

Simulation based team training in surgery — a review

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Abstract

The healthcare environment in surgery is complex, dynamic and often ambiguous. Besides subject knowledge and technical skills, other competencies, such as team work, communication skills and situation awareness, are required to ensure better patient-related outcome. Teams that demonstrate poor non-technical skills make more technical errors, often resulting in patient morbidity or mortality. Different hospital-based locations, such as operating rooms, intensive care units, emergency rooms and surgical wards, are the areas where poor team dynamics prevail. Simulation-based team training is a strategy to provide inter-professional training and experiential learning opportunities for surgeons, anaesthetists and allied health professionals. It helps them to effectively respond in complex situations in complex surgical environment. Simulation-based team training has 3 components; didactics, simulation itself, and debriefing. Literature has shown that simulation-based team training in surgery improves identification of team-based behaviours, improves team performance and overall patient safety.

Keywords: Simulation, Team, Team work, Inter-professional, Education, Surgery.

Introduction

The healthcare environment, particularly in the specialty of surgery, is complex, dynamic and often ambiguous. Surgery professionals are exposed to intense physical and emotional challenges while completing their tasks.¹ Patient safety depends on both technical and non-technical skills which include team work, communication skills, situation awareness and leadership skills.² These competencies are critical for surgical disciplines where the level of synchronisation in the activities carried out by the emergency care team in high-risk clinical situations decides survival of the trauma victim; and coordination of the operating room (OR) teams directs the outcomes for the person on the operating table, especially when operations do not go as intended.

According to the report published in 2000 titled, "To Err is

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Human", approximately 70% of errors occur because of lack of non-technical skills in surgery (NOTSS).³ Lack of coordination and communication within the team taking care of the patients have been identified as the most common yet most important factors adversely affecting patient outcomes. Teams that demonstrated poor NOTSS were found to make more technical errors, often resulting in patient morbidity or mortality.⁴

Although NOTSS have been incorporated into the essential competencies of a surgeon, formal teaching and assessment of these skills remain a challenge for surgical training programmes. The traditional training in surgical disciplines, unfortunately, focuses primarily on the acquisition of technical skills and relevant knowledge with minimal emphasis on NOTSS.

Concept of team and team work in surgery

Baker et al. defined a team as "two or more individuals who have specialised knowledge and skills to perform specific roles and complete interdependent tasks to achieve a common goal or outcome".⁵ Team work is individual team members' interrelated actions, thoughts and feelings allowing them to function as a team.⁶ Effective team work is a complex and challenging task that requires alignment of many qualities and competencies at all levels i.e., individual, group and organisation.⁷

The composition of teams in healthcare is very diverse. A common example is that of an OR team that includes surgeons, anaesthetists, scrub technicians and nurses in addition to the surgical trainees. Teamwork involves situation awareness, clear and open communication and coordination processes involving task management and information-sharing that bring together individual knowledge, skills and attitudes in the service of a common and valued team goal.

Team work is a late arrival in the field of medical education, but the best global healthcare organisations place particular emphasis on developing multidisciplinary teams that, despite having different training and skill-sets, work together to form a great 'expert team' rather than 'team of experts'.

How expert teams work

The role of team leadership is crucial for team

effectiveness and synergy. Team leaders have the tasks of planning team duties, delegation of roles, provision of coaching, coordination of team actions, conflict resolution, monitoring the task and provision of feedback.⁸ In the context of inter-professional surgical teams, this role certainly belongs to the surgeon who is regarded as the 'captain of the ship'.

Team members need to have a collective team awareness which is defined as a distinguished knowledge sets distributed across team members and knowing the ones abilities and limitations to perform respective task.⁹ This concept is particularly important in the OR setting where all stakeholders should know about each other's expertise and have trust in the assigned roles.¹⁰ The integration of individual tasks and bringing them into a collective set of tasks is called coordination.¹⁰ It helps to enhance understanding among team members and creates accountability.¹¹ There are various examples of effective coordination in healthcare settings, such as surgery checklists, timeouts and protocols.¹⁰

Barriers to team work

Professional culture is shaped by the values, problem-solving approaches and language/jargon specific for the professional group. These professional cultures contribute to the challenges of effective inter-professional teamwork.¹² Varying composition of a team adversely affects the opportunity to develop a team identity with shared mental models and trust.² The challenge for members of inter-professional teams is to manage the team processes that occur in all teamwork while simultaneously managing their individual professional identities.¹³ Other factors affecting team behaviours are related to the local organisational culture, including management of staff behaviour, variable case demands, team members' technical competence, perceptions regarding optimal interpersonal and team behaviours, and fitness of organisational structures and processes to support teamwork.¹⁴

Military, aviation industry and orchestra are the examples where personnel possessing different knowledge and skill-sets are trained together and thus learn to work as a team.¹⁵ Surgeons in particular are trained essentially in silos with rare chances of being trained together with colleagues and allied health professionals. Due to this lack of function as a team, during crisis situations, the chances of failure and medical errors are increased.¹⁵ As surgeons do not practice situations like severe bleeding or airway emergency, they are not prepared to optimally perform a team task in real-life situations.

The specific OR environment

OR is the place where team dynamics are less than ideal and it is where silo mentality prevails. It is a place for multi-professional interaction where true inter-professional team work is needed, but several factors limit the performance of team in OR.¹⁶

These include the presence of multiple specialties (surgery/ anaesthesia/ nursing/ technicians and trainees; time pressure; frequent turnover of patients and staff during the course of a day; and a steep hierarchy.

Due to these limitations, there prevails a toxic OR culture¹⁷ characterised by increasing tension, confusion about individual roles and responsibilities, communication gap and, thus, ineffective teamwork.¹⁸ This culture leads to a negative impact on patient-care, leading to technical errors, distractions and increased morbidity and mortality.^{19,20}

Lingard et al.²¹ and Nagpal et al.²² found lack of communication and transfer of the vital peri-operative information among healthcare workers resulting in adverse effects, including procedural errors. Improving teamwork in ORs is an important way to reduce the intra- and post-operative morbidity.

Other hospital-based locations, such as emergency rooms (ERs), intensive care units (ICUs) and surgical wards, represent the areas where poor team dynamics also prevail. Studies have shown that the entire process of surgical care of patients in the ER, wards, OR and then recovery room to ICU and back to the ward shows failure of communication and information transfer even between surgical trainees and the attending surgeons.²³

Timely action in critical situations

In a fast-paced environment, surgery, anaesthesia and nursing teams require timely action and critical thinking in life-threatening and high-stake situations where the margins of error are exceedingly rare.⁵ What is important in a crisis situation is not only the expertise, but the ability of the healthcare team to anticipate and diagnose it, organise and then plan and execute the treatment strategy as an interrelated group.¹⁵ Several studies have shown that around two-thirds of medical errors are due to failure of teamwork and communication gaps.²⁴

Need for inter-professional education (IPE) and team training

Literature suggests that current teamwork in surgery is less than ideal¹⁸ and there is a need of inter-professional education (IPE) among the team members. IPE, by

definition, involves participation of 2 or more healthcare professionals learning from, about and with each other by any type of educational training, teaching or learning sessions.²⁵

Team training creates a common understanding of how to work in teams with regard to patient safety.²⁶ Interventions focussing on teamwork have shown positive impact on healthcare team processes and patient outcomes.²⁷ Literature shows that effectiveness of team training is independent of training design and implementation, trainee characteristics and characteristics of the work environment. The effect of team training can be demonstrated on every level of Kirkpatrick's evaluation criteria.⁴ Therefore, team-training concepts are increasingly being implemented in many high-risk medical fields as a tool to ensure that interdisciplinary medical care teams are best prepared for emergency situations.

Role of simulation for team-training

Traditionally, the training of healthcare professionals was based on the 'apprenticeship model' of "see one, do one, teach one".²⁸ Over the evolving time, there is a growing use of simulation due to various factors, such as increasing emphasis on patient safety, limitations of duty hours, restriction in healthcare practice, variable learning opportunities, and, more recently, due to incorporation of outcome-based education models.⁵

Although simulation has been around in its indigenous form since centuries, including military fields, aviation industry adapted it in a more scientific way, using the computer technology to develop 'flight simulators' allowing practice in a safe environment to ensure safety of the passengers. Conventionally, surgery as a discipline was slower to adopt simulation in its gamut.⁵ Most of the institutions across the globe are using simulation training in their surgery education curriculum, but these are largely in silo and confined to one specific specialty.

Simulation training provides a variety of advantages, including not only the practice of technical skills but also decision-making, communication and leadership skills.²⁹ It can be stopped as many times as necessary to make a teaching point and to correct the deficiency. Simulation is also being utilised for not only summative assessment, but for the formative assessment as well.⁵

Simulation-based team work training

Historically, simulation in surgical training has been focussed on improving technical skills.³⁰ In the recent era, models have evolved where team members practise their tasks as interdependent unit rather than in isolation.¹⁶

Research in surgical education has recently explored and developed simulation-based team-training (SBTT) strategies to improve the team dynamics, and transforming the trainees into competent and accomplished surgeons.^{3,31}

SBTT offers a safe environment where team members can learn NOTSS with and from one another, and it provides an opportunity for reflection and self-recognition that serve as a basis for experiential learning through deliberate practice with the aim of providing high-quality patient care in real life. SBTT has been shown to improve perceptions, performance and confidence of the learners regarding teamwork and team communication.³² SBTT also improves leadership skills by transferring complex skills to the clinical environment, thus indirectly affecting patient-care.³³ Studies have shown that inter-professional SBTT course improves leadership, communication and teamwork by developing learners' insight about these areas and their role in a team.³³

Introduction of SBTT programme / course

Rigorous educational design processes are needed to develop SBTT along with robust assessment of needs to determine the required curriculum and the choice of the target team competencies and performance assessment.^{10,34}

Careful planning is required to introduce an SBTT course. The first step is to determine the target groups and level of training required. An example is doing simulation training in OR involving multiple professionals at various hierarchal ranks, such as junior and senior surgery residents, anaesthesia residents, consultant surgeons, anaesthetists, scrub technicians, anaesthesia technicians, circulating nurses and OR coordinators.⁵

The second step is to identify and arrange the physical environment where the simulation-based scenarios would be practised.

Administration support is required to overcome logistical challenges. A buy-in from all relevant parties is important before organising SBTT. This includes hospital management, OR administration and inter-professional departments like surgery, anaesthesia and nursing.¹⁵

The objectives of the course are delineated and course planning is done. Generally SBTT has 3 elements; didactics, simulation, and debriefing using the principles of adult learning theory of Kolb cycle involving the learning as a continuum of experience, reflection and experimentation³⁵ (Figure).

a) Didactic component: The curriculum should include a

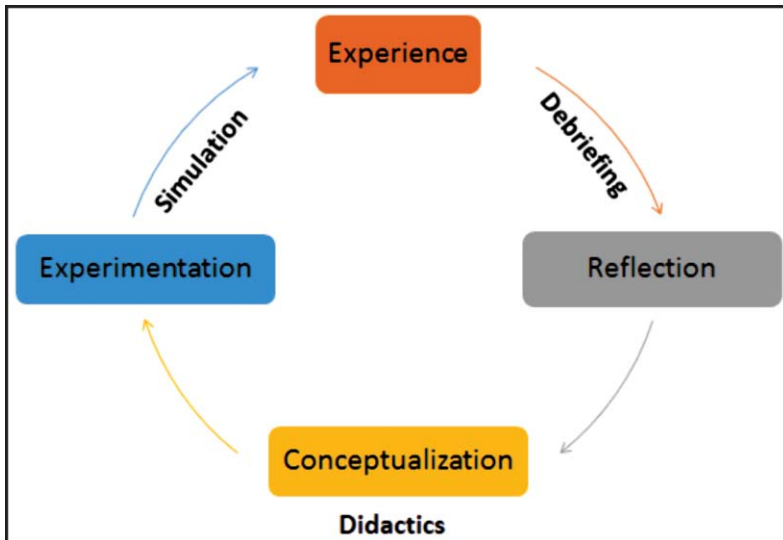


Figure: The components of simulation-based team training (SBTT) superimposed on the fundamentals of Kolb Learning Theory.

suitable topic with appropriate content and strategies.¹⁸ It should be incorporated into the existing academic framework by involving students, faculty and leadership in curriculum development.

A didactic programme provides orientation to the participants about the introduction, including the participants, their roles in the hospital, experience, prior exposure to a particular situation, purpose of course, its execution and debriefing process. This also includes gaining confidence from participants by informing them that the course is all about learning and learning from mistakes.¹⁵

b) Designing a simulation scenario: Well-designed scenarios form a core component of SBTT.³⁶ These scenarios should be 'event-based' involving a preparatory work and use of role-play. The scenarios need to be conceivable to the participants and must be engaging for all team members. There should be an element of realism so the learners could think, act and interact with their interdisciplinary team members in a realistic manner.³⁶

One of the ways is to dramatise a real encounter such as the one discussed in some previous quality of care / morbidity and mortality meeting. One can use actual details, such as patient's history, physical examination findings, events and the outcome.

The scenarios must fit within the timeframe of the course, but should allow ample time to practise teamwork. The scenarios should have some crisis features, including challenging situations requiring teamwork

management.¹⁵ An example is that of a bleeding patient on OR table during surgery. While managing the scenario, team dynamics should be observed. This strategy could help assess crisis management abilities and leadership skills in a simulation setting rather than identification of competency deficits in real clinical environment.¹⁰

c) Debriefing: The debriefing should have 3 phases. In the first phase, the structure of scenario is explained, the errors are identified as teaching points and the participants are encouraged to share their experiences. This is the reaction phase.

The second phase is the understanding phase and comprises discussion of medical issues, like diagnosis, condition such as a bleeding tumour, and the attitudes and behaviours of the participants. The last phase is the summarisation phase where constructive criticism is provided.¹⁵

d) SBTT environment: In introducing simulation-based education, equipment cost and availability is a problem, especially if it is being performed in a simulated environment using high-fidelity virtual reality (VR) simulator. To overcome this problem and to improve the feasibility, simulation-based multidisciplinary team training can be performed utilising a real clinical 'in situ' learning environment, such as OR on a weekend using real equipment as augmented reality (AR).

SBTT in literature

Despite appropriate guidelines for use of SBTT, the evidence in surgical literature is limited.³⁴ The research focuses on the aspects of SBTT role in intra- and inter-professional team-working, patient safety, identification of team-based behaviours and crisis resource management.

SBTT has been utilised to train consultants, residents and even students in various areas, including OR, post-operative and trauma settings in surgery.^{37,38}

Improved team-based performance was observed when both student OR teams and trainee OR teams had undergone SBTT.³⁹

Improvement in perception as well as actual team performance was reported after SBTT in two of the highly stressed areas of surgery; trauma and cardiac surgery.³⁶

Two systematic reviews assessed the effectiveness of

healthcare team training. Weaver et al.⁴⁰ evaluated 40 peer-reviewed papers. These studies explored issues related to training design, implementation, debriefing and evaluation and outcome measures. Buljac-Samardzic et al.⁴¹ included 297 studies in their systematic review after analyzing 7 major databases and found that number of studies regarding team interventions have exponentially increased over the last decade. The research is more on the outcomes and SBTT is the strategy which provides the greatest opportunities for improvement in team functioning.

Weller et al.⁴² showed that simulation training in general surgery improved teamwork and communication skills measured by the validated Behavioural Marker Risk Index (BMRI) tool, compared to pre-simulation measures. Steinemann et al.⁴³ showed that intervention using human patient simulator-based in situ team training in trauma units leads to improvement in teamwork scores compared to pre-simulation levels.

Conclusion

SBTT provides experiential learning opportunities to the surgical team to respond to crisis situations. The introduction of simulation-based training has changed the old description of apprenticeship model of "see one, do one, teach one" to "see one, do many with simulations, and teach one".

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