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Simulation Based Clinical Systems Testing in the Pediatric Emergency Department to Prepare for COVID-19 Pandemic

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Simulation-based Clinical Systems Testing in the Pediatric Emergency Department to Prepare for the COVID-19 Pandemic

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Introduction and Objective

Introduction:

The emergence of the highly transmissible COVID-19 disease resulted in major challenges to our global health systems. In response to the accelerated deployment of hospital-wide protocols to prevent SARS-CoV-2 transmission, we integrated simulation based clinical systems tests (SbCSTs) with rapid cycle deliberate practice concepts to identify latent safety threats (LSTs) in the new workflows and provide recommendations for mitigation. We evaluate this novel approach of testing and training staff for feasibility and utility based on staff assessments.

Objectives:

We hypothesized that a rapidly deployed in situ simulation-based clinical system test (SbCST) could help identify LSTs in the newly developed protocols for COVID-19 patients in the emergency department (ED). The primary outcomes were:

1. The number/frequency of LSTs identified and the recommendations for mitigation.
2. The evaluations by staff related to the process collected via post-training survey data.

Methods

This study took place in a tertiary care children's hospital ED and was approved by the IRB as non-human subject research. We used Gaumard™ mannequins, and portable monitors (SimMon™).

Scenario Flow:

Our simulation-based clinical systems tests were designed to take place in situ in the ED and last 60 to 90 minutes. Each simulation consisted of five phases:

1) Pre-briefing (5 minutes):The most recent hospital guidelines regarding COVID-19 and PPE
2) Simulated case for testing (5-15 minutes): Length of scenario depended on complexity and testing needs.
3) Debrief (15-20 minutes): Scripted "debrief to improve" approach.
4) Repeat case (10-15 minutes): Abbreviated scenario adapted to specific needs (e.g., demonstrating the airborne airway management protocols.)
5) Final debrief (10 minutes): Final summary and evaluation survey.

Study design and setting:

Our work was adapted from methods described by Colman et al in "Simulation-based clinical systems testing for healthcare spaces: from intake through implementation."[1] We reconfigured the SbCST framework to include questions for debriefing that focused on the challenges presented by the new system modifications and PPE usage. Each case used "tipping-point"(s) to test workflow. Short scripted debriefs reviewed guidelines, staff input, and the simulation was repeated. Participants evaluated the SbCST with a survey. Three sim staff collected observations on a standardized form for which process was tested, staff response collected, and LSTs identified. High priority LSTs were reported directly to the ED COVID response team.

(Ref:1. Colman, N., Doughty, C., Arnold, J. et al. Simulation-based clinical systems testing for healthcare spaces: from intake through implementation. Adv Simul 4, 19 (2019). https://doi.org/10.1186/s41077-019-0108-7.)

Results

A total of 76 ED staff participated in 44 trainings conducted over 35 days. Participant data is presented in Table 1. In all, 65 participants filled out the post debriefing survey. Participants identified 103 LSTs. These LSTs are presented by themes and frequency in Table 2. Examples of common LSTs by category and associated recommendations and actions are listed in Table 3.

Table 1: Total Participants by discipline and evaluations completed n=76

Clinical Role	Participants (%)	Completed Evaluation	Complete evaluation (% total staff group participants)
MD/DO	22 (29)	19	86
RT	9 (12)	9	75
RN	30 (39)	24	80
PharmD	4 (5)	4	80
ED Tech	9(12.)	8	89
NP	2 (3)	1	50
	76	65	

Table 2: Latent safety threats by themes and frequencies

Latent safety threat common themes	Frequency (%)
Risk for staff exposure to COVID	18 (17.5%)
Items Missing	18 (17.5%)
Known/Suspected COVID patient transfer process	13 (12.6%)
Known/Suspected COVID patient EARS process	12 (11.7%)
Communication between staff inside/outside room	10 (9.7%)
Known/Suspected COVID patient intubation process	9 (8.7%)
Difficulty hearing among team in the room while in PPE	8 (7.8%)
Potential delay in patient care	6 (5.8%)
Limiting staff entry to avoid COVID exposure	4 (3.9%)
Time out prior to patient transfer/transport	2 (1.9%)
Gap in knowledge of usual workflow	2 (1.9%)
Problems with new technology	1 (1%)

Table 3: Examples of common latent safety threats (LSTs) by category, recommendations and actions taken.

Latent safety threats (Grouped by category)	Frequency	Recommendation to leadership/administration	Actions taken
Communication: Team split between inside and out of resuscitations rooms impairs staff communication with members outside the room.	10 (9.7 %)	· Facilitate communication by using walkie-talkies with handsfree mode.	Walkie-talkies deployed to pharmacy as lead person outside of room.
Equipment Missing: New COVID-19 guidelines restructured clinical spaces so airborne equipment and supplies missing	18 (17.5%)	· Airway resuscitation equipment for COVID19-suspected patients (i.e., viral filters for BVM, anesthesia bags, high-flow oxygen devices, intubation kits) should be added to negative pressure isolation rooms	· Room equipment updated, and equipment locations clearly labeled.
Isolation measures: Strict adherence to current hospital-wide PPE guidelines resulted in a delay in care for a deteriorating patient due to uncertainty of PPE when entering room or needing to doff and then don a higher level of PPE if already in the room when a patient deteriorates	18 (17.5%)	· Simplify PPE guidelines by requiring donning of airborne/contact PPE for all possible COVID19 patients. Airborne PPE *plus* N95 masks should be required for trauma activations and anticipated aerosol-generating procedures (AGP) before entering room	· ED leadership team worked with infection control to clarify the needs during patient care. · Clarifying PPE signage placed outside exam room doors
Job Aid/Task: Existing hospital-wide patient transfer guidelines only applied to non-critically ill patients not requiring an AGP. Staff unclear about the process of moving critically ill patients between clinical areas.	13 (12.6%)	· Develop clearer guidelines for critically ill patients including movement: 1. Travel routes 2. PPE needs &Aerosol generating procedures. 3. Pre-transfer time out & communication w/ ED charge nurse 4. Identifying a "clean person" not in PPE to open doors during transport 5. Transport staff in airborne precaution PPE should not doff PPE until accepting staff in appropriate PPE.	· Specific and streamlined guideline developed, tested, and refined through subsequent simulations. · Final guideline posted on the institutional COVID-19 web resource page.

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Table 4: Descriptive statistics from post-training evaluation (*using a 5-point Likert scale*)

Survey Question: (N=65 participants)	Mean	SD	Median	Min	Max
Each question in this block began with "This sim-based approach was…" (1=Strongly disagree to 5=Strongly Agree)					
1. Worth the time it took?	4.8	0.44	5	3	5
2. An acceptable way to improve system readiness and staff knowledge?	4.9	0.43	5	3	5
3. An effective way to test changes and provide solutions?	4.9	0.39	5	3	5
4. The debriefing process allowed staff to share ideas for improvement?	4.8	0.47	5	3	5
5. Improved our team functioning	4.3	0.74	4	3	5
Each question in this block used (1=Novice to 5=Expert)					
1. I know when to use which types of PPE to use in different situations	4.1	0.70	4	3	5
2. I know how my clinical practice has changed due to COVID-19 cases in my unit.	4.2	0.65	4	3	5

Discussion

We found that in situ simulation is a good way to test the development of new protocols. The SbCST format enabled us to identify LSTs and address unexpected problems with protocols. During these in situ simulations observers identified 103 LSTs, including: inaccessible equipment, inappropriate positioning of personnel and equipment, and unreliable communication with those outside of the treatment room. The testing of the newly developed clinical protocols/ processes allowed for changes and improvements to be made without risk to the patient or infectious risk to the staff. Based on the staff perceptions from the post debriefing surveys this method was highly rated and worth the time it took. This would indicate that this method could/should be strongly considered whenever a highly complex degree of change is being developed.

Conclusion

This study showed that SbCST methods are adaptable for preparedness evaluation and training. By combining SbCST with Rapid cycle deliberate practice methods, many LSTs were quickly remediated prior to patient care. Participant evaluations revealed a high regard for this method. This work highlights a new application of SbCST that could increase system preparedness and reduce errors. This approach is applicable in diverse clinical settings for designing, evaluating and training staff in new protocols and procedures.