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Review Article

Designing Sequential Simulation: Recreating Clinical Pathways

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Abstract

Simulation is the technique that can replace or amplify real experiences with guided ones, which is immersive and enable the replication of the real world situation in an interactive fashion. Many simulation activities focus on single clinical scenario simulation. However, as in the real world environment, clinical cases are complex and requires a continuum of management steps, more accurately depicted in a clinical pathway. Sequential simulation (SqS) addresses this and can focus on education/ training, assessment, research as well as healthcare systems integration. 'Sequential' means 'in logical order and sequence' as well as progression in a systematic fashion. SqS can simulate any combination or permutation of the care pathway. Often, certain aspects or points of care along the pathway are selected to be the focus, when these have been identified as the crucial learning points. SqS provides a lot of flexibility and options for trainers and simulation faculty in their planning of teaching scenarios. When properly conceptualized and planned, SqS can enact any combination of the work processes and clinical pathways in institutions and organizations.

The author shares her experience with training inter-professional teams using SqS as well as the general framework in planning such activities, within an institution. Essentially, SqS is able to enhance learners experience, increase realism, fidelity and satisfaction, beyond just improving the technical aspects of clinical practice.

Keywords: *Sequential simulation (SqS); Clinical Pathways; Fidelity and Satisfaction*

Introduction

From a traditional perspective, simulation has always involved a single clinical scenario or encounter. These may be made up of the spectrum of common clinical cases, to the rarely encountered ones. The former is familiar to many and easily configured for training purposes. The latter however are less known and seen, but when encountered, would similarly, require rapid decision-making in management. Thus, training through simulation, for the rarer cases, are just as important [1-5]. The real life continuum of clinical care does not usually represent isolated or individualized clinical encounters. They tend to be more inter-professional, multidisciplinary and longitudinal in characteristics. This is where sequential simulation (SqS) is able to better instill realism and uplift the fidelity as well as enact the temporal elements of simulation-based training. Simulation is the technique that can replace or amplify real experiences with guided

ones, which is immersive and enable the replication of the real world situation in an interactive fashion. As in single clinical scenario simulation, SqS can also focus on education/training, assessment, research as well as healthcare systems integration [1,6-10]. 'Sequential' means 'in logical order and sequence' as well as progression in a systematic fashion. SqS can simulate any combination or permutation of the care pathway. Often, certain aspects or points of care along the pathway are selected to be the focus, when these have been identified as the crucial learning objectives. SqS provides a lot of flexibility and options for trainers and simulation faculty in their planning of teaching scenarios. When properly conceptualized and planned, SqS can enact any combination of the work processes and clinical pathways in institutions and organizations [11-14].

Clinical pathways represent structured plans of care, which helps in the translation of guidelines into practice and action. These pathways are usually criteria-based, evidence-based and should be decided upon and practised in advance. They are also data-driven, so strategic changes can be made based on observations which can meet performance measures. SqS can be conducted in a variety of settings within healthcare institutions, for the assessment of both technical and non technical capabilities, as well as with a view to improving the existing processes and pathways [15-19]. Some applications of SqS would include [9,10,15,18,20-23]:

a. Training inter-professional teams in the delivery of care. This is especially for complex cases such as multiple trauma, combined neonatal-obstetric emergencies or cardiogenic shock. In managing these cases, multiple specialties will be involved and the algorithm for activation need to be practiced. The focus often is on coordination, communication and teamwork, besides the technical skills.

b. Training to inculcate values of 'systems-based practice', where healthcare personnel will realize their role in the bigger picture of things in an institution.

c. Testing the effectiveness and efficiency of the current workflow as well as mapping the future systems and algorithms.

d. Planning work processes in a new department. This may be linked to patients arrival, registration, triage, investigation turnaround time, treatment and observation as well as admissions and discharge timing.

e. Training to handle work flow that crosses multiple departments or areas of work. An example would be a patient being transported to the Emergency Department (ED) by paramedics from the EMS (Emergency Medical Services), how the patient is stabilized and managed in the ED and subsequently sent to the emergency operating theatre (OT) for urgent surgical intervention. Here, there is the domain of the prehospital environment, which then moves into the ED and the OT.

f. Training in the transfer of an infectious patient (e.g. Covid 19, MersCoronaVirus, Ebola) from the ED to the inpatient isolation ward or intensive care unit. The route to take, the elevators involved (which should not have any public members using it for risk of cross-infection spread), the corridors and passageways to take, in order to minimize contact as well as the PPE (personal protective equipment) for the staff carrying out the transfer must be pre-planned and practised.

g. Preparation for mass casualty and disaster response. These will be situations which need adequate planning to handle the upsurge in view of the potential to overwhelm the system and resources.

Besides the above examples there are many other scenarios and pathways which can be enacted using SqS. As can be seen, these scenarios are more complex than the usual single element simulation and will thus need systematic and robust planning, coordination and dry runs. The other important element in SqS is that of time; time interval, time span, time transitions and turn-around time. These temporal considerations are highly relevant in SqS as compared to the single scenario clinical simulation. They may affect the planning to meet certain key performance indicators (KPIs) or standards. These are especially critical in handling time-dependent diagnoses [6,7,15,17,22,23].

General principles in planning sequential simulation

The following are the steps involved in conceptualizing and planning SqS. The preparation is important in order to ensure maximal benefit in meeting the set objectives (Figure 1):

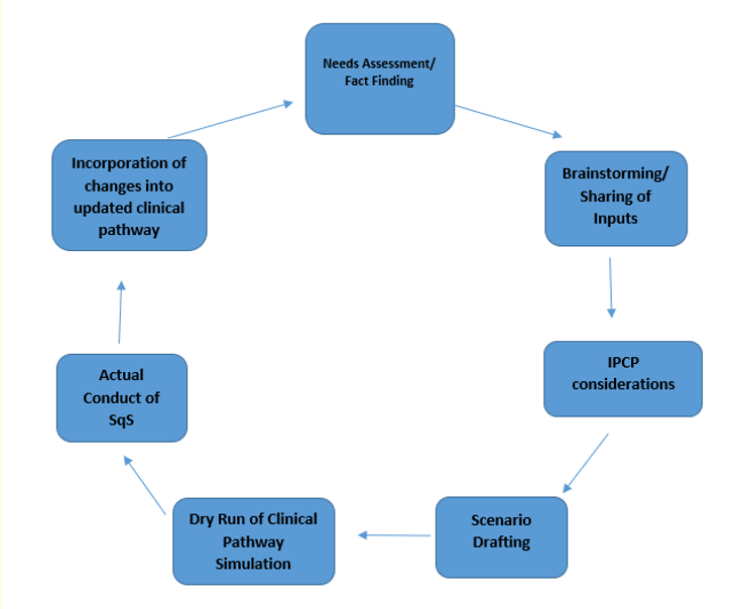

Figure 1: *Planning sequential simulation cycle.*

a. **Needs assessment/fact finding:** The following are some of the questions to be answered:
   - Why are certain processes needed or necessary.
   - Are there redundant steps involved.
   - Can the steps be simplified, made easier and clearer for all staff concerned.
   - Are updates required, especially if the current practice is outdated and not evidence-based.
   - Are all the inter-professional personnel involved aligned with every step.
   - Does everyone involved have the 'big picture view'. This requires conversations and dialogue with the ground staff.
   - What are the current problems and issues encountered and are there different views and perspectives.

b. **Brainstorming and sharing session:** Based on a. above, all relevant information, facts and observations should be weighted, deliberated and considered, in terms of taking them forth. More sharing sessions or focused group discussion may be required. It is crucial to involve the different stakeholders in order to have their views heard**.**

c. **Incorporation of inter-professional collaborative practice (IPCP):** It is always important to involve all groups of healthcare personnel. Each may have inputs and perspectives which are different. Issues which may be clear for one group may represent a 'blind spot' for another. Relevant disciplines and specialties must be involved from the beginning.

d. **Scenario drafting:** There may be several rounds of this with fine-tuning at each stage to ensure the most accurate representation. Each profession or specialty will also ensure accuracy from their perspective.

e. **Dry run or trial run of clinical pathway:** Once set and finalized, the trial run of the SqS scenario is important. At this stage further edits and fine-tuning is still possible. This is usually conducted in situ or in the natural environment to ensure physical fidelity. This is also the stage where the clinical pathway is being tested via the SqS scenario.

f. **Actual conduct of the SqS:** During this phase there will be expert faculty and debriefers who will be present to make their observations. Latent threats may be brought forth by the simulation. Using a framework such as Healthcare Failure Mode Effect Analysis in these observations can ensure comprehensiveness. Other than this, any debriefing model can be used to debrief the participating teams.

g. **Change implementation and incorporation into future workflow:** All the necessary changes to the clinical pathway, new observations, latent threats and alterations are reviewed for adoption. This also involves discussion with the departments and specialties concerned for their buy-in and concurrence, before finalizing the inter-professional clinical pathway**.**

Sequential simulation and clinical pathways

SqS enables immersive, deliberate and repetitive practice of clinical pathways [24]. This supports the principles of adult learning as well as patient safety/quality. It also supports the elements of inter-professional collaborative practice (IPCP), spanning the domains of a) values and ethics, b) roles and responsibilities, c] communications and d) teamwork [25]. When using SqS for assessment, it is important to specify which part of the pathway is being tested, or whether the whole pathway is involved. These are important considerations in the recreation of the SqS to ensure accuracy and appropriate fidelity. With SqS, care processes become transparent to all staff. It also helps support continuous life-long learning and improvement initiatives. The regular practice also keeps it evidence-based [7-12].

From the examples in figure 2 and 3, it can be seen that [23,26-28]:

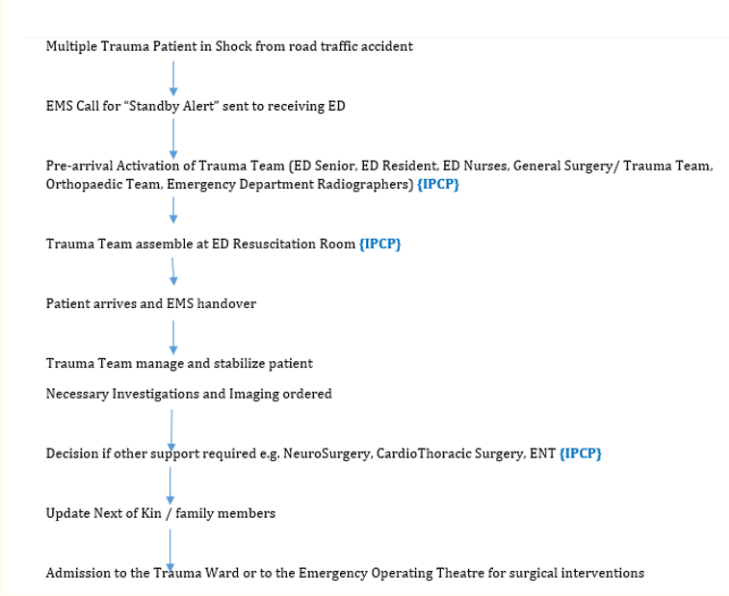

Figure 2: *Sequential simulation: Multiple trauma clinical pathway.*

Legend: EMS: Emergency Medical Services; IPCP: Inter-Professional Collaborative Practice; ENT: Ear, Nose and Throat Speciality.

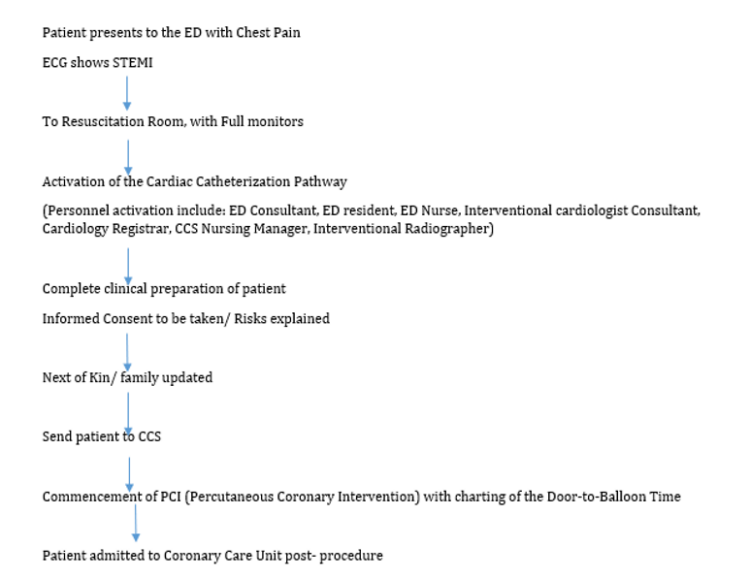

Figure 3: *Sequential simulation: Activation of cardiac catheterization suite (CCS) for a patient with ST-segment elevation acute myocardial infarction (STEMI).*

a. There is a need for a clear, well practiced algorithm in the clinical pathway.
b. Inter-professional collaborative practice is critical for the flow to run smoothly. This is where each stakeholder from all the specialties involved, know their roles and perform in a coordinated way.
c. If the clinical pathway is practiced often, staff will be more familiar, more integrated in their approach, be open to changes to the pathway in case of any latent threats which are picked up and improve their inter-professional communications as well as performance behavior.

SqS can be used in any setting such as the ED, Intensive Care Units, wards or high dependency areas. The scenarios can combine any permutation of steps, workflow or processes as intended. SqS is valuable to be incorporated as part of the department's quality improvement initiatives [25,29-32].

For the smooth running of the SqS, the staff of the Simulation centre; e.g. administrative staff, simulation technologist, must not be left out. They must be appraised from the beginning. Their role in mobilizing equipment for insitu simulation at the respective clinical areas, preparing the scenario, moulaging as appropriate, getting consent from participants of the SqS exercise, video-taking of the session and involvement in dry run sessions are critical [2,23].

Conclusion

SqS enables the repetitive, deliberate practice and review of clinical pathways. It helps to uplift performance of IPCP and the understanding/ appreciation of complex healthcare processes. The discovery of latent threats during SqS helps in the evaluative process of workflows and technical tasks, which has to be updated based on evidence. The regular incorporation of changes and updates is part of

the life cycle of these work processes and clinical pathways. Beyond the technical, SqS help teams work together, respect one another, improve communications, confidence, collaboration as well as their psychological safety. SqS also provides a platform for regular discussions and engagements, as well as help in reducing the power distance, if any within the culture of the institution or department. All these factors can impact day-to-day practice [28,29,33,34].

Bibliography

1. Lateef F. "Simulation based training: Just Like the Real Thing". *Journal of Emergencies, Trauma and Shock* 3.4 (2010): 348-352.
2. Pek JH., *et al*. "Simulation training for emergency teams". *Journal of Medical Education* 7.4 (2015): e39-e44.
3. Pothiawala S and Lateef F. "Simulation training in Emergency Medicine: an integral component of residency curriculum". *Hong Kong Journal of Emergency Medicine* 19.1 (2012): 41-46.
4. Tyerman J., *et al*. "Pre-simulation preparation and briefing practices for healthcare professionals and students: a systematic review protocol". *JBI Evidence Synthesis* 14.8 (2016): 80-89.
5. Nickson CP and Petrosoide A. "Translational simulation: from description to action". *Advances in Simulation* 6.1 (2021): 1-11.
6. Weldon SM., *et al*. "Collaborative healthcare remodeling through sequential simulation: A patient's and frontline staff perspective". *BMJ Simulation and Technology Enhanced Learning* 2.3 (2016): 78-86.
7. Weldon SM., *et al*. "Sequential simulation: an innovative approach in educating GP receptionist about integrated care via a patient's journey: a mixed method approach". *BMC Family Practice* 16 (2015): 109.
8. Kassab E., *et al*. "Blowing up the barriers I surgical training: explaining and validating the concept of distributed simulation". *The American Surgeon - SAGE Journals* 254 (2011): 1059-1065.
9. Allihaibi WG., *et al*. "Solving the emergency care pathway by a new integrated simulation: optimization method". *IEEE Access* 9 (2021): 100895-100910.
10. Ahmed MA and Alkhanus TM. "Simulation options for an ED healthcare unit in Kuwait". *European Journal of Operational Research* 198.3 (2009): 936-942.
11. Gunal M and Pidd M. "Discrete event simulation for performance modelling in healthcare. A Review of the Literature". *Journal of Simulation* 4.1 (2010): 42-51.
12. Apsland E., *et al*. "Clinical pathway modelling: a literature review". *Health Systems* 10.1 (2021): 1-23.
13. Gomez-Hernandez JJ and Srivastava RM. "One step at a time: The implementation of sequential simulation and beyond". *Mathematical Geosciences* 53 (2021): 193-209.
14. Weldon SM., *et al*. "Sequential simulation used as a novel educational tool customized at healthcare managers: a patient-centred approach". *BMJ Simulation* 4 (2018): 13-18.
15. Kozan E and Diefenbach M. "Hospital ED simulation for resource analysis". *Industrial Engineering and Management Systems* 7.2 (2008): 133-142.
16. Andersen AR., *et al*. "Staff optimization for time dependent acute patient flow". *European Journal of Operational Research* 272.1 (2019): 94-105.

17. Bahari A and Asadi F. "A simulation optimization approach for resource allocation in an ED healthcare unit". *Global Health* 15.1 (2020): 14.

18. Ozcan YA., *et al*. "Improving the performance of a surgery based clinical pathway. A simulation optimization method". *Healthcare Manage* 20.1 (2017): 1-15.

19. Huddy JR., *et al*. "Sequential simulation of clinical pathway: a tool for public and patient engagement in point of care diagnostics". *BMJ Open* 6 (2016): e011043.

20. Monks T., *et al*. "Evaluating the impact of a simulation study in emergency stroke care". *Operation Research for Healthcare* 6 (2015): 40-49.

21. Fong AJ., *et al*. "Efficiency improvement in the operating room". *Journal of Surgical Research* 204.2 (2016): 337-383.

22. Dryver E., *et al*. "Medical crisis checklist in the ED: a simulation-based multi-institutional RCT". *BMJ Quality and Safety* 30 (2021): 697-705.

23. Lateef F., *et al*. "Infection control measures in situ simulation and failure mode effect analysis to finetune change management during Covid 19". *Journal of Emergencies, Trauma and Shock* 13.4 (2020): 239-245.

24. Kinsman L., *et al*. "What is a clinical pathway? Developing a definition to inform the debate". *BMC Medicine* 8 (2010): 31.

25. Lateef F. "At the core of interprofessional collaborative practice: How Emergency Physicians are leading the way during COVID 19 and into the new norm". *American Journal of Emergency Medicine and Critical Care* 4.1 (2021): 14-20.

26. Lavraga-Garcia B., *et al*. "Simulation-based education in trauma management: a scoping review". *International Journal of Environmental Research and Public Health* 19 (2022): 13546.

27. Bentley S., *et al*. "A simulated mass casualty incident triage exercise. Sim Wars". *Med Ed PORTAL* 15 (2019): 10823.

28. Purdy E., *et al*. "Taking simulation out of its 'safe container': explaining the bidirectional impact of psychological safety and simulation in an ED". *Advances in Simulation* 7 (2022): 5.

29. Lateef F. "Robust ED framework for handling SARS, COVID 19, Monkey Pox and other threats. Making Resilience a Priority". *Journal of Medical and Research Publications* 5.5 (2022): 1-13.

30. Lateef F., *et al*. "In Situ simulation to plan Malignant Hyperthermia workflow in the ED". *Journal of Medical and Research Publications* 6.2 (2022): 1-13.

31. Colquhou HL., *et al*. "Method for defining interventions to change in healthcare professionals behavior: a systematic review". *Implementation Science* 12 (2017): 30.

32. Seys D., *et al*. "Better organized care via care pathways: a multicenter study". *PLoS One* 7 (2017): e0180398.

33. Ford SR and Pearse RM. "Do integrated care pathways have a place in critical care?" *Current Opinion in Critical Care* 18.6 (2012): 683-687.

34. Nilsen P. "Making sense of implementation, theme models and frameworks". *Implementation Science* 10 (2015): 53.

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