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A Simple Low-Cost Method to Integrate Telehealth Interprofessional Team Members During In Situ Simulation

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Abstract

Introduction: With the growth of telehealth, simulation personnel will be called upon to support training that integrates these new technologies and processes. We sought to integrate remote telehealth electronic intensive care unit (eICU) personnel into in situ simulations with rural emergency department (ED) care teams. We describe how we overcame technical challenges of creating shared awareness of the patient's condition and the care team's progress among those executing the simulation, the care team, and the eICU.

Methods: The objective of the simulations was to introduce telehealth technology and new processes of engaging the eICU via telehealth during sepsis care in two rural EDs. Scenario development included experts in sepsis, telehealth, and emergency medicine. We describe the operational systems challenges, alternatives considered, and solutions used. Participants completed surveys on self-confidence pre-/post- simulation in using telehealth and in managing patients with sepsis (1-10 Likert scale, with 10 "completely confident"). Pre-post responses were compared by two-tailed paired t-test.

Results: We successfully engaged the staff of two EDs: 42 nurses, 9 physicians or advanced practice providers, and 9 technicians (N=60). We used a shared in situ simulation clinical actions observational checklist, created within an off-the-shelf survey software program, completed during the simulations by an on-site observer, and shared with the eICU team via teleconferencing software, to message and cue eICU nurse engagement. The eICU nurse also participated in debriefing via the telehealth video system with successful simulation engagement. These solutions avoided interfering with real ED or eICU operations. Post simulation mean ratings of confidence

using telehealth increased from 5.3 ± 2.9 to 8.9 ± 1.1 (-3.5 , $P < 0.05$), and in managing patients with sepsis increased from 7.1 ± 2.5 to 8.9 ± 1.1 (-1.8 , $P < 0.05$).

Conclusion: We created shared awareness between remote eICU personnel and in situ simulations in rural EDs via a low-cost method using survey software combined with teleconferencing methods.

Keywords

telehealth; in situ simulation; electronic intensive care unit; simulation operations

Introduction:

The use of telehealth continues to rise in the hope that this technology will increase quality and improve access to specialized care. The technology is spreading into more care settings for more conditions.¹ Telehealth techniques extend well beyond telephone connections and range from video calls, to remote monitoring with or without video interfaces, to ancillary methods such as text messaging. Telehealth is proposed as a method to share scarce resources such as specialist physicians and nurses across large health care systems including accountable care organizations.²

We believe that simulation centers and in situ simulation programs will be called upon to support implementation of these new technologies and associated care processes. Already, in an effort to stretch the faculty labor force, simulation and other training centers have integrated tele-methods for teaching and debriefing.³⁻⁷ However, conducting simulations for education with tele-debriefing is a different challenge than attempting to simulate a care process with the telehealth team engaged remotely in the simulated care process.

We integrated real telehealth electronic intensive care unit (eICU) nurses into in situ simulations designed to increase the use of telehealth technology and engagement with the eICU team in the care of septic patients in rural emergency departments (EDs). The charge of the eICU team is to provide an extra layer of monitoring over all critically ill patients, including those in the ED, across our multi-hospital system with 24/7 patient vital sign trend monitoring, 24/7 critical care nurse staffing, and after hours critical care physician staffing. The eICU is located at the tertiary care center physically separate from the rural EDs. Sepsis was chosen as a focus of these simulations as it was a priority condition for this multi-hospital system.

The need for systems of shared awareness between in situ simulations at the rural EDs and the eICU became apparent during scenario creation and pilot testing. The proposed simulations for sepsis presented several technical challenges including cueing for involvement of the eICU team and ensuring eICU awareness of clinical actions completed by the bedside care team caring for the simulated patient at the rural ED. In our real system, shared awareness of patient status is created by the electronic health record (EHR) that evolves as charting occurs, an automated sepsis best practice alert (BPA) triggered by EHR data, and by inclusion in the eICU physiology monitoring software (Philips Apache©).

These systems could not be integrated into the simulations without impacting on-going care of real ED patients.

Our goal is to share the development of alternative solutions for shared awareness between the in situ simulation professionals, the ED bedside team (simulation participants), caring for the in situ simulated patient, and the eICU nurses participating via telehealth. We discuss options considered, choices, and preliminary deployment findings.

Methods:

Simulation Objective:

The objective of the in situ simulations was to support the implementation of a new process of engaging the eICU nurses located in an eICU monitoring station, via a telehealth cart interface, in the care of severely septic patients in two rural EDs. The secondary simulation objective was to review sepsis bundle components⁸ and care goals with the bedside team.

Simulation Setting, Equipment, and Participants:

Rural ED site A was a 42-bed acute care hospital, with an annual ED census of approximately 14,000 visits, located 53 miles from the affiliated tertiary care center, also the site of the telehealth eICU support. Rural ED Site B was a 99-bed acute care hospital, with an ED census of approximately 22,000 visits, located 50 miles from the affiliated tertiary care center. The simulations took place in an ED patient care room with the patient played by a standardized participant (SP) actor and vital signs generated by Laerdal SimMan® Essentials output to the monitor. Simulation debriefing took place in the hallway outside the ED patient care room after the first and second simulation “acts” (see below), and in the ED patient care room with the SP and eICU nurse engaged after the third simulation act (see schematic representation in Figure 1.). Participants were the physicians, advanced practice providers, nurses, and staff present in the rural EDs. They participated as interprofessional teams. This effort was part of a larger performance improvement study approved by the local institutional review board, and all those surveyed signed a written consent to participate.

Proposed Real Care Telehealth Technology and Process Change:

In order to improve the care of septic patients in the rural EDs and care transitions to the intensive care unit (ICU), the health system purchased telehealth video carts for these EDs. The telehealth carts provide bidirectional high definition video and audio, and consist of a rolling platform with a rechargeable battery, a computer, a screen, and a camera (shown in figure 2). The plan for real patient care in the new process was that ED staff use the cart to contact the eICU nurses, thus allowing the eICU nurses to view the patient, and communicate with ED bedside staff. During real care, the eICU would be alerted to the patient’s presence by the automated sepsis BPA in most cases, and could view the patients EHR as care would be charted in real time by the ED bedside nurse. If the ED bedside nurses take the step of adding the patient to the eICU vitals monitoring system (Philips Apache©), the eICU can also see vital signs, vitals trends, and use trend based alerts. Phone conversations between the eICU nurses and bedside nurses would occur as in the old care process, as bedside ED nurses are often moving between multiple patients and would not

always be standing in visual view of the cart or within earshot of the cart microphone and speaker.

Simulation Scenario:

Simulation scenario development efforts were supported by a large simulation center that serves a multi-hospital, multi-clinic health system. Experts in critical care (WT), emergency medicine (LB, WB, AV, JV, EP), and telehealth (WT), along with bedside ED nurses from the engaged EDs, and eICU nurses participated in scenario development and pilot testing in the simulation center before rollout to the rural EDs.

Our scenario was structured as a 3-Act-3-Debrief session (60 min)(see Figure 3 scenario flow diagram). The simulated septic patient advanced through the sepsis spectrum of illness from systemic inflammatory response syndrome (Act 1), to severe sepsis (Act 2), and then septic shock (Act 3). In the debrief after Act 1, after having met the patient and completed a preliminary assessment, the participants came to the hallway outside the room and learned to turn on both the cart and the application used for telehealth video conferencing (Vidyo®, v2.2.2). After turning on the system, they interacted with the eICU nurse, then turned the system off again. To begin Act 2, the eICU nurse confederate alerted bedside clinicians via a phone call that the patient may be septic, noting the sepsis BPA alert had gone off (as can happen in real care). During scenario Act 2, the eICU nurse encouraged the team to set up the cart so that he/she can help monitor the simulated septic patient (photo of telehealth cart at bedside in Appendix 1). During Debrief 2, the investigator-debriefing facilitators (LB, WB, AV, EP) discussed potential barriers and facilitators to the use of telehealth. In Act 3, the eICU nurse participated in the ongoing simulation, and also participated in Debrief 3 via the telehealth cart. This final debrief included discussion of the tenets of sepsis care.

All eICU nurses were in-serviced in communications' protocols for the care of septic patients in the ED using the telehealth video cart method prior to this rollout effort and their participation during the simulation cases was entirely via telehealth. Two of the eICU nurses had been pre-briefed on the in situ simulation scenario content, and were thus confederates in simulation execution. The in situ simulations were also supported on-site at the rural ED by telehealth support staff who provided in-person education on the use of the telehealth cart during Debrief 1.

Design Objectives:

Our design objective was to create real time shared awareness between the rural ED participants and the eICU nurses during in situ simulation that would allow the remote eICU team to engage with ED participants, so that the learners would gain confidence in the use and possible value of telehealth. In addition to the state of the patient's vitals, the eICU nurse participating in the scenario needed to be aware of clinical actions taken by the participants caring for the simulated patient in the rural ED (for example medications delivered, laboratory studies ordered, procedures completed). We also needed methods to alert (see Results: Technical Solutions Considered, and Results: Chosen Technical Solution) the eICU team to re-enter the scenario with changes in patient condition to demonstrate the monitoring vigilance value of the additional eICU monitoring.

Post Event Evaluation:

Simulation ED care team participants completed surveys via tablet devices using survey software (Qualtrics© 2015, Provo, UT). The survey asked their perceived self-confidence pre- and post- the in situ simulation in using telehealth, and in managing ED patients with sepsis. The scale was 0-10, with 0 anchored at “not at all confident,” 5 as “moderately confident,” and 10 as “completely confident.” The pre-post responses were compared with a two-tailed paired t-test (Excel v2013 Microsoft Corp). The eICU nurses were considered confederates in creating and executing the scenario, and thus were not surveyed, but rather simply reported their perceptions (included in Results). No formal qualitative analysis was conducted.

Results:

Over the course of one month, at site A we ran 3 simulation days, with 10 interprofessional teams, including 5 physicians or advanced practice providers, 20 nurses, and 5 ED technicians. Over the course of one month at site B, we ran 4 simulation days, with 8 interprofessional teams, including 4 physicians or advanced practice providers, 22 nurses, and 4 technicians (Total N=60 for both sites combined). Post event simulation ratings of pre-post self-confidence in using telehealth increased from a mean of 5.3 ± 2.9 to 8.9 ± 1.1 (3.5 , $P < 0.05$), and self-confidence in managing ED patients with sepsis increased from a mean of 7.1 ± 2.5 to 8.9 ± 1.1 (1.8 , $P < 0.05$).

Technical Solutions Considered:

We considered various alternatives to maintain shared awareness during simulations that integrated the eICU team, each with positive and negative ramifications. We considered use of the EPIC© EHR sandbox, a non-production instance of EPIC© used primarily for training people how to use the EHR. Positives included its real integration into their work flow, the normal feed that would happen with the BPA, and the normal checking of the shared EHR by the telehealth nurses. Negatives included the use of simulation time that would be used up as participants log in with different than usual usernames and passwords, the need to ensure everyone would login to the same sandbox electronic chart environment, and that each retrieved item (such as a particular lab test) would have to be added to this particular sandbox environment and multiple patient instances for each day would have to be created. We chose not to integrate the EHR via EPIC© EHR sandbox, because our learning objectives did not require the integration, it was not time efficient, and it would have consumed additional resources.

We also considered placing the simulated patient in the eICU monitoring system. The process of incorporating real ED patients into eICU monitoring is quite simple and involves entering the patient name and record number into the ED monitoring system (usually patients are designated only by room number on central ED monitors). However, having a simulated patient in the real eICU monitoring system (Philips Apache©) might then alert any of the eICU nurses, rather than our planned confederate, and could disrupt their normal patient care.

We considered integrated methods within the audiovisual recording system, but these were suboptimal. In part this was due to a lack of a unified multi-site simulation recording system at our site. Today's integrated simulation recording systems may accomplish this function, through real-time rating of simulated clinical actions taken by learners. However, shared multi-site awareness of the rating during the real time rating process is still in early development for most systems.

We also considered text messaging as a method of notification, but texting is limited in the amount of information that can be transmitted, and depends on reliable cellular data networks which may be more difficult in the rural setting or may be restricted by cell phone transmission barriers in dense hospital buildings.

Chosen Technical Solution:

We agreed that we needed a real-time simulation critical clinical actions checklist filled out by an observer on site that was simultaneously viewable by the eICU nurse participating in the simulation. This effectively documented orders that had been given or results that had been reviewed, all relevant to meeting sepsis care goals. The simulation checklist could have taken any form, but we chose an off-the-shelf survey software (Qualtrics© 2015, Provo, UT), as it would gather completion data from the checklist. We then shared that checklist real time via teleconferencing software (Microsoft® Lync® 2013, Redmond, Washington) and used the messaging software within the teleconferencing software to cue the eICU nurse to call in to the rural ED and engage the on-site team (see figure 4. for screen shot, and Appendix 2 for actual checklist). Faculty debriefers were on site and would cue the on-site observer via simple nods or hand signals at the end of a debriefing phase (approximately 10 minutes) during which 2 hours of simulated patient time had passed. The observer would in turn cue the eICU nurse with messaging so that he/she could re-enter the case with new information gathered during the 2-hour vigilance phase (eICU assisting with monitoring). See figure 5 for a schematic of the information flow in real care compared to simulated cases. This solution relied on a stable Wi-Fi network, which is available in most locations including rural hospitals in developed countries.

The teleconferencing software and simulation clinical actions checklist method worked well to maintain shared awareness in lieu of the multiple real care systems. The eICU nurses could ascertain which actions had been accomplished and which sepsis bundle compliance issues still needed to be addressed. Text messages in the teleconferencing software from the bedside observer informed the eICU nurses that the previous stage debrief was wrapping up, and they could call the ED and tell the bedside team the simulated patient's status had deteriorated. The eICU nurses participated successfully in the simulations and debriefings via the telehealth cart after the final team care process. They reported that the shared checklist technique was able to reliably inform them of the care items the patient had received. The method of text message via teleconferencing software notification for when to re-engage allowed them to continue alternative work in the eICU while awaiting their participation. Informally, eICU nurses noted that viewing simulated patient vitals via the telehealth monitor was functional but not perfect, and that familiarity with the case and expected course compensated for this limitation. The limitations of the eICU nurses field of

view could also hamper real patient care, if the patient is not connected directly to the eICU remote vital sign monitoring system (Philips Apache©).

Discussion:

Simulation is a promising tool for process change.^{9, 10} In situ simulation in particular can allow participants to experience the new process, in this case the use of telehealth in the care of septic patients. The integration of the sending (the rural ED) and receiving site (in this case the eICU) are important both to ensure the technology is operating as intended and to begin the socialization that leads to trust in the eICU team. In this study, we demonstrated the successful integration of rural ED participants and the remote eICU care team, with real-time shared awareness, to improve confidence with telehealth technology and sepsis care.

We are not aware of other published efforts to integrate eICU nurses into the care of the simulated patient. In particular, since we were raising awareness of the benefits of eICU engagement such as detection, monitoring vigilance, mutual support, bundle compliance, and transitions of care; we felt that integration of the eICU nurses was vitally important to our efforts. Using the telehealth equipment constituted a chance for deliberate practice,¹¹ and participating as an interprofessional team helped establish a social learning context. Per Bandura's social cognitive theory, teams that participate in this fashion should be more likely to demonstrate the trained behavior,¹² in this case engaging the eICU, thus leading to a more successful implementation process. Both the eICU nurse informal verbal feedback to the authors, and our survey data suggest we successfully overcame the technical barriers to telehealth integration during in situ simulation. Whether the rural ED teams go on to use telehealth in the care of severely septic patients remains to be seen and is the subject of our ongoing study.

There were other learning points we garnered outside of those pertaining to shared awareness. In comments during debriefing, both eICU nurses and bedside team members indicated that communicating with a live patient actor was important for establishing communication patterns between all health care team members and the patient. In particular, the expectation to explain the technology to patients and families is needed to ensure they accept this method of care. The simulations helped the eICU nurses understand camera positioning and microphone limitations. We also witnessed collegial team-building occurring because of the shared experience between the eICU nurses and the ED teams.

For scenario development we found iterative integration trials conducted at our simulation center, using all the proposed communications mechanisms, to be extremely helpful for both technical execution and communication expectations. The eICU nurses participated in simulations with full awareness of the scenario details, so that they could react in ways that represented useful and realistic practice patterns. Rural ED personnel also participated in scenario refinement at the simulation center. We found that refining the scenarios as a team created a much deeper awareness of the envisioned communication process between ED and eICU personnel. By scenario pilot testing with the eICU nurse engaged we could set the expectations for achieving contact, communicating, and using telehealth in context.

The cost effectiveness of this strategy is important, because in situ simulation can already be quite resource intense¹³. Most systems will have existing access to web teleconferencing and survey software that should serve the purpose of connecting the sites. We note that survey software has many pitfalls as an observational checklist tool, including the lack of time stamping of clinical actions and lack of connection to other learner or performance improvement data capture systems. However, outside of research projects looking at specific response or intervention times, these systems should be adequate for a basic log, with most able to export to spreadsheet programs for data analysis.

Limitations:

Shared awareness is difficult to maintain in the normal course of care in complex clinical environments.¹⁴ In situ simulation presents many of the same challenges without the benefit of the usual care systems for information transfer. Our re-creation of information transfer substituted systems for the real care information transfer methods thus threatening verisimilitude of the simulation. However, we believe a useful simulation that allowed for communication practice across sites for the new process was achieved. Certain other aspects of shared awareness were also unrealistic. For example, the simultaneous presence of all interprofessional team members at the bedside would occur only briefly during real care, and the simulated patient was not included in the unit-level local ED vitals monitoring system as would occur in real care.

Some EHRs might allow for the creation of fictitious patients in the production EHR. Such a system would be desirable for simulations such as ours, and for unannounced simulated patients in other settings. However, this creates the safety threat of accidental exposure of real patients to orders intended for the simulated patient. As we were not changing any of the sepsis order sets, we did not feel that time spent doing electronic order entry advanced our objectives of integrating telehealth. We note that we also carefully ensured physical safety by conducting an instrument count-like inventory of all simulated equipment and medications used.¹³⁻¹⁵

Conclusion:

We created shared awareness between remote eICU personnel and in situ simulations in rural EDs via a low-cost method using survey software combined with teleconferencing methods.

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Appendix 1.

The actor playing the patient with the bedside clinician, and the electronic intensive care unit (eICU) nurse participating in the simulation via the telehealth cart.

Appendix 2.

The bedside in situ simulation clinical actions checklist for the sepsis case that was shared via the teleconferencing software from the bedside observer of the in situ simulation to the electronic intensive care unit (eICU) nurse.

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Figure 1.

A schematic representation showing the location of participants in the rural emergency department, and the remote electronic intensive care unit (eICU) nurse.

Figure 2.
The telehealth cart used both for real clinical telehealth audio-visual connection and for in situ simulation connection between the bedside care team and the electronic intensive care unit team.

Figure 3.
Scenario flow of the 3-Act-3-Debrief sepsis in situ simulation scenario to introduce telehealth technology.

InSitu location

St. Jame's Pontiac

St. Mary's Galesburg

Pre-Brief Start Time (Approximately 10 minutes)

1520

ACT I Start Time

1531

ACT I: Goal of Act One is Patient Assessment, Identification of SIRS criteria, initiation of septic work-up, and placing on monitor

	Observed	Not Observed
Assessment of history by physician and/or nurse	☒	☐
Patient placed on monitor	☒	☐
2nd IV started	☐	☐
CVC ordered	☐	☐
Antibiotics ordered (name in box below)	☐	☐
CBC ordered	☒	☐
CMP ordered	☐	☐
U/A ordered	☐	☐
Lactate ordered	☒	☐
IVF (1 liter) bolus ordered	☐	☐

Figure 4.

A screen shot that demonstrates an in situ simulation clinical actions checklist within the survey software (Qualtrics©) and the same checklist within the teleconferencing connection (Microsoft Lync©), with use of a messaging function.

Usual Flow of Clinical Information

Simulated Flow of Clinical Information for Shared Awareness

Figure 5.

A schematic representation of the real clinical data streams and the substitute data streams we created to accomplish interprofessional in situ simulation that engages the electronic intensive care unit in the care of the rural emergency department patient.