Penerbit Akademia Baru

Journal of Advanced Research in Social and Behavioural Sciences

Journal homepage: www.akademiabaru.com/arsbs.html
ISSN: 2462-1951

Impact of Simulation Based "Death Scenarios" in Teaching Undergraduate Medical Students about Multidisciplinary Team Function in Patient Care

Open Access

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ARTICLE INFO

Article history:
Received 18 January 2018
Received in revised form 6 February 2018
Accepted 28 March 2018
Available online 26 May 2018

ABSTRACT

Experiencing the death of a patient is one of the most challenging aspects of training for medical students. Exploring what students learn from this difficult experience is useful for a multitude of educational objectives. Role of death and dying in experiential learning of medical students is well documented. Death is a multidimensional subject with significant variation in different cultures and religions. Teaching about death and life-saving skills to undergraduates poses a serious ethical dilemma. Critical patients need to be protected from novice practice. Advent of clinical skills labs with simulated patients has made it easy to teach care of critical patients to medical undergraduates. Our research question was, "How does imminent death of a simulated patient influence learning about and acting as a multidisciplinary medical team among pre-clinical medical students?" Clinical scenarios aided by simulated patients depicting imminent death of the patient were used to study development and performance of a medical team. We could not find similar researches done in Pakistan or other SAARC region countries. This is a double blind, randomized, controlled interventional study. Experimental (n = 40) and control (n=40) groups were trained in life saving skills in a skills lab. Experimental group was taught using scenarios depicting death of patients while control group was taught using scenarios with critical patients, only. Both groups were tested for effective team function in resuscitating a simulated patient. Scores for attributes of effective teamwork were compiled and analyzed in SPSS V-21. No significant difference was seen in Pre and Post-test scores for experimental and control groups. Teamwork attribute scores were significantly higher for experimental group compared with control group, (p value - < 0.001) for all attributes tested. Simulated case scenarios depicting death of the patient are an effective tool to teach medical undergraduates about effective teamwork.

Keywords:
Death, simulation, life-saving skills, medical education, skills lab

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1. Introduction

Death and dying are unique experiences for medical students. Most remember patients whose deaths they witnessed as medical students. Research has shown that death of a patient is a complex subjective experience for medical students [1]. Increased level of anxiety in medical students around dying patients is well documented [1]. Several medical curricula in the west address death and dying as a separate subject. There is limited exposure to actual patients during pre-clinical years. A review of the Index Medicus using 'Death' as a search keyword from 1960 to 1971 showed not a single article about an undergraduate curriculum teaching death and dying in medical schools in United States [2]. Barton was one of the first medical teachers who regularly met with his undergraduate students in small groups. He published his experiences on educational value of death at undergraduate level [3].

Liston reported that about half the medical schools in the United States had included some amount of formal teaching on death and dying in their undergraduate curricula between late '60s and 1973 [4]. By 1980, 104 out of 114 (92%) medical schools in the United States had formal, planned out courses followed by formative assessments about death and dying [5]. In England, in 1983 only four of 62 medical schools reported the absence of a programme for medical students on death and dying but the exposure to the topic of death and dying was limited to only an hour in a five-year course [6] . Advocates of patient exposure in pre-clinical years recommend that death and dying should be taught for better educational outcomes in terms of empathy and effective communication with patients and families [7].

Death is a complex medical, social, cultural and spiritual issue. This is the reason that several learning outcomes can be taught using death [9,10]. It is one of the major social and cultural stimuli for groups to come together and act in unison. This makes death a hypothetical stimulus for effective teamwork. Experiencing the death of a patient leads students to seek encouragement through colleagues. Clinical exposure to dying patients brings about a change in students' perceptions to view death as a part of life instead of being something traumatic [9]. Students appreciate the professional environment of the hospital and assume team positions in formalizing the death of a patient, as they feel more responsible for their patients [9]. Objective measurements of patientcare attitudes and knowledge parameters have shown that medical students who reported personal or professional experiences with death had positive attitudes and knowledge scores that were statistically significant compared with those who did not report such experiences [10]. Such studies call for innovations in teaching medical students about death and dying. Innovations that can help inculcate useful clinical care attributes such as empathy and teamwork, especially when dealing with critical patients and their families.

Simulation labs and clinical skill centers are very useful in teaching about death to medical students. Benefits of scenario based and simulation enhanced teaching include exposure of students and trainees to critical life and death situations without jeopardizing actual patient care in hospitals. Role of death and dying patients in experiential learning of medical students is well documented[11]. Teaching about life saving skills [12] and effective teamwork [13] in undergraduate medical curricula has received serious consideration over past decade. Failure of ability to function as an effective team was cited as the leading cause of preventable medical errors in several studies [12,13]

Keeping this background in view, we began with the question; How does imminent death of a simulated patient influence learning about and acting as a multidisciplinary medical team among pre-clinical medical students? Limited data exists to support the role of patient's death as a tool in teaching multidisciplinary teamwork at undergraduate level.

2. Materials and Methods

This is an experimental study. A double blind, randomized, interventional protocol was followed. Institutional Ethical Committee for Undergraduate Medical Research reviewed and cleared the study protocol in 2016. Six "Skill Stations" were designed to teach life-saving skills in critical situations. Learning outcomes, visual aids such as mounted photographs and flow charts, verbal cue cards and simulation material were discussed and documented for each skill station. Table 1 gives the detail of each skill station.

Teaching scenarios and assessment rubrics were vetted in three rounds among principal investigator and the "Skills Committee" comprising of one physician, one cardiologist, two surgeons and three senior clinical medical students. Visual aids were inspected from varying visual angles and distances and in consort with the teaching scenarios by the same committee and approved after revision. Simulation materials were tested and approved as well. Dresses and linen around simulations was designed to resemble our teaching hospital. All intravenous fluids and medications were purchased from local companies. Stethoscopes, thermometers, BP apparatuses and other clinical gadgets were placed on practice stations, as and when required to make the simulated set up look like actual hospital setting, (see Table 1).

80 pre-clinical students from first year were enrolled, after informed consent, for training to become peer tutors on skill stations. First, they were randomly assigned to skill stations to get trained as peer tutors for that skill. Then they were further randomly assigned to two groups, an experimental group, who were taught using scenarios depicting imminent death of a patient; and a Control group, who were taught using scenarios with critical patients but death was not mentioned during testing. Students and the evaluation team were both blinded to assignment in experimental or test groups. All students took pre-tests with multiple choice questions about life saving skills. They were taught by an AHA certified instructor for total of eight hours per skill station over a one month period. One session was thirty minutes in duration and comprised of theoretical teaching. Both groups took post-tests at the end of the eight-hour theoretical teaching sessions.

This was followed by scenario based testing and demonstration of skill around props and simulations. Four sessions were planned. Each session included practice and testing with cue cards and simulations/props. Experimental group was tested using simulated patients who faced death and died at the end of exercise. Control group was given patients with critical life-threatening illnesses but death was not mentioned in scenario scripts. The simulated patients in scenarios given to control group did not die at the end of exercise. Both groups practised in separate spaces and were instructed to not "leak" the testing scenarios to other students. Remedial sessions were given for students not meeting required standards. A total of fifty hours of teaching were recorded over twenty-six days.

A final exit test of skill performance was given at the end. Clinical scenarios depicting life threatening situations were presented to both experimental and control groups. Both groups were asked to treat and possibly resuscitate simulated patients as a five to seven-member "Code Team" working together to treat the patient. Score cards, (Table 3), were developed, de-novo, after systematic literature search in Pub Med, Pub Med Central, Google Scholar, Pakmedinet and Embase using, "Multidisciplinary Medical Teamwork" as keywords [15-17]. Both groups were observed by the evaluation committee members and scored for skills representative of multidisciplinary medical team function (Table 3).

Table 1
Detail of "Skill Stations" used to train Peer Tutors in Skills Lab

BASIC LIFE SUPPORT, ADULT			
Learning Outcomes	**Visual Aids**	**Verbal Cue Cards**	**Simulations/ Prop Material**
Identifies need for CPR Calls for helsp Clears airway Performs rescue breaths on adult victim Performs effective CPR on adult victim Performs Heimlich manoeuvre on adult choking victim	BLS algorithms from American Heart Association Illustrations of Heimlich maneuver Compression number and depth in Effective CPR	Single-rescuer CPR Two-rescuer CPR Heimlich required	Leardal Resusci-Anne (pediatric model) QCPR Compression board
PEDIATRIC BLS Identifies need for CPR in a child Calls for help Clears airway while maintaining C-spine stability Performs rescue breaths Performs effective CPR Uses two-finger technique in infant Performs back blows and chest thrusts maneuver on child/infant choking victim	**Visual Aids** Paediatric BLS algorithms from American Heart Association and American Academy of Paediatrics Illustrations of choking in child and back blow manoeuvre Compression number and depth in Effective child CPR	**Verbal Cue Cards** 5-year-old child found in a park. Needs single-rescuer CPR Child seized in school and found unconscious. Two-rescuer child CPR Choking 2-year old requiring back blows 4-year-old victim of drowning	**Simulations/Prop Material** Leardal Resusci-Anne (adult model) Compression boards
ABCDE of TRAUMA Performs ABCDE assessment in acute trauma victim Clears airway while maintaining C-spine stability Performs rescue breaths Performs ambu-bagging upon indication Describes indications for endotracheal intubation Performs effective CPR on trauma victim Prioritizes IV sites Selects appropriate fluid for resuscitation Performs "Disability" survey	**Visual Aids** Illustration of trauma victim survey points C-spine collar Parts of ambu bag Endotracheal tube and laryngoscope Color coded IV cannulas Board for patient transport Patient Transport Kit	**Verbal Cue Cards** Motor vehicle accident victim requiring C-spine stabilization and fluids Bomb blast victim requiring IV fluids and disability survey with prevention of exposure Gun shot injury victim requiring endotracheal intubation and blood transfusion	**Simulations/Prop Material** Resusci-Annie Leardal QCPR Resusci-Baby Leardal QCPR Ambu-bag Oxygen tubing

RAPID IV ACCESS	**Visual Aids**	**Verbal Cue Cards**	**Simulation/Prop Material**
Recognizes signs of impending shock Prioritizes IV sites in adults and children Selects appropriate IV fluid in shock resuscitation Performs IV cannulation with aseptic precautions Recognizes phlebitis	Color coded IV cannulas Phlebitis IV fluid charts Algorithm Management of Shock	Patient with early impending shock requiring rapid IV access and fluid infusion Checking patency of IV cannula in a child	Plastic arm with anatomically located veins
SUTURING SKILL **Learning Outcomes**	**Visual Aids**	**Verbal Cue Cards**	**Simulation/Prop Material**
Differentiates mono vs. poly filament suture material Selects appropriate suture material and needle for simple surgical wounds Describes indications for three common suture techniques Performs simple interrupted, simple continuous and mattress sutures on props	Illustrations: Monofilament sutures Polyfilament sutures Types of suture needles Simple interrupted sutures Simple continuous sutures Mattress sutures Non-suture materials for wound repair		Suture materials with different needles Foam pads with thin semi-porous covering, (mimicking skin) Suture scissors Toothed and non-toothed forceps Derma-bond material
RAPID INTERPRETATION OF ECG **Learning Outcomes**	**Visual Aids**	**Verbal Cue Cards**	**Simulation/Prop Material**
Calculates heart rate and analyzes rhythm from ECG strip Calculates PR, RR, QRS duration Differentiates supraventricular from ventricular tachycardia Recognizes heart blocks Estimates axis of the heart from direction of QRS complex	Illustration ECG paper Formula for calculating heart rate and axis Abnormalities of rate, rhythm and axis	Cases describing: An athlete with sinus arrhythmia A child in pain A 60-year old on Beta blocker SVT, VT, VF, AF, Heart blocks LVH, RVH	ECG Strips with: Normal sinus rhythm Tachycardia Bradycardia Arrhythmias Chest x-rays and ECG strips with LVH & RVH

Table 2
Demographic and Educational Details of Peer Tutors. (Percentages given)

Skill Station	'n'	Male/Female %	Mean Age, (Yrs)	Major Ethnicity %	Education FSc/Cambridge %	Peer Tuition Experience %
ECG	14	45.0/55.0	20+/-2.3	Pushtoon	98.0/2.00	2.0
BLS, Adult	14	57.0/33.0	22+/-2.1	Pushtoon	99.0/1.00	5.0
BLS, Child	13	30.0/60.0	21+/-2.0	Pushtoon	99.0/1.0	3.0
ABCDE	18	27.0/73.0	21+/-2.2	Pushtoon	100/0.0	4.0
Rapid IV	12	10.0/90.0	22+/-1.5	Pushtoon	100/0.0	2.0
Suturing	09	80.0/20.0	20+/-2.0	Pushtoon	95/5.0	0.0

Table 3
Score Card for Scoring Multidisciplinary Medical Team Function in Exit Exam

S. No	Multidisciplinary Teamwork Attribute	Frequency Rating Scale[16] 1: Rare. One or two rare examples of the behaviour occurred. 2: Isolated/minimum. There were isolated examples of the behaviour throughout the observation. 3: Intermittent/standard. There were intermittent examples throughout the observation. 4: Consistent. There were consistent examples of the behaviour throughout the observation.
1.	Communication Skills	A. Listens carefully B. Speaks clearly C. Informs about progress
2.	Technical Communication	A. Vocalizes steps taken B. Repeats orders C. Records progress D. Gives clear referral orders, (when indicated)
3.	Professional Relationships	A. Punctual B. Respectful C. Assertive D. Supportive
4.	Patient Relationships	A. Respects dignity B. Keeps family informed C. Advocates patient's rights
5.	Problem Solving Skills	A. Identifies problem B. Prioritizes problems C. Assigns roles and goals D. Gives feedback
6.	Educational Attitudes	A. Discusses issues on site B. Quotes best evidence C. Asks questions D. Interested in teaching
7.	Procedural Skills	A. Observes protocol B. Obtains "Informed Consent" C. Maintains anti-sepsis D. Checks progress

Table 4
Paired t-test Results for Pre-Test and Post-Test Scores of Control and Experimental groups

#	GROUPS	PRE-TEST SCORES	POST TEST SCORES	P VALUE
1.	Control, (n=40)	1.30 ± 0.791	3.53 ± 0.716	<0.001
2.	Experimental, (n=40)	1.43 ± 0.958	3.55 ± 0.749	<0.001

Data was analysed using SPSS V-21. Two sample t-test was applied to calculate the difference in scores between experimental and control groups.

2. Results

A total of eighty undergraduate medical students from pre-clinical years were enrolled. Demographic characteristics of study participants are given in Table 2. Forty students were randomly assigned in experimental and forty in control group. There was no statistical difference in Pre-Test scores between experimental and control groups. Both groups showed significant improvement in

mean scores in Post-Tests after the eight-hour theoretical teaching sessions. Again, both experimental and control groups showed improvement and no significant difference was noted between the two groups in Post-Test scores, (see Table 4).

Scores for multidisciplinary team function between experimental and control groups were significantly different in all eight attributes of multidisciplinary medical teamwork observed by the evaluation committee, (p-value - <0.001), (see Table 5). Experimental group scored significantly higher compared with the control group for all the attributes of medical teamwork tested. Difference between scores in "Communication Skills" was most significant between the two groups followed closely by differences in "Educational Attitudes", "Patient Relationships" and "Professional Relationships", (see Table 5).

Table 5
Paired t-test Results for Multidisciplinary Medical Teamwork Scores of Control and Experimental groups

#	VARIABLES	CONTROL	EXPERIMENTAL	P VALUE
1.	Pre-Test	1.30 ± 0.791	1.43 ± 0.958	0.526
2.	Post Test	3.53 ± 0.716	3.55 ± 0.749	0.879
3.	Technical Communication	2.40 ± 0.6325	3.20 ± 0.6284	<0.001
4.	Problem Solving	2.425 ± 0.6655	3.725 ± 0.6975	<0.001
5.	Procedural Skills	2.563 ± 0.7695	3.463 ± 0.6923	<0.001
6.	Communication Skills	1.925 ± 0.6558	3.95 ± 0.6679	<0.001
7.	Data Gathering Skills	2.50 ± 0.725	3.838 ± 0.6543	<0.001
8.	Patient Relationship	2.363 ± 0.6601	3.988 ± 0.6252	<0.001
9.	Educational Attitudes	2.088 ± 0.5761	3.813 ± 0.6951	<0.001
10.	Professional Relationship	2.425 ± 0.7970	3.775 ± 0.7246	<0.001

3. Discussion

Our study showed significantly better acquisition of attributes required for multidisciplinary medical team function among students who were exposed to simulations and scenarios depicting imminent death of the patient. Trauma teams and Code teams are the norm in hospitals, all over the world. It is important to introduce teamwork ethics and principles as early on in student life as possible.

Our results support the notion that teaching scenarios and simulations about critically ill patients encourage development of academic and personality traits required for teamwork among training students. A landmark study by Smith-Han *et al*. [9] showed that facing the death of a patient had several positive and negative effects on undergraduate students. They concluded that students who faced death of their patients felt emotionally moderated and they sought reassurance through closeness and comfort of their peers [9]. They underwent a transition in terms of their understanding of their views about being doctors [9]. They viewed death as a part of life rather than something shocking, with resultant maturity and dampening of emotions [9]. Students began to perceive the professional surroundings and pace of work of the hospital by beholding the familiarity of death [9]. They seemed to accept their role in solemnizing the death of a patient [9]. They also felt more responsible for their patients [9]. Although our study is quantitative, however, our results reflect more frequent display of similar traits in our students who were exposed to scenarios with dying patients.Our results show that difference in scores for "Communication Skills" was most significant between the two study groups. Härgestam *et al.* [18] report communication, specifically "Closed Loop Communication", initiated by the Team Leader in a Trauma Team, to be beneficial for teamwork.

They tested sixteen, six-member, trauma teams on a patient simulator pre-programmed to represent a severely injured patient (injury severity score: 25) suffering from hypovolemia due to external trauma. Our simulations were similarly representative of critical patients, who died at the end of exercise in case of the experimental group.

Research studies about encounters with death and dying among undergraduate medical students are a handful. One of the earlier research studies about pre-clinical undergraduate students views after facing death of a patient by Hull *et al*. [19] concluded saying, "There is increased need for teaching about death and dying particularly before clinical training and at the time of graduation. Another time may be at the beginning of human dissection.". Earlier reports of inadequacies in preparation of young medical graduates to deal with death and dying patients mostly explore the emotional and affective burden faced by young doctors facing mortality, early on in their professional careers. Ahmedzai *et al.,* [20] reported that the junior house staff who were surveyed in their study felt that the nursing staff were more helpful and supportive compared with senior medical staff in dealing with terminal patients and death on wards. There is a paucity of data about actually using death of a simulated patient to enhance student performance in certain areas, specifically, taking care of critically ill patients and being effective team members in critical situations.

All of our study participants were natives of Pakistan. Majority were Pushto speaking and were ethnic Pushtoons. We recognize the fact that teamwork is not studied at all in this particular ethnicity and culture. Our study population comprised of a good mix of male and female medical students. Differences in scores based on genders will be reported in future after further in-depth analysis. It is known that gender differences result in different styles of verbal and non-verbal communication, moral and ethical obligation to values, and self/workplace expectations [21]. In the health care set ups, where physicians are frequently male and nurses, female, communication problems are further accentuated by gender differences.

Our study is a pilot study in this area. With an approved study protocol and required infrastructure for skill stations in place, we plan to conduct this study with larger groups of students and more in-depth data analysis along with qualitative exploration of impressions and ideas of students in both groups.

4. Conclusion

Simulated case scenarios depicting death of the patient are an effective tool to teach medical undergraduates about effective teamwork

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