
and quarantine of both learners and faculty, coupled with social distancing measures meant that virtual options were attractive [15]. The acute disruption created by the arrival of COVID-19 created a “sense of urgency” so crucial to leading effective change. Kotter describes eight steps of leading change, and, uniquely, in the case of a disaster causing the disruption, the first step, a sense of urgency, is created by the event itself (Table 1) [10, 11]. A major disruption necessitates major change. The team (in this case medical educators) need little convincing of the “need for change in a bold way,” and the importance of acting immediately is apparent; as such Kotter’s second step is achieved. With COVID-19 as the disruptive example, failure to act would degrade undergraduate and postgraduate education impacting not only students, but also healthcare of patients as the workforce matures. Similarly, steps 2–6 of Kotter’s theory are self-propagating during disruption (namely building a guiding coalition, forming a strategic vision and initiatives, enlisting a volunteer army, enabling action by removing barriers, and generating short-term wins) [10, 11]. We have seen during the early COVID-19 pandemic the willingness of educators and physicians to form coalitions (e.g., within the World Health Organization, COVIDSurg part of the NIH Global Health Research Unit on Global Surgery) to collaborate, disseminate, and share work for the benefit of all [16–18]. There was a real feeling of community and togetherness at the beginning of the pandemic, so crucial both for provision of informed healthcare but also for continuation of high quality medical education. The “short term wins” described as essential by Kotter were seen in the first waves as more was learnt about successful viral management. The same being true in medical education as events were transitioned virtually and successes occurred. Learning events were able to continue even though the online transition provides significant challenges, particularly when these

Table 1  Kotter’s eight steps process for leading change [11, 12] and relationship to Principles of navigating educational disruption

| Kotter’s step | Details                                                                 | Principle                  |
|---------------|-------------------------------------------------------------------------|---------------------------|
| 1             | Create a sense of urgency: “Help others see the need for change through a bold, aspirational opportunity statement that communicates the importance of acting immediately” | Assessment                |
| 2             | Building a guiding coalition: “A volunteer army needs a coalition of effective people – born of its own ranks – to guide it, coordinate it, and communicate its activities” | Meeting Needs             |
| 3             | Form a strategic vision and initiatives: “Clarify how the future will be different from the past and how you can make the future a reality through initiatives linked directly to the vision” | Assessment & Meeting Needs|
| 4             | Enlist a volunteer army: “Large scale change can only occur when massive numbers of people rally around a common opportunity. They must be bought-in and urgent to drive change – moving in the same direction” | Meeting Needs             |
| 5             | Enable action by removing barriers: “Removing barriers such as inefficient processes and hierarchies provides the freedom necessary to work across silos and generate real impact” | Meeting Needs             |
| 6             | Generate short-term wins: “wins are the molecules of results. They must be recognized, collected and communicated – early and often – to track progress and energize volunteers to persist” | Meeting Needs & Evaluation|
| 7             | Sustain acceleration: “Press harder after the first successes, Your increasing credibility can improve systems, structures and policies. Be relentless with initiating change after change” | Meeting Needs & Evaluation|
| 8             | Institute change: “Articulate the connections between the new behaviors and the organizational success, making sure they continue until they become strong enough to replace old habits.” | Meeting Needs & Evaluation|

and quarantine of both learners and faculty, coupled with social distancing measures meant that virtual options were attractive [15]. The acute disruption created by the arrival of COVID-19 created a “sense of urgency” so crucial to leading effective change. Kotter describes eight steps of leading change, and, uniquely, in the case of a disaster causing the disruption, the first step, a sense of urgency, is created by the event itself (Table 1) [10, 11]. A major disruption necessitates major change. The team (in this case medical educators) need little convincing of the “need for change in a bold way,” and the importance of acting immediately is apparent; as such Kotter’s second step is achieved. With COVID-19 as the disruptive example, failure to act would degrade undergraduate and postgraduate education impacting not only students, but also healthcare of patients as the workforce matures. Similarly, steps 2–6 of Kotter’s theory are self-propagating during disruption (namely building a guiding coalition, forming a strategic vision and initiatives, enlisting a volunteer army, enabling action by removing barriers, and generating short-term wins) [10, 11]. We have seen during the early COVID-19 pandemic the willingness of educators and physicians to form coalitions (e.g., within the World Health Organization, COVIDSurg part of the NIH Global Health Research Unit on Global Surgery) to collaborate, disseminate, and share work for the benefit of all [16–18]. There was a real feeling of community and togetherness at the beginning of the pandemic, so crucial both for provision of informed healthcare but also for continuation of high quality medical education. The “short term wins” described as essential by Kotter were seen in the first waves as more was learnt about successful viral management. The same being true in medical education as events were transitioned virtually and successes occurred. Learning events were able to continue even though the online transition provides significant challenges, particularly when these

Table 2  Kern’s six steps of curricular development [9] and relationship to Principles of navigating educational disruption

| Kern’s step                        | Details                                                                 | Principle                  |
|------------------------------------|-------------------------------------------------------------------------|---------------------------|
| Problem Identification and General Needs Assessment | Identification and critical analysis of a healthcare need or problem | Assessment                |
| Targeted Needs Assessment          | Assessing needs of targeted group of learners and their learning environment | Assessment                |
| Goals and Objectives               | Creation of broad and general goals for the education and specific, measurable objectives | Meeting Needs             |
| Educational Strategies             | Choosing the curriculum content and educational methods that will most likely achieve the educational objectives | Meeting Needs             |
| Implementation                     | Implementation and evaluation of the educational effort and includes: obtaining political support, identifying and procuring resources, identifying and addressing barriers to implementation, introducing the education, administering and refining the curriculum in a cyclical way | Meeting Needs             |
| Evaluation and Feedback            | Assess performance of learners and the curriculum, may be formative and/or summative | Evaluation                |
events are large (e.g., for an entire medical student class) and associated with multiple educational strategies, educators, and learning environments. Motivation was provided by the drive to provide virtual iterations of in-person educational events to maintain accessibility so as not to disadvantage a certain group of learners (e.g., those in isolation or quarantine) [19–21].

During a disruption in medical education the real test, however, is achieving the final steps described by Kotter (sustain acceleration and institute change strong enough to replace old habits) [10, 11]. Using the COVID-19 pandemic as an example, reaching Kotter’s steps 7 and 8 has been testing and prohibited in part by issues related to emergence of the Delta and Omicron variants and non-vaccination with resultant moral injury to healthcare workers and educators [22, 23]. Lux describes social dynamics of the COVID-19 pandemic and states “very likely, repeated waves of increases in infection rates…would let previous prevention measures look futile so that over time, a more fatalistic attitude may take over” [24]. Similar issues affect managing mental distress relating to other causes of disruption to medical education, and the long-term challenge is to establish durable change in the best interests of our students. With regard to COVID-19, the transition to peri- and post-pandemic represented a critical juncture for educators. Focus should be placed not only on sustaining education during this disruption but also on reliably assessing efficacy of new strategies to identify which should continue post-disruption. All of which needs to be achieved as the workforce is losing steam.

To provide an illustrative example, for the last decade, our institution has organized an in-person weeklong event for the fourth year medical students each April in order to prepare them for intern practice. This has historically included Advanced Cardiovascular Life Support (ACLS) sessions, panel sessions with residents or interns, and a selection of simulated high acuity clinical scenarios with simulated patients (SPs) that may be reasonably encountered by an intern on their first day of clinical practice. When the COVID-19 pandemic led to social distancing in March 2020, this event was canceled due to inadequate time to effect a high quality transition to a virtual platform. The consequences of this lost training opportunity and of the lack of in-person clinical and educational events on our current trainees are concerning and largely unknown and were our driver for change. For the 2021–2022 academic year, our organizing committee sought to convert our rising intern preparation week to a hybrid format to enable the transitioning fourth year medical students’ adequate preparation for intern life. Through this experience, we highlight the importance and approach to evaluation of any “new” educational strategies to identify which are effective and address challenges of achieving Kotter’s steps 7 and 8 for these new pedagogical approaches even after resolution of the disruption.

Principles of Assessment

The most important step to begin navigation through an educational disruption is a thorough assessment of the need for change. See Fig. 1 (COVID-19 as disruptor example). It is essential that the “new” modality is the most effective method of learning for students based on a thorough assessment of the situation, recognizing this may be fluid as the disruption evolves or resolves. This stage aligns with Kotter’s steps 1 and 3: building a sense of urgency defined by the disruptive event and also informing the strategic vision and mission of the change [10, 11] (Table 1). Viewing this through an educational lens, the first phase covers both the problem identification, general needs assessment, and targeted needs assessment steps of Kern’s curricular development process [9].

The disruption to education caused by the COVID-19 pandemic led to a proliferation of virtual educational events. It is easily assumed, particularly with the challenges of the disruption, that an educational strategy is the most appropriate or most effective, just because it is available and appears to solve the current problem. Certainly, clinical education has likely been permanently changed by the current pandemic but just because we can offer events virtually does not mean we universally should. It is crucial to assess the balance of factors favoring each modality that can realistically be offered as an alternative to the traditional modality. Using the example of the intern preparation week, when in-person and virtual learning options were compared for this large-scale event (i.e., the entire M4 class) in a socially distanced climate, the scales tipped in favor of the virtual format. Also important to consider are the consequences of canceling the event. For example, some events may be more easily deferred if their outcome is not time sensitive, but for others (such as our rising intern preparation week) these must be completed before a specific date for learners to benefit.

The next step is assessment of fit, with regard to both educational materials and the proposed platform of delivery, and corresponds with step 3 and 4 of Kern’s curricular development process [9] (Table 3). The new educational strategy employed should be able to meet the defined learning objectives at least as well as the previous learning event. For a virtual transition, educational materials will usually be available for the traditional in-person event and should be considered for inclusion in the online format (examples from the intern preparation week include ACLS materials in the form of Portable Document Format (PDFs), current clinical guidelines around acute medical emergencies, and Advanced Trauma Life Support (ATLS) materials). Some educational strategies may be inappropriate for a virtual platform and require adaptation. An illustrative example from our rising intern preparation week is that one of our scenarios was a
trauma simulation. During the traditional in-person event, this simulation involved multiple learners working physically as a team to perform both the primary and secondary surveys and concomitant patient management. Clearly, this physicality does not translate well to the virtual platform. We identified this problem through pilot testing, and alternative educational strategies were crafted and employed. In this case, we produced a video of an “ideal trauma activation” utilizing expert clinicians and highlighting learning objectives such as team working, interprofessional communication including closed loop techniques, and leadership skills.

With regard to fit, for some large-scale events, a hybrid approach may enable social distancing rules to be met and all learners to attend; however, it is important to ensure that all learners in this situation receive a high-quality educational experience. If this is not possible, a totally virtual event should be planned. The final part of the assessment phase is identification if appropriate and adequate resources are available. This applies to not only educational expertise but also technological expertise, subscriptions, space (if required for hybrid event), and, crucially, educator and learner buy-in. As the organizational team (or “guiding coalition,” Kotter step 2), it is important to build a narrative clearly defining the mission of this change, rooted in the need to continue education through the disruptive process.

This is key to enlisting a “volunteer army” (Kotter step 4) and is essential for the success of the endeavor.

### Principles of Meeting Needs

Robust strategies to meet the identified needs should be developed through regular committee planning meetings for the new learning event. This coalition formation phase of leading change should include those individuals who were involved in the traditional format of the education, prior to the disruptive event. Care should be taken to include both subject matter and educational experts within this group. Meetings should occur with a frequency dependent upon the timeline to meet the transition deadline and with the recognition that these disruptions likely require a shorter timeline and more intensive efforts than usual curricular development (our group met weekly to achieve a 6-month transition window). During these meetings, the logistical, educational, and technological needs of the event, learners, and educators must be addressed. These include setting expectations, aligning instruction and content with learning objectives and clearly delineating the process of engagement and evaluation. See Fig. 2, Tables 4, and 5. All must be given equal attention as neglect of one can sabotage the entire event.

Key to this process is applying the principles of Universal Design for Learning which include the provision of multiple means of engagement for learners [19–21]. For example, providing education on the virtual platform meets a wide range of learner needs in terms of geographic and social distancing considerations, with multiple educational strategies, i.e., video-based simulation learning, simulated patients, and socially distanced hands-on learning to reinforce this. Creation of multi-modality learning within large-scale virtual educational events also allows multiple means of perception (i.e., simulated patients, video simulations), physical action, expression, and communication (i.e., chat, verbal interactions) [19]. Intertwined with this is the importance of cognitive load theory in planning alternative instructional strategies during a disruption. Miller suggested limits to working memory capacity in 1950 [25], a concept built upon in by Sweller in the 1980s to describe the effect and influences
of intrinsic (associated with essential aspects of task performance) and extraneous (associated with non-essential aspects of task performance) cognitive loads on learning during instructional events [26]. Germaine cognitive load refers to that associated with intentional use of cognitive learning strategies [27]. In our example of intern preparation week, the aim was to keep the intrinsic cognitive load similar between the traditional and “new” educational events. This was achieved by consistency in the content with minimal adaption of the materials required to translate them to the virtual platform. This ensured that the content was not made more challenging virtually and avoided increasing intrinsic

Fig. 2 Principles of Meeting Needs (example with COVID-19 as the disruptor)

Table 4 Key instructions for learners (utilizing COVID-19 as the disruptor and transition of a capstone event for all MS4s to the virtual platform as the educational change)

1. Clear description of dates and times for sessions. Crucial to include time zone if appropriate
2. Emphasize importance of timeliness and “Zoom etiquette” i.e. no driving, quiet environment, no inappropriate chat/verbal comments, respect for co-learners, simulated patients and faculty, appropriate clothing
3. Build in a time buffer. Ask learners to login 10–15 min before and keep in waiting room to allow event to start on time and educators to brief in main room before learners enter
4. Provide a clear description of learning objectives and expectations
5. Describe any pre-course materials; provide links and requirements if using flipped classroom approach
6. Describe the format and provide any additional resources necessary (e.g. narrated video of instructions recorded by organizers in Zoom) to aid learners’ access and understanding of how they navigate the sessions
7. Be specific about the format of the sessions and engagement within these i.e. chat function encouraged or disabled, participants expected to be on video, Q and A use and if this is anonymized, etc
8. Describe importance of changing name in Zoom to the format: first name, last name, no nicknames so as to be able to track attendance
9. Emphasize importance of downloading the most recent Zoom updates
10. Delineate the chain of communication if there are any technology issues, i.e., “Tech support” in the room who communicate with planning committee and with “Lead Tech Support”
Table 5  Key preparation for faculty (utilizing COVID-19 as the disruptor and transition of a capstone event for all MS4s to the virtual platform as the educational change)

A. Faculty education session
1. Member of planning committee arranges teaching session for faculty before event. Schedule well in advance and have small group sessions specific to faculty group i.e. specific simulation scenario or panel session. Avoid one large group session to cover all needs, as it will be effective for none
2. Host in the platform to be used for education so you can rehearse and troubleshoot technical issues as necessary
3. Clearly describe learning objectives for learners of the session each faulty member is teaching
4. Describe the expectations of faculty with regard to both educational content, educational strategy and technology
5. Provide sufficient support for faculty such that they can concentrate on educating. For example, in our learning event for the Trauma scenario with a video, we had Tech Support play the video with predetermined “start” and “stop” times and Faculty had a script with question prompts for each video “stop” time. The faculty would signal to Tech Support when to re-start video after the questions had been asked and answered. This reduces the cognitive load of faculty and improves educational experience for learners
6. Describe how learners will interact with faculty during session e.g., chat only, audio, video
7. For simulation, sessions provide education that at minimum discusses the importance of the fiction contract, creating a psychologically safe learning environment and details the Vegas Rules. Provide education to faculty on debriefing in the virtual environment. We chose the work of Cheng et al. [32] to base our faculty education on

B. Instructions for faculty
1. As per Table 4
2. Organize a “huddle” for course organizers, technical support and committee planning members just before each event is due to start. This will allow any issues to be dealt with in real time, a short brief to be conducted and everyone to be well prepared to start the event on time
3. Provide specifics of number of learners in each sessions, times rooms will change and times for breaks to allow faculty to moderate and monitor the pace of their teaching/discussion
4. Reinforce the importance and expectations of the brief-simulation-debrief model for simulation sessions and the importance of the debrief incorporating learner, simulated patient and faculty feedback
5. Describe how in panels sessions the moderators (i.e., course organizing committee) will be directing the conversation based on the questions in the chat/Q and A from the learners
6. Emphasize that if there are any technical issues there is a robust support system including Technical Support in the room who communicate with Lead Technician and the committee planning team. If technical issues are to occur faculty should continue to teach in an adapted fashion if this is permitted to allow the support team time to fix the issue. Faculty should be aware that an enforced break may be required and the session adapted around this

cognitive load on an unfamiliar learning platform. Managing the extraneous load of a new event following an educational disruption is more difficult. The learners are aware of the disruption and are likely affected by this, possibly both physically and mentally, which brings extraneous load to the situation before elements of instructional design are contemplated. Educators must factor in the extraneous load of new delivery of this content. In our example, the instructional methods were kept as consistent as possible between the in-person and virtual events, e.g., panel sessions, simulations for these reasons. The cues given to the learners in simulations were visual and aural similar to in-person, although we recognize that on the virtual platform, simulated participants (SP) have described challenges to effective non-verbal communication with learners [28]. With this in mind, learner recommendations included having Zoom in “speaker view” when interacting with the SP to maximize the resolution and minimize extraneous load. In addition, virtual backgrounds (e.g., hospital bed, drip stands) are rapidly and easily available and improved the fidelity of the simulation for the learners. This enabled the learners working memory capacity to be dedicated to the task utilizing the active learning strategy of simulation. With due attention to cognitive load theory during transition of education during disruption, barriers can be removed to enable effective educational action (Kotter’s step 5) and hence maximize learning (Table 1) [10, 11].

When additional technology is required to meet learners’ new needs during times of educational change, this can be daunting, especially if medical educators are not subject matter experts in technology. Despite initial reservations that planning committees of virtual large-scale multi-modality educational events may have, the virtual platform is well placed with features to facilitate these. Examples include the “large meetings” add-on that can allow for up to 1,000 participants on one virtual platform, while also allowing up to 50 break out rooms. Events of these size would be challenging in person and, with enough facilitators and educators, are more easily organized virtually. In addition, Webinar functions allow panelists to be “pinned” (i.e., shown at all times) and non-video participants hidden in order to de-clutter and optimize the learner interface with the event. Chat functions can be anonymized or directed only to panelists to enable privacy and optimize learner engagement. Polls also enable more active learning strategies to be employed and can also
be anonymized in order to allow learners to feel more comfortable responding honestly. The virtual features could be maximized through collaboration within the “guiding coalition” of this event and technology subject matter experts. Finally, it must be recognized that virtual learning may not be possible in all disruptive situations. For the COVID-19 pandemic, the virtual environment has provided a means of continued engagement and interaction with learners over distance and minimization of the infective risk. Other disruptions to education may be caused by events leading to building destruction; physical space being inaccessible or unsafe and an internet connection may be disrupted or may not exist at all. In those instances, the “guiding coalition” during the “Principles of Assessment” phase should direct efforts to determining what change is required to meet the needs the disruption has caused.

Principles of Evaluation

Evaluation is the crucial sixth step as described by Kern in curricular development and is formative in the circular process of renewal [9] (Table 2). It is therefore inadequate to merely translate an educational event to a different modality to deal with a disruption without determination that this event was at least as effective as the traditional offering. Following the hyper-acute phase of the COVID-19 pandemic, there was a need to adopt a thoughtful and considered approach to use of the virtual platform. Initially educators were required to make a rapid virtual transition with little idea whether these strategies were effective. Success of some of these events was important to bolster morale regarding this rapid change, and “short term wins” were generated (Kotter’s sixth step) [10, 11]. After the immediate effect of the disruptor to education has passed, efforts should focus on identification of those elements best suited to the virtual environment, and which features make this so, to best serve educators to incorporate successful elements into durable educational strategies. With this is the challenge of translating the “best bits” from the changes precipitated educational disruption into long term benefits (Kotter’s steps 7 and 8; sustain acceleration and institute lasting change) [10, 11]. The most effective way to achieve these final steps is to demonstrate robust evaluative evidence to support elements/ events and their continuation post-disruption.

The updated Kirkpatrick model of evaluation is useful in times of rapid change as it provides a concise framework to guide evaluative comparison [12, 13]. Where possible, the evaluations used for in-person events should be modified for the virtual event to enable like to be compared with like. Evaluation should include the educational content, faculty performance, and the efficacy of technological approach utilized. Quantitative and qualitative evaluations are both useful. Ideally, the efficacy of the virtual educational event should be evidenced by objective and measurable results (Kirkpatrick level 4). This may be challenging, particularly if the transition window is short. Using our example of the rising intern preparation week, it would be robust to have a measure of the effect of the learning event on intern performance (level 3). However, the logistical and organizational challenges of this prohibited performance of such an evaluation as more than half of the MS4 class matriculated to a different institution for intern year. When survey and pandemic fatigue are factored into this also, it is even more challenging to gain evaluative data pertaining to higher Kirkpatrick levels. The “guiding coalition” should be mindful of this and realistic about the limitations faced in order to avoid erosion in morale and degradation of buy-in from the “volunteer army” (Kotter’s step 4) [10, 11].

Massive Open Online Courses or MOOCs have proliferated in the last few decades and offer learners to access education and resources that they would not have in-person. These were available pre-pandemic, and lessons learnt regarding principles of evaluation for MOOCs can be important in assessing which changes made to learning during periods of educational disruption can be useful beyond this. Chesnai et al. identified a knowledge gap regarding evaluation of MOOCs [29]. While most evaluations have historically focused on assessing participation, assignments, and self-reported learner outcomes, the authors identified a lack of determination of how learning happens and assessment of medium and longer-term behavioral and cognitive outcomes of participants [29]. As we have linked the principles of adapting an event during a time of educational disruption to Kotter’s theory of leading change, Chesniak et al. utilize theories of change to focus evaluations on the process of learning itself [29, 30]. Educators responsible for evaluation of education adapted during a disruption can utilize evaluations based on theory of change in order to identify strategies that can be effective and durable beyond this [30]. This need not be limited to the virtual platform and can be built into the delivery and evaluation of any new educational event to provide a more robust evaluation. De novo changes specific to the disruption response should be evaluated. For example, virtual simulations were rapidly adopted during the COVID-19 pandemic, and yet their efficacy and safety has not been not widely understood. For any simulation event, it is essential to assess the psychological safety learners experienced within the format [31, 32]. Recent experience with and recommendations for debriefing in the virtual environment has been published and can help organizers, educators, and facilitators in performing effective debriefs for these virtual events [33, 34]. One such approach involves the Communities of Inquiry (CoI) framework, which highlights and allows assessment of educator presence, social presence, and cognitive presence within
the debriefing activity [34]. When the disruptor requires translation of education to the virtual platform is important to recognize the barriers associated with the platform and construct strategies within the virtual debriefing to enhance the psychological safety of learners and hence efficacy of the debrief. Evaluation tools based on the CoI framework may help identify and address issues with this to ensure optimum learning.

**Broader Application of Principles**

In this work, we use the example of transition of a mandatory rising intern preparation week from in-person to virtual for all MS4s to illustrate the applications of the Principles described. Many other educational events were disrupted during the COVID-19 pandemic including pre-clerkship blocks and core clinical rotations. In the hyperacute phase, many learning events were cancelled, with a negative impact on the medical student experience including mental health issues, burnout, and imposter syndrome [35]. Preparing educators for future disruptions may mitigate these. By adhering to the Principles of Assessment, Meeting Needs, and Evaluation, we provide guidance by which an educational disruption can be handled.

Early in the disruption, we recommend open and clear dialogue with all stakeholders (learners and educators) to provide a targeted needs assessment (per Kern [9]) of the situation. This allows educators to set new realistic goals and objectives for the disrupted curriculum that meet the current needs of the learners. This is crucial not only to ensure the learners do not feel abandoned, but also to ensure longevity of our workforce to ultimately benefit our patients. Dialogue also promotes a positive educational culture and psychological safety allowing a team-based approach to providing a solution to the disruption. Leadership support is also crucial to enable educators to effect and maintain quality educational changes. With regard to clinical rotations, if disruption of access to patients is seen, simulated patients (SPs) and clinical skills models can provide a useful adjunct or temporary replacement to allow maintenance and development of learner skills. Access can be improved for learners utilizing the virtual platform, e.g., telesimulations, but attention should be paid to learner engagement, crucial for translation of teaching to learning [36–38]. Virtual learner engagement may be difficult to assess, but recent tools have been developed, and active learning strategies described to promote engagement (e.g., gamification, flipped classroom approach, polling) [36–38]. When assessments such as OSCEs are performed through the virtual platform, it is important to consider the security of this modality, to ensure fair and accurate assessment and to protect learners, educators, and support staff, e.g., SPs. Strategies that can be employed include screen sharing while on virtual communication platform to ensure learner does not have reading materials open and/or a proctor in the room with examiner/SP to monitor student behavior/eye movements. Desktop sharing and third party security outsourcing are also options but comes with security risks which should be offset against the benefits of these approaches.

**Future Directions**

The landscape of education has been changed by the disruption of the COVID-19 pandemic. Utilization of the virtual platform for healthcare education has been accelerated, and although there are challenges to establishing large scale virtual events such as we describe (e.g., effort required, expertise, and time commitment), there are clearly identifiable benefits including increased engagement of learners and ability for learners to participate in a location that suits them. Scaffolding educational responses to disruption following the three principles outlined above that are rooted in Kern’s six steps of curricular development [22] and cognizant of Kotter’s framework for leading change [11, 12] may allow educators to craft the most effective and durable educational strategies.

Throughout the response to disruption, it is essential to perform evaluations of any new event as a guide to which parts may be most effectively incorporated into sustainable educational efforts. Challenges to this are identified as Kotter’s 8-steps are traversed, and the “guiding coalition” should be realistic about what evaluative efforts are feasible. An illustrative example from our rising intern preparation week that has influenced our future educational plans is that the medical students greatly valued the addition of the “ideal trauma activation” video component (50% of respondents who completed answer to an open-ended question regarding identification of the best part of the week). The video was an adaptation made for the virtual learning environment and had never been offered in person. Verbal feedback from students during the debriefs and written evaluations provided qualitative data and revealed that the students who valued the video found that this format provided higher educational value than in-person trauma simulations they had previously been involved in. Specific representative examples include appreciation of the ability to “stop-start” the video and have question and answer sessions with subject matter experts in real time, which was facilitated by the Zoom platform. Further, they appreciated the ability to see “the way it should be done.” Verbal responses from MS4s in the debrief described that during their in-person simulation experiences they had worked together as a group and, although received feedback, did not believe they got a good idea of what a “perfect performance” would look like. These data led us to incorporate
a video-component in our sustainable curriculum, and we also plan to pilot video-based, video-, and SP-based and SP-alone comparisons for non-trauma scenarios in order to determine the most effective educational strategy for our learners during the pandemic and beyond.

**Conclusion**

Disruptions in education can occur at any time and for multiple reasons. Utilizing a framework to guide this process can provide some order within the chaos for medical educators and provide a way in which to provide durable change where beneficial. As an example, we describe that although translation of large-scale multi-modality educational events from in-person to the virtual platform is a challenging task, with an integrated team-based approach, it can be successful and allow increased learner engagement. In addition, virtual learning events may allow increased access to high-quality medical education beyond the geographical restrictions in-person learning imposes. To manage any educational disruption, adequate resources and preparation with involvement of an inter-professional, multi-disciplinary team of experts in the planning committee are required.

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**Declarations**

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**Conflict of Interest** The authors declare no competing interests.

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