Rapidly building surge capacity within a pandemic response using simulation-based clinical systems testing

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ABSTRACT

Introduction As the SARS-CoV-2 virus spread across the globe, hospitals around the USA began preparing for its arrival. Building on previous experience with alternative care sites (ACS) during surge events, Texas Children's Hospital (TCH) opted to redeploy their mobile paediatric emergency response teams. Simulation-based clinical systems testing (SbCST) uses simulation to test preoccupancy spaces and new processes. We developed rapid SbCST with social distancing for our deployed ACS, with collaboration between emergency management, paediatric emergency medicine and the simulation team.

Methods A two-phased approach included an initial virtual tabletop activity followed by SbCST at each campus, conducted simultaneously in-person and virtually. These activities were completed while also respecting the need for social distancing amidst a pandemic response. Each activity's discussion was facilitated using Promoting Excellence and Reflective Learning in Simulation (PEARLS) for systems integration debriefing methodology and was followed by compilation of a failure mode and effects analysis (FMEA), which was then disseminated to campus leaders.

Results Within a 2-week period, participants from 20 different departments identified 109 latent safety threats (LSTs) across the four activities, with 71 identified as being very high or high priority items. Very high and high priority threats were prioritised in mitigation efforts by hospital leadership.

Discussion SbCST can be rapidly implemented to hone pandemic responses and identify LSTs. We used SbCST to allow for virtual participation and social distancing within a rapidly accelerated timeline. With prioritised FMEA reporting, leadership was able to mitigate concerns surrounding the four Ss of surge capacity: staff, stuff, structure and systems.

INTRODUCTION

As the SARS-CoV-2 virus began to spread across the globe, the USA started preparing for its arrival.[1] The Federal Healthcare Resilience Task Force suggested alternative care sites (ACS) as one way to mitigate potential capacity shortages in medical facilities due to an anticipated surge.[2] In response to the global pandemic, Texas Children's Hospital (TCH), building on experience from two previous deployments of the ACS, elected to redesign, implement and test mobile paediatric emergency response team (MPERT).[3 4]

The MPERT concept was created during Houston's response to Hurricane Katrina (2005), caring for thousands of displaced persons from directly affected areas and then again during the 2009 H1N1 influenza pandemic, as an ACS for a surge of low-acuity patients.[3] In 2009, the MPERT was open for 7 days, seeing 356 patients (18% of total Emergency Center (EC) volume), with a median of 48 patients/day.[4]

As hospital leaders discussed the coronavirus (COVID-19) pandemic response, reactivation of the MPERT was considered as an option to mitigate a potential surge of low-acuity patients. In 2020, compared to 2009, TCH now included three distinct hospital campuses: TCH-Medical Centre (TCH-MC), TCH-West Campus (TCH-WC) and TCH-Woodlands (TCH-WL), with two of the three sites having adjacent Texas Children's Urgent Cares. While the previously used site was available for TCH-MC, the community campuses, TCH-WC and TCH-WL, had never had an MPERT deployment. This undertaking would require a multidisciplinary approach to the design, build and implementation.

With direction from the Incident Command System, emergency management and paediatric emergency medicine (PEM) leaders developed plans for a tri-campus MPERT response, with an overall goal to serve as ACS's for screened, stable, low-acuity patients during a surge; imagine the 'worried well' type of patient. Initial goals and processes, including a patient selection algorithm and available resources for the MPERT spaces, were aligned, using experience from previous MPERT deployments and projected needs regarding the COVID-19 response.

Simulation-based clinical systems testing (SbCST) has been previously described to identify latent safety threats (LSTs) prior to opening new healthcare facilities, typically with months of simulation planning prior to implementation, and additional time to remediate potential safety issues prior to opening.[5 6] However, there are no published descriptions of the rapid use of SbCST to develop and improve processes for pandemics and temporary units, which by necessity operate on a much shorter timeline, in this case also with additional requirements for physical distancing. We describe the use of both tabletop simulation and SbCST using video conferencing technology to rapidly test MPERT processes for a pandemic response across three hospital campuses. These sought to identify LSTs within the commonly referenced four Ss of surge capacity: staff, stuff, structure and systems.[7]

METHODS

We designed a two-phased approach to SbCST for MPERTs, first with a videoconference tabletop simulation, followed by individual in situ simulations at each campus with videoconferencing for observers. SbCST typically requires months to years of planning including the evaluation of architectural designs, processes and workflows; scenario planning; conducting the SbCSTs; and subsequent modifications prior to opening.[6] Colman describes SbCST for a new paediatric subspeciality outpatient centre with 12 months of planning and 3 months of systems tests.[5] In contrast, due to the pandemic response timeline, design and execution of the SbCST was accomplished in just under 2 weeks, with novel physical distancing modifications required due to COVID-19. While the scope and care spaces are not equal, this timeline is much tighter than what has been described.

The first phase, the tri-campus tabletop simulation, was hosted via videoconferencing for all participants with the exception of the simulation staff in charge of facilitation, who were physically distanced in a conference room. The goal was to evaluate the MPERT spaces and processes prior to buildout and activation through conceptualisation and imagining LSTs in the environment, technology and equipment, processes of care/workflows, roles and responsibilities, and clinical knowledge and performance. Specific objectives for the scenarios were derived from informal iterative needs assessments by members of emergency management and PEM (table 1). Key stakeholders including EC leadership, infection control, patient safety and quality, patient registration, security, and both medical and nursing leadership from all three campuses were invited to the teleconference. During orientation, in addition to reviewing simulation best practices surrounding psychological safety and confidentiality and fiction contract, participants were assured that each campus would be asked for input unique to their campus with a focus on systems issues, not individual performance or knowledge. Participants were encouraged to speak one at a time and to use the chat feature within the video conferencing tool. The specifics of personal protective equipment (PPE) required for patients, caregiver and care team were tabled due to the evolving pandemic, and instead, reassurance was provided that we would follow recommendations at the time of MPERT activation.

Scenarios were introduced individually followed by a facilitated discussion as participants virtually 'walked' the patient from the time they presented to the MPERT, through their patient care to discharge. Facilitators rotated the discussion to the participants from each campus and monitored comments in the chat to maximise full participation of the large multidisciplinary group. The discussion was facilitated using Promoting Excellence and Reflective Learning in Simulation (PEARLS) for systems integration debriefing methodology including reflective, open-ended and clarifying questions.[8]

Members of the simulation team not tasked with facilitation observed the tabletop discussion and transcribed the debriefings. Subsequently, the facilitators, trained in failure mode and effects analysis (FMEA) methodology, used the transcripts to identify themes and assign FMEA scoring based on the institutions standardised scoring tool (table 2). This report was disseminated to all key stakeholders for review prior to the initiation of phase 2.

The second phase, consisting of individual campus SbCSTs, required that the buildout of each MPERT was complete and stocked with equipment and supplies. Using the FMEA from the tabletop exercise in phase 1, objectives were further defined and a single patient scenario used (table 3). Aligning with the first phase, key stakeholders were invited to participate via teleconference unless actively providing care in the scenario.

Each SbCST began with electronic registration of both in-person and virtual observers, consent to confidentiality and photography, orientation to simulation for both virtual and physical participants and review of the agenda. The participants proceeded to the MPERT location for scenario prebriefing and orientation to the space.

Participants who attended physically were expected to abide by social distancing guidelines, including physical separation and universal masking. The patient care team mirrored planned MPERT staffing and included employees from the EC leadership team and/or clinical staff who were overflow on the day of the simulation. The volunteer team included two nurses (one bedside nurse and one triage nurse), a patient care assistant (PCA), a medical provider and one to two registration staff. Teleconferencing equipment was configured using a mobile workstation that was manoeuvred throughout the simulation, following the patient. The virtual participants were able to follow the patient, represented by a low-fidelity manikin, and the confederate parent, from arrival to discharge.

Debriefing immediately followed each SbCST, with observers and participants gathering both virtually and in-person to discuss process gaps and identified LSTs. In the same process as used in phase 1, discussion was facilitated using PEARLS for systems integration debriefing methodology, simulation staff observed and transcribed, and then compiled location-specific FMEA reports that were disseminated to hospital leaders.

Table 1 Phase 1 scenarios with objectives

	Tabletop scenarios	Scenario objectives
1	A 14-month-old toddler (girl) with fever and cough. Vital signs show haemodynamic stability. Examination is non-focal.	Participants will discuss and identify LSTs that may arise when a patient ▶ requires administration of a medication ▶ requires a urinary catheterisation ▶ requires point-of-care urinalysis ▶ is moved to the sub-wait area
2	An 8-year-old boy with fever, cough and runny nose. Vital signs show haemodynamic stability. Examination concerning for diminished air movement with wheezing.	Participants will discuss and identify LSTs that may arise when a patient ▶ requires non-urgent transfer to the emergency centre
3	A 5-year-old girl with fever and sore throat, and household contact with positive SARS-CoV-2 testing. Vital signs show haemodynamic stability. Examination concerning for pharyngitis.	Participants will discuss and identify LSTs that may arise when a patient ▶ requires nasopharyngeal testing ▶ requires a rapid strep test and throat culture ▶ requires a prescription to be printed at discharge
4	A 5-month-old baby (boy) with fever and crying who decompensates in the MPERT waiting room.	Participants will discuss and identify LSTs that may arise when a patient ▶ requires emergent higher level of care than provided at MPERT

LSTs, latent safety threats; MPERT, mobile paediatric emergency response team.
Patient scenarios are not from an actual patient. Any resemblance to a real person, living or deceased, will be a coincidence.

RESULTS

Within a 2-week period, 111 non-unique participants from 20 different departments (table 4) identified 109 LSTs across the two phases (table 5), with 71 very high or high priority items (table 6).

Table 2 FMEA scoring tool

	4—Catastrophic	3—Major	2—Moderate	1—Minor
Severity categories	**Failure could cause death, injury** Patient outcome: ▶ Death or major permanent loss of function (sensory, motor, physiological or intellectual) Visitor outcome: ▶ A death; or hospitalisation of ≥3 Staff outcome: ▶ A death; or hospitalisation of ≥3 Equipment/facility damage: Firer beyond incipient stage; or damages ≥US$250 000	**Failure could cause high degree customer dissatisfaction** Patient outcome: ▶ Permanent lessening of bodily functioning (sensory, motor, physiological or intellectual); or ▶ Increased length of stay or increased level of care for ≥3 patients Visitor outcome: ▶ Hospitalisation of 1–2 visitors Staff outcome: ▶ Hospitalisation of 1–2 staff; or ▶ ≥3 Saff experiencing lost time, or restricted duty Equipment/facility damage: ▶ Damages US$100 000–250 000	**Failure can be overcome, but there is minor performance loss** Patient outcome: ▶ Increased length of stay or increased level of care for 1–2 patients Visitor outcome: ▶ Evaluation, treatment of 1–2 visitors Staff outcome: ▶ Medical expenses, lost time, or restricted duty for 1–2 staff Equipment/facility damage: ▶ Damages US$10 000–100 000; or ▶ Fire, at/smaller than incipient stage	**Failure not noticeable to customer, no effect on delivery of service** Patient outcome: ▶ No injury, nor increased length of stay, nor increased level of care Visitor outcome: ▶ Evaluated but no treatment Staff outcome: ▶ First aid only, no lost time, or restricted duty Equipment/facility damage: ▶ Damages <US$10 000; or ▶ Loss of utility without adverse patient outcome
Probability ratings	**Frequent** Likely to occur immediately or within a short period (may happen several times in 1 year)	**Occasional** Probably will occur (may happen several times in 1–2 years)	**Uncommon** Possible to occur (may happen sometime in 2–5 years)	**Remote** Unlikely to occur (may happen sometime in 5–30 years)

Risk priority number (RPN) is calculated by multiplying severity score by probability score. Issues are considered significant priorities if RPN is between 8 and 16 on scale of 1–16.
FMEA, failure mode and effects analysis.

Table 3 Phase 2 scenario with objectives

SbCST scenario	Objectives
A 14-month-old toddler (girl) who presents with fever and cough. Vital signs reveal a febrile but haemodynamically stable child. Examination is non-focal and therefore this patient is considered to have fever without a localising source.	Observers identify potential LSTs that are encountered when a patient ▶ presents to MPERT for evaluation and treatment ▶ undergoes quick registration ▶ process through initial triage ▶ is placed in the MPERT waiting room ▶ is moved to a patient care space ▶ requires medication administration ▶ requires a urinary catheterisation ▶ requires point-of-care testing ▶ is moved to the sub-waiting area to wait for results ▶ undergoes full hospital registration ▶ requires a discharge prescription ▶ is counselled and discharged from the MPERT

LSTs, latent safety threats; MPERT, mobile paediatric emergency response team.
Patient scenarios are not from an actual patient. Any resemblance to a real person, living or deceased, will be a coincidence.

Tabletop

Representatives from all campuses gathered virtually for a 3-hour tabletop discussion of four patient scenarios (Tables 1 and 4). Twenty-one LSTs were identified (table 5) with high priority themes (table 6) (online supplemental material 1).

Participants discussed PPE, limited medications, restriction to point of care (POC) laboratory testing as well as SARS-CoV-2 nasopharyngeal PCR swabs, and other supplies needed for the MPERT. Resource concerns, such as the need for readily available nasopharyngeal swabs for SARS-CoV-2 testing to avoid unnecessary delays, were identified. Participants identified the need for a simple, standard electronic heahth record (EHR) interface as MPERT staffing would come from a variety of clinical areas. Unique EHR-related considerations included the need for adequate workstations and laboratory label printers. Providing accurate standardised discharge instructions was also highlighted. A video message (English and Spanish) with standardised discharge instructions for possible SARS-CoV-2 was available, and two campuses had televisions playing this video. Participants recommended a television for the third campus and standardised handouts for families.

Identified systems' LSTs included ensuring appropriate patient selection, efficient patient flow, implementing adapted workflows and escalating to the EC if needed. For example, participants suggested a modified workflow in which staff would order laboratory testing, gather the materials and print the label prior to entering the patient area, enabling staff to only enter the patient room once. During the scenario in which a patient required escalation of care, participants considered the available resources and discovered that the MPERT proximity to each campus's EC would allow for rapid transport if needed.

West Campus

This was the first SbCST. A multidisciplinary group of participants (table 4) identified 29 LSTs (table 5) with high priority themes (table 6) over 2 hours (online supplemental material 2).

The TCH-WC MPERT was in an exterior hallway immediately adjacent to the EC, posing unique facility challenges. This placement allowed for only one point of access for patients. Initially, patients were registered quickly and escorted through the entire MPERT to start triage at the closed end and then proceeded stepwise back towards the entrance. During the simulation, it was observed that this design inadvertently increased the back and forth for both patients and MPERT staff. The participants suggested reversing this and relocating triage adjacent to the entrance so patients could be fully triaged and sent directly to a care space or the waiting space. The care spaces were intentionally set up with plastic chairs as opposed to exam tables or stretchers given anticipated short stays and for easy disinfection. For urinary catheterisations of young children with fever, a procedure area was

Table 4 Participants and departments represented with campus distribution

	Participants	Departments represented		Participant distribution			
				TCH-MC	TCH-WC	TCH-WL	Floater
Tabletop	34	Simulation Emergency Management Nursing EC Leadership from each campus Physician EC Leadership from each campus Advanced Provider Representation Patient Safety Environmental Services	Patient Care Management Infection Control Facilities Hospital Leadership Pathology Central Supply	35%	21%	23%	21%
TCH-WC	28	Simulation Emergency Management Nursing EC Leadership from TCH-WC Physician EC Leadership from TCH-WC Patient Safety Infection Control	Facilities Hospital Leadership Pathology Central Supply Registration	18%	57%	4%	21%
TCH-WL	29	Simulation Emergency Management Nursing EC Leadership from TCH-WL Physician EC Leadership from TCH-WL Patient Safety Patient Care Management Infection Control	Facilities Hospital Leadership Pathology Central Supply Registration Admissions Business Operations	13%	0%	66%	21%
TCH-MC	20	Simulation Emergency Management Nursing EC Leadership from TCH-MC Physician EC Leadership from TCH-MC Patient Safety Infection Control Security	Facilities Hospital Leadership Pathology Central Supply Registration Quality Environmental Services	70%	0%	0%	30%

EC; TCH-MC, Texas Children's Hospital-Medical Centre; TCH-WC, Texas Children's Hospital-West Campus; TCH-WL, Texas Children's Hospital-Woodlands.

Table 5 LST's identified, sorted by category and priority

	Resource issues			Systems issues			Facility issues			Clinical performance issues			
	High priority	Very high priority	Total identified	High priority	Very high priority	Total identified	High priority	Very high priority	Total identified	High priority	Very high priority	Total identified	Total LSTs identified
Tabletop	1	2	6	3	2	14	1	0	1	0	0	0	21
TCH-WC	6	1	11	2	9	11	4	0	5	1	1	2	29
TCH-WL	7	0	12	4	3	11	8	0	9	0	0	0	32
TCH-MC	4	0	8	3	0	10	5	4	9	0	0	0	27

TCH-MC, Texas Children's Hospital-Medical Centre; TCH-WC, Texas Children's Hospital-West Campus; TCH-WL, Texas Children's Hospital-Woodlands.

located at the terminal end of the MPERT space. The participants found that this was too far from the care spaces and recommended part of the supply area be converted into a procedural space to improve efficiency. The SbCST also revealed opportunities to improve staging of equipment and supplies. Participants suggested optimisation of trashcans and hand sanitiser stations. They suggested separate mobile workstations for the care team and equipping the nurse's station with an attached lab printer, to improve efficiency and support social distancing. Participants recommended disposable stethoscopes, medication storage, along with commonly used supplies, be placed adjacent to patient care room entrances.

Due to the geographical proximity of the initial medical screening exam (MSE) for all EC patients to the MPERT entrance, there were concerns that unscreened patients might inappropriately go directly to the MPERT, especially during high arrival times. Participants suggested the formation of separate lines for the MSE and MPERT, with clear signage and to relocate the MSE to just outside the entrance. LSTs specific to infection control included workflow for clustered care and proper usage of PPE. The participants discussed the organic nature of the care interactions and appropriate timing of patient care, but all agreed cluster of care was a priority to minimise care team exposure.

Woodlands

This was the second SbCST. A multidisciplinary group of participants (table 4) identified 32 LSTs (table 5) with high priority themes (table 6) over 2.5 hours (online supplemental material 3).

The TCH-WL MPERT was built within a pre-existing radiology waiting room that was a negative pressure room with two doors allowing for one-way traffic. The proposed triage location did not allow for patient privacy; participants identified an alternative space that would provide greater privacy. Participants suggested signage to delineate the individual partitioned rooms for both patient navigation and staff clarity. SbCST revealed the need for a table for medications and other supplies.

Systems LSTs included process inefficiencies such as shared workstations and inconvenient printer locations. Individual computer workstations for each clinical staff member as well as conveniently placed printers support social distancing and

Table 6 Identified high and very high priority themes

	Resource issues											
	EHR concerns	Surge plan	Absent trash cans	Sanitisation equipment	Registration materials	Triage equipment	Storage of PPE	Need for a runner	Dedicated workstations	Bedside workstations	Communication devices	Specimen collection process
Tabletop	X											X
TCH-WC		X	X						X	X	X	X
TCH-WL				X					X	X	X	X
TCH-MC					X	X	X	X				

	Systems issues								
	Ambulance arrival	Specimen collection process	Medication tracking	Process for patient transfer	Combining assessments	Patient discharge process	PPE	Registration process	Patient flow
Tabletop							X	X	X
TCH-WC	X	X					X	X	X
TCH-WL			X	X			X	X	X
TCH-MC					X	X	X	X	

	Facility issues									
	Maintain confidentiality	Dedicated workstations	Adjustment to layout	Registration capacity	Triage capacity	Layout of triage area	Social distancing practices	Echoing	Missing patient divider walls	Crowd control	Signage
Tabletop	X										
TCH-WC		X	X								
TCH-WL				X	X						X
TCH-MC						X	X	X	X	X	X

EHR, electronic health record; PPE, personal protective equipment; TCH-MC, Texas Children's Hospital-Medical Centre; TCH-WC, Texas Children's Hospital-West Campus; TCH-WL, Texas Children's Hospital-Woodlands.

streamlined workflow. A rapid influx of patients was an anticipated system stressor. Identified solutions included an additional registration area, a PCA to assist with triage, and a dedicated runner to alleviate the burden on MPERT staff.

Infection control LSTs included sterilisation of high touch surfaces such as pens and clipboards during registration, proper PPE disposal and adequate hand hygiene stations. Participants also recommended bundling care to minimise staff exposure and PPE use. In addition to the previous suggestion for the provider to bring testing supplies when first entering the room, it was suggested that anticipatory guidance be discussed during the initial provider exam to minimise unnecessary returns to the room.

Main campus

This was the final SbCST. A multidisciplinary group of participants (table 4) identified 27 LSTs (table 5) with high priority themes (table 6) over 2 hours (online supplemental material 4).

The TCH-MC MPERT was located across from the EC in a single-storey covered parking garage. A surge of arrivals posed concerns for registration and triage. Ideal flow would be registration first, triage second and then directly to a room or waiting area. The proposed arrival area did not accommodate more than one or two persons waiting. Participants suggested separate registration and triage tables, allowing for direct access to the waiting area should triage become overwhelmed. SbCST revealed several opportunities for wayfinding. Participants suggested signage for each patient care space, waiting areas, and exit location and process. As the space is normally a parking lot, pre-existing 'one-way' signs needed to be covered to prevent confusion.

LSTs included processes and workflow optimisation. Examples included supply storage, location of computer workstations and printers, and location of POC testing. They requested a mobile workstation near the supply area for quick access to the EHR. The existing printer for discharge materials was relocated near the exit to decrease staff back and forth. Additionally, the original POC testing space was remote to the patient care area: participants suggested it be moved adjacent to the care space. LSTs specific to infection control included workflow for clustered care and proper usage of PPE. As in other SbCSTs, participants brought up clustering of care including the timing of obtaining lab testing.

DISCUSSION

Previous work has shown the benefit of using SbCST preoccupancy in new design spaces to identify LST's. To our knowledge, this has never been performed on a timeline conducive to disaster/pandemic planning. What we have accomplished with our four activities, across three campuses, shows that, while not traditional, SbCST can be implemented rapidly, using virtual and in-person simulations, to test and address LSTs in ACSs during a pandemic. It is the writers' belief that this process could be extended to other ACS and disaster responses depending on the needs of the institution and community.

In the world of disaster management, the components of surge capacity are referred to as the four Ss: staff, stuff, structure and systems. Using the FMEAs produced, we were able to quickly modify the build space to address the four Ss and mitigate potential LSTs as summarised in the following sections.

Staff

At the time of the simulations, staffing for each MPERT included two providers, two bedside nurses, a triage nurse, a PCA and at least one person for registration. After the FMEAs were reviewed by each campus, additional staffing in the form of institutional security officers was requested based on concerns that were brought up regarding patient flow and wayfinding. As suggested by Iserson in his considerations for ACSs, security personnel with experience handling patients within the system should be used given the possibility that local law enforcement will be overwhelmed.[9]

Stuff

Throughout the tri-campus simulations, concerns regarding ease of access to commonly used supplies were brought up. All three campuses addressed this concern by bringing in portable, easy-to-disinfect tables that could be stocked and positioned within or near patient care areas. Additionally, the simulations allowed the MPERT staff to take an informal inventory of the stocked supplies, and modifications were made based on provider and nursing suggestions. Bundling patient care between the nurse and provider highlighted the need for separate workstations for each. Additional workstations were moved into the spaces to allow for each bedside provider and nurse to have their own workstation. Within our institution, separate printers are used for specimen labels. Concerns regarding proper specimen labelling suggested that these printers be moved to the nursing workstations.

Structure

As the MPERT care spaces used previously occupied space (ie, hallway, parking garage and waiting room), numerous facility modifications were required. While not a part of the SbCST itself, phase 2 requiring the physical build space provided an opportunity for facilities to run through a set-up and breakdown. Based on this experience, our facilities team felt that, similarly to the team from Boston Children's Hospital in 2009, they would require a 24-hour window to establish and stock the ACS.[10] It was noted that while intuitive to MPERT staff, patients and families might find these new spaces confusing and that all the MPERT care spaces would require clear and multi-lingual signage to promote wayfinding. As an ACS for low-acuity patients, patient flow was an important factor when designing and testing the MPERT space. All campuses made modifications to their layouts based on the simulations including movement of where triage was conducted and the treatment room was positioned within our TCH-WC MPERT, where registration was completed at the TCH-WL MPERT and the layout of the triage space at TCH-MC MPERT. The partitioned patient areas in the MPERTS do not provide the same level of privacy as private rooms in ECs. Participants identified unwanted breeches of confidentiality as a potential concern; however, it was felt that the limited MPERT scope of practice would minimise this issue.

Systems

As the intention of the MPERT was to allow a surge of low-acuity patients to be seen in a succinct and safe manner, proper registration was required. Concerns were brought up about this process needing to be modified and streamlined from the EC process to avoid registration becoming the rate-limiting step. Multiple solutions were suggested, and ultimately registration folders were used to allow the parent to work on their registration throughout the encounter versus waiting until patient care was completed to complete their full registration. With the suggestion of registration folders for our patients, additional information was added to these packets to facilitate families accessing their results post-discharge from the MPERT. Additionally, while it was predicted that most of the patients presenting to MPERT would arrive by private vehicle, the question of how to navigate an ambulance arrival with a patient who was appropriate for the MPERT was brought up, and a new process was created.

Conclusions

Using SbCST for our MPERT allowed us to identify and proactively address LSTs within the four Ss, all prior to occupancy. As we have described previously, this process is usually one that can take months or even years. In the setting of a disaster response and pandemic planning, we were able to use the same framework for planning, demonstrating that SbCST and FMEAs are feasible and can be used to identify LSTs even within a temporary new build space. Of course, the unique nature of this response required some modifications to what the simulation team would call 'normal'. This included the tight planning period we have discussed as well as utilisation of virtual methods within both the tabletop and in-person simulations.

Limitations

As one would expect, social distancing recommendations required implementation of virtual methods within these simulations. While virtual methods allowed for a vast multi-disciplinary attendance, it also could have distracted from the simulation and/or allowed observers to miss parts of the simulation they would have otherwise commented on. As there was no blinding or restriction to observers by campus, future campus stakeholders could view simulations before theirs. It is assumed that changes may have been made to the build spaces prior to simulation based on the experience at other sites. In addition, there may be unaccounted bias because the FMEA ratings were assigned solely by the simulation team.

Future directions

While not always feasible based on the timeline of the response, this experience has shown our institution that SbCST can be rapidly deployed within temporarily built spaces to identify and mitigate identified LSTs. This work was found to be extremely beneficial in the formation of these ACSs, and this strategy will be routinely used by the institution in response to future preparedness efforts. Notably, the SbCST framework could prove beneficial in review of several of our current preparedness efforts, many of which include the establishment of temporary areas of care, such as with decontamination team response and family reunification planning. Historically, preparedness plans have been tested through drills implemented by our emergency management team, but this experience has shown the power of engaging with the simulation team for future drills and exercises.

What is already known on this subject

- Simulation-based clinical systems testing has been described to identify latent safety threats prior to opening new healthcare facilities.
- Simulation-based clinical systems testing typically occurs after months of simulation planning with additional time to remediate potential safety issues.

What this study adds

- ▶ Simulation-based clinical systems testing can be used for alternative care sites resulting in mitigation of latent safety threats prior to occupancy.
- ▶ Simulation-based clinical systems testing can be successful despite a rapid timeline.
- ▶ A combination of virtual and in-person techniques can be used in simulation-based clinical systems testing.

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