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Planning a Multi-Casualty Trauma Scenario: Uplifting the Fidelity Through Hybrid Simulation

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Abstract

Major trauma management requires a rapid, organized and structured approach. When encountering a real major trauma patient, it can be overwhelming and daunting for a novice practitioner or a medical student. Time delays have been closely linked to higher morbidity and mortality. Simulation-based trauma training can help learners familiarize themselves and inculcate a systematic, step by step approach. This can be repeatedly practiced to reach proficiency. For the single patient scenario it is less complex but for multi-casualty and mini-mass casualty and even for large scale disaster response, the situation calls for a very organized, methodical approach with some degree of adaptability and flexibility at ground zero. Conceptualizing, planning and executing simulation-based multi-casualty trauma training is a good educational platform. In this paper, the author shares how the planning and use of hybrid simulation concepts and preparation can uplift these trauma training scenarios and enhance the elements of learning, realism and fidelity. Issues linked to the planning and execution are discussed with detailed sample scenarios for reference as well.

Hybrid simulation refers to the use of at least two simulation tools or modalities in combination, to enhance the scenario, increase its fidelity and improve the inter-phasing as in eal world scenarios. Multiple types of simulation modalities can also be used within the same scenario and this is most appropriate in the context of multi-casualty trauma situations.

Keywords: *Hybrid simulation, trauma, multi-casualty.*

Intruduction

Simulation is the replication of clinical scenarios to reflect real world situations. It is conducted in a simulation laboratory or controlled environment which allows learners to make mistakes and practice repetitively until mastery or proficiency is attained. It can also be conducted in situ, ie. in the actual clinical environment such as the intensive care unit, the emergency department or the wards. Simulation has widespread applications today, not just in teaching and training but also in assessment as well as research, across many disciplines of healthcare and medicine. It is impactful because it offers

immersive, experiential and realistic replication of learning, that also enables deliberate, repetitive practice. (1-5) Simulation-based training provides learners a safe space to develop their skills, capabilities, clinical reasoning processes as well as decision making. The ability to repeatedly learn and relearn allows them to attain proficiency with a deeper understanding. With this, their ability to learn by application can also be strengthened through the use of integrated teaching by faculty in order to attain curriculum objectives. This simulation based learning impact on healthcare and medical related education is now supported by very comprehensive and robust evidence in the literature and this applies to both the acquisition of technical and non-technical skills. (2, 3, 5-10)

Hybrid simulation on the other hand refers to the use of at least two simulation modalities in combination, to enhance the scenario, increase its fidelity and improve interfacing as in real-world practice. Hybrid simulation can also refer to the utilization of multiple types of simulation modalities in the same scenario or setting (11-15)

Management of trauma is time dependent. This is the reason for stipulating time guidelines such as the platinum 10-minutes and the 'golden hour', post-incident. Delays have been linked to increased incidence of both mortality and morbidity. The rapid identification as well as management of trauma casualties is very crucial. (16-18) Having standardized guidelines such as the Advanced Trauma Life Support, is definitely helpful to set the stage for systematic approaches as well as rapid and robust follow up. (19) To excel and be familiar with these complex trauma management, simulation-based training has become commonly used as a mode of training. With the wide spectrum of clinical trauma scenarios which can be created with the current moulage capabilities and technologically driven models, there is greater realism, as well as a more exciting and stimulating learning climate for learners. (20-26)

The Simulation Curriculum: Trauma Scenario Creation

The following section represents the systematic steps in coming up with hybrid trauma simulation scenarios: (14, 15, 27-29)

a. Planning and Conceptualization

Planning is the first step and a fundamental determinant of how the simulation experience will turn out as well as its success. The physical, psychological and environmental fidelity, must be decided and prepared in coming up with the plans. This has to be done in a systematic and logical fashion, targeted

to the level of the learners being trained. There are infinite possibilities to the spectrum of scenarios, both single and multi-casualty, as well as larger scale, disaster response type simulation. The learning goals that are set, will dictate the simulation training design. It may focus on skills-based training (linked to medical knowledge, skills and communications) or scenario-based (where the focus is on teamwork, prioritizing debriefing and reflection for example). The planning of the curriculum will help decide on what resources are needed for the hybrid simulation, the time frame required for the conduct of the simulation training, the incorporation of inter-professional elements (as most trauma cases will be managed by inter-professional teams today) and also the assessment of both technical versus non-technical skills. The training must also support the learning by clinical reasoning in these trauma scenarios. Other considerations with trauma hybrid simulation training would include: (30-33)

- The mechanism
- Place of incident, location
- Number of casualties
- What injuries to showcase, manage
- Equipment requirements
- Time factor
- Assessment points/ use of checklists

In this paper, our focus is on simulating multi-casualty trauma scenarios, as well as how to uplift the simulation with the use of hybrid simulation techniques.

b. Moulage and Special Effects

Moulage capabilities have certainly altered the face of simulation. Its brings scenarios to life and enhances realism and fidelity. It also helps support the imagination and creativity of the simulation technologist or personnel trained in this procedure. Moulage can be done on both standardized patients as well as mannikins, and be incorporated into the hybrid simulation. It can range from simple, basic moulage to more complex special effects. In trauma cases, moulage certainly has been helpful to inject realism to the narrative. For trauma scenarios, injuries such as abrasion, bruises (contusions), variety of wounds, lacerations, avulsions, amputations, punctures and different degrees of burns can be depicted. Besides these, more generic effects such as shock (cold, clammy, thread pulse), cyanosis, sweating, bleeding, vomitus etc can also be moulaged.

c. Staging the Scene/ Environmental Fidelity

The decision on location of the scenario and how to set the scene to depict the mechanism of the incident in trauma is important. In some institutions, props are used to re-create scenarios. This can be left to the ingenuity of each group and faculty planning the trauma simulation. The use of hybrid simulation should be planned in an integrated fashion.

d. Standardised Patients (SP), Manikins and others

SPs are trained actors who simulate a variety of medical scenarios to enhance the level of realism of the enactment. They have to be briefed and given a manuscript to follow. They will also need to be moulaged with the respective injuries as deemed necessary. This has to be explained to the SPs beforehand so they are in agreement. Similarly, the manikins of a wide variety can be used; from the high fidelity 3G Sim-Man to lower fidelity ones which cannot re-enact certain capabilities, but are good enough to showcase certain types of injuries. Often each manikin and SP is tagged with a card or the frequently used MedTag, which summarizes their triage categories, types of injuries and important or succinct findings. (34) Training the SPs on "acting out" the scenario and also how to respond to questions is also important. Dry runs are often conducted before the actual day of the simulation. If there are scenarios which require the SPs to have wearable technology affixed to them, they have to practice and be put through dry runs to test out the performance.(35) High fidelity manikins are life-size and can simulate many functions such as breathing, pulses, heart sounds, pupillary reactions and others. This can help "connect" with the learners. The latter have to be given an orientation to these capabilities especially if they are using these high fidelity equipment for the first time. This is done during the "Pre-briefing" session. (29, 36)

e. Assessment of Performance

The points of assessment as well as the skills and competencies to grade will depend on the learning objective set for the hybrid simulation scenario. Matrix and checklist can be used as well. They are helpful with some degree of standardization across faculty making the observations. In trauma scenarios, some of the commonly assessed skills include:

- Initial approach
- Proper conduct of primary and secondary survey

- Ability to pick and identify all the relevant injuries, especially the serious and life-threatening ones

Non technical skills assessed include teamwork, communications and others (Table 1). Table 1 is an example of a team performance matrix developed locally, with some aspects of cultural nuances taken into account.

Faculty must come together prior to the simulation session to agree upon the marking scheme, even with the use of checklist and matrix, as being fair and consistent with different groups of learners is important.

f. Conduct of Debrief, Evaluation and Feedback (3, 6,9, 10, 37-39**)**

This is carried out in a similar fashion to other types of simulation-based learning and will not be elaborated here(as it is not the main subject of this paper).

Domains	**Communications**	**Below Expectations (1 point)**	**Meet Expectations (2 points)**	**Above Expectations (3 points)**
	Use of clear, concise, closed loop communications			
	Level of comfort of leaders/ members when interacting with on another			
	Efficient and timely sharing of information			
	Use common language; no dialects or side colloquial conversations			
	Demonstration of active listening skills			
	Appropriate use of non- verbal communications skills			
Domain	**Team Interaction with Patient and Next-of-Kin**			
	Inclusive in engagement of patient/ NOK, with timely updates			
	Awareness of patient's autonomy and respectful to their/NOK'S views			
	Ability to appreciate/ respect cultural and ethnic nuances			
	Provision of interpretation as needed			
	Adequate demonstration of empathy			
Domain	**Situational Awareness**			
	Awareness of/ Adaptation to big picture view as scenario progresses			
	Familiar with and utilises systems-based practice and capabilities as needed			
	Ability to plan forward and anticipate			
Domain	**Team Dynamics**			

	Leaders/ members are empowered with role clarity			
	Shared leadership and respectful delegation is practised as relevant			
	Collaborative, positive and friendly team dynamics			
	Senior team members are nurturing to younger ones			
	Hierarchy is not a barrier to role execution			
	Team management is timely with appropriate prioritization			
	Constructive counter-checking and review amongst team members			
	Handling of distractions and interruptions			
	Team's shared mental model was clear to all			
Domain	**Decision Making**			
	Group/ Team's clinical reasoning process is clear			
	Decision making is robust and dynamic as scenario progresses			
	Regular review and reassessment to adjust priorities and strategies			
	Inclusivity in decision making			
Domain	**Global Performance Score**			
	Demonstration of Positive IPCP competencies: 1. Values/ ethics 2. Roles and responsibilities 3. IP communications and 4. Team work			
	This is a high performance team			
	There were no 'power-distance' barriers noted			

Table 1: An example of a locally used Teams Performance matrix for assessment during Simulation-based learning

Multi-casualty Hybrid Trauma Simulation Plans

Some sample scenario plans with details of the hybrid simulation needs and models are depicted in Tables 2 and 3 below

For Table 2, the scenario is:

The collapse of a 6 storey building, located at the foot of a hill during heavy downpour in the monsoon season. The scene has to be set appropriately in a large and spacious hall or room. In some instances props may be added, but this is not necessary. The 11 casualties detailed in Table 2 will be prepared

accordingly with the relevant instructions for SPs and moulage for the manikins, with the appropriate injuries. They may also be tagged with the relevant information using the Medtag cards. (34)

	Scenario	Vitals	Moulage	Comments
1.	Male, 40 years with left sided chest pain and SOB (SP)	BP: 110/65 HR: 70 RR: 29	Right sided chest bruise	Having an AMI Right sided chest contusion
2.	Male , 20 years with fracture of the left forearm, in pain and shouting (SP)	BP: 160/90 HR: 97 RR: 28	Left forearm deformity	Fracture radius ulnar on the left
3.	Female, 30 years, walking in a daze and asking repeatedly : " where am I?", "what happened to me" (SP)	BP: 110-65, RR: 20, HR: 68	Torn clothes and bruises on the face and upper limbs	Post Traumatic Stress Disorder
4.	Female , 18 years, with asthma attack. She lost her Ventolin Puff and inhaled dust from the explosion (SP)	BP: 129/76 HR: 112 RR: 30	Dirty face with soot, soot stains on clothes	Acute Asthma attack
5.	Male 22 years, fracture both thighs and cannot walk (Manikin with Moulage)	HR: 129 BP 89/55 RR: 18	Bruise and deformity of both thigh and can show open fracture if "bone" available	Open Fracture thighs bilaterally
6.	Female 18 years, crying and does not want to talk (SP)	BP: 99/56 HR: 56 RR: 16	Dust and dirt over face and arms	PTSD (post traumatic stress disorder)
7.	Male 60 years, abdominal pain and lying down due to pain (Manikin with Moulage)	BP: 82/55 HR: 132 RR: 28	Bruise over abdominal wall	Intraabdominal injury and needs surgery fast
8.	30 year old male with chest pain on the right and shortness of breath. Pain is worse on breathing (Manikin with Moulage)	BP: 110/68 RR: 30 HR:89	Bruise over right upper chest	Right sided pneumothorax
9.	32 Male, with amputated finger and multiple bruises and grazes over the upper limbs and lower limb(SP)	BP:139/65 RR:20 HR: 76	Amputated thumb on the right hand	Amputated finger Multiple bruises/ grazes
10	Elderly , with right leg pain (Manikin with Moulage)	BP: 170/97 RR: 19 HR: 90	Bruise and swelling/ redness. Closed fracture	Fracture tibia fibular on the right
11	20 year old girl with shortness of Breath (SP)	BP: 110/90 RR: 35 HR:100	Dirty clothes and face with dust and soot Carpo-pedal spasm of both hands/ fingers and breathing rapidly	Anxiety attack with hyperventilation

Table 2: Standardised Patients and Manikin with Moulage Distribution Among Casualties

For Table 3 the multi-casualty scenario is a highway pile up accident involving 3 cars. Table 3 depicts the plan for the use of hybrid simulation models.

	Casualty Characters	Initial Assessment	Further Treatment	Type
1	Conscious, Shouting in Pain	Massive Bleeding from Femoral Region	Wound Packing and Bandaging	Simulated Patient
2	Conscious, Blunt Trauma to Chest	Needle Decompression	Chest Tube	Simulated Patient
3	No breathing, No pulse	Dead	NA	Patient simulator/ manikin CAE Juno
4	Unconscious, Obstructed airway	Position Airway, Patient breathes	Cardiac Arrest (female patient)	Patient Simulator/ manikin CAE Ares
5	Conscious, Disoriented, Amputated Toes	Blunt Trauma to Chest	Breathing complications Needle Decompression	Patient Simulator CAE Ares
6	Conscious and Moaning in Pain	Suspect Spinal Injuries	Immobilization	Simulated Patient
7	Conscious and Moaning in Pain	Minor Injuries	Bandage	Simulated Patient

Table 3: Another Example of a Multi-casualty Trauma Scenario using Hybrid Simulation

Limitations

Even s hybrid simulation uplifts the fidelity, there are still limitations. There may be the inability to reliably and accurately re-create the exact clinical scenario, with the chaos, distractions and some of the stressors. However adequate planning can overcome some of these barriers, to a certain extent. Also standardized patients are actors where the actual, invasive procedure cannot be performed on. High fidelity manikins are very costly to procure and something not achievable by all centres and institutions. Thus the proper planning, innovative approach and execution of hybrid simulation can be very useful in overcoming some of these limitations and challenges.

Conclusions

Simulation offers a conducive immersive, environment for learning and training. Whilst it can help refresh practitioners' knowledge and skills of infrequently performed procedures and rarely encountered clinical cases, simulation based learning is very useful to train for proficiency in common, "bread and butter" type of cases. (40-43) The incorporation of Hybrid simulation elevates th scenario

experience, increases the immersiveness and realism and bring the learners one step closer to the real clinical scenario or situation as they would encounter it. Especially in trauma cases and those involving multiple casualties, the systematic steps and robust approach requires practice to inculcate familiarity, focus and the level of respect needed in approaching such clinical patients, as well as working with inter-professional colleagues. (44) It can certainly help uplift the usual traditional educational experience or classroom teaching. Eventually, all training is conducted to help advancement of patient care. (45)

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