Review Article

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Utilizing Simulation Technology to Train Doctors in Indian Society of Toxicology Life Support Course at Poison Control Centre

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Abstract

Simulation has been widely adopted as a training and assessment tool in medical education. Conventional teaching methods may be inadequate to properly train healthcare providers for rare but potentially lethal events in Toxicology such as managing associated polytrauma in alcoholic drink and drive cases, Acute Brain stroke due to cocaine toxicity, acute coronary syndrome in Cannabis and cardio-respiratory arrest in Opioid abuse. We have observed that Simulation based training, by enhancing provider skills, can subsequently decrease medical errors and increase patient safety.

Keywords: Toxicology; Poisoning; Overdose; Simulation; Training.

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Introduction

Indian Society of Toxicology have created ISTOLS-Indian Society of Toxicology Life support course with international training skills for the purpose of educating consultants and resident doctors, as well as Nurses and paramedics in life saving skills course for managing toxicology and various trauma management certified courses for fixed duration on regular basis, to update their skills and knowledge. Medical simulation offers the challenge of integrating medical knowledge, attitudes, and skills in case scenarios, procedure-based learning activities, and role playing.[(1)]

Mannequins come in various shapes and sizes and can serve different purposes, including replication of the clinical deterioration and imitation of an adult in distress secondary to acute medical event.[(2)] Fidelity describes the extent to which the appearance and behavior of the mannequin imitate the appearance and behavior of an actual patient.[(3)] Simulation based training, by enhancing provider skills, can subsequently decrease medical errors and increase patient safety.[(4)] Simulation is especially effective in developing skills in procedures that require eye–hand coordination and ambidextrous maneuvers, such as securing airway in compromised airway due to vomiting and aspiration in unconscious state, vascular access in cardiovascular collapse, shock and cardiac arrest and the use of laryngoscopes for endotracheal intubation in respiratory compromise.[(5)]

ISTOLS is one of the unique CME Bedside simulation training organized by Pioneers in the field of Toxicological emergencies, addressing the common poisonings found in Indian subcontinent. Participants learned to identify poisoning, recognise drug overdoses, recall

relevant antidotes with routes and doses, utilize the resources available bedside in rescuing critically ill intoxicated patients. Participants underwent simulation training bedside for understanding the pathophysiology of envenomation and got practical tips in administering antidotes, anticipating adverse events of therapy and preparing mind maps for the future practical situations during real life management of intoxications.

We have recently conducted ISTOLS on 21st December in Poison Control Centre, Amrita Institute of Medical Sciences by training 24 resident doctors and consultants in critical care, emergency, forensic medicine and toxicology.

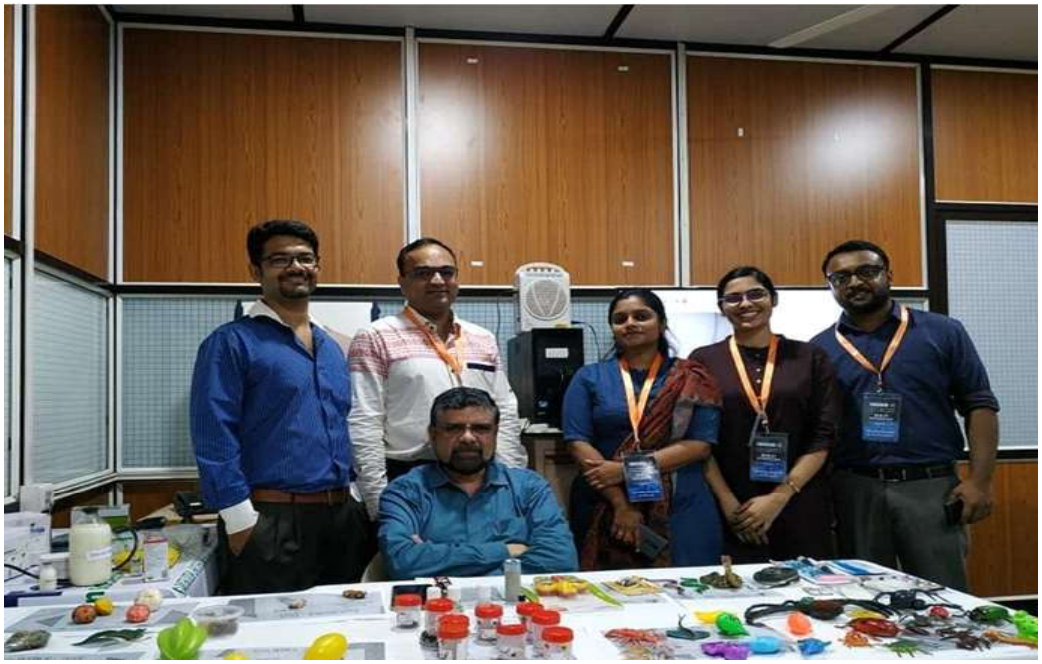

Photo. 1: Our ISTOLS simulation team of instructors at Poison Control Centre AIMS Kochi – Dr Ramakrishnan, Dr Vivekanshu, Dr Athira Aji, Dr Remya S, Dr Nirmal (From left to Right) and Dr Vijay Vasudev Pillay (sitting in middle) on 21-12-19 during Annual IST conference alongwith IST Toxic Medley of simulated plant parts, venomous animals, fishes, insects, smells as station for participants.

Fig. 1: Common Poisonous mushrooms, simulated by colouring the edible mushrooms with sketch pen to look alike Amanita, Jack O' Lantern, Psilocybe, thus learning Toxicology in non-toxic manner.

Fig. 2: Dhatura seeds simulation by chilli seeds.

Fig. 3: Poisonous animals (Dart Frog) Venomous insects (Black widow spider, Scorpion, Red scorpion, Honey Bee, Wasp, Spanish Fly, Centipede, Tarantula), non-venomous (Common Spider, Cockroach, Red Beetle) of rubber used for simulation training including beetle, spider, scorpion and dart frog. Thus learning Toxicology in non-toxic manner.

On 21st November 2019, Similarly, we conducted ISTOLS in Grande Internationale Hospital, Kathmandu, Nepal successfully by training 34 resident doctors and consultants in critical care, emergency, forensic medicine and toxicology

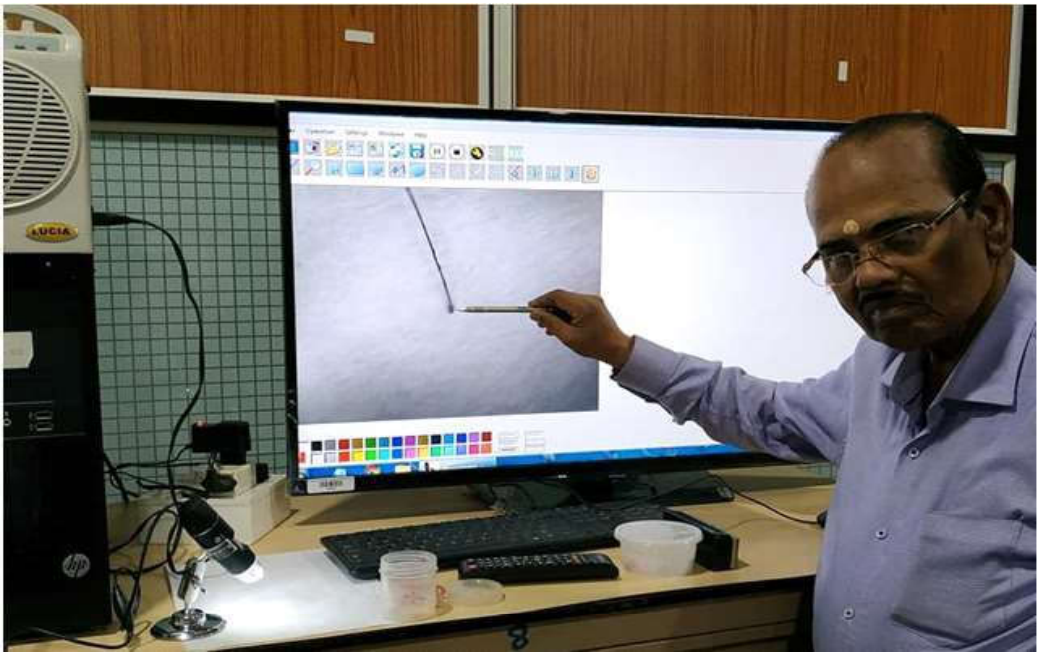

Fig. 4: Demonstrating bedside point of care, using Digital microscope magnified 1000 times on-spot, identifying human hair of thallium poisoning victim in ISTOLS by Dr Gopalan, Simulation training Lab in charge, AIMS Kochi.

On 29th July 2019, in Sarvodaya Hospital, Faridabad, we have conducted ISTOLS workshop successfully by training 55 resident doctors, NRHM Rural Medical Officers of Haryana and consultants in critical care, emergency, forensic medicine and toxicology.

Fig. 5: Marine envenomation teaching by venomous fishes, Fugu, Sting Ray, Star fish with sting, Jelly fish with tentacles, Blue-ring octopus, shellfish and non-venomous Octopus, scenarios simulated by similar look alike toys, thus learning Toxicology in non-toxic manner

Fig. 6: Different Venomous Snakes for identifying 4 Toxidromes, by big 4, Cobra and Viper, and non-venomous Green Snake, Brown Snake; utilising look alike toys, thus learning Toxicology in non-toxic manner

Fig. 7: Simulating rattling sound of rattle snake by colliding magnetic pellets and differentiating with death rattle in victim, simulated by rattle toy sound.

On 23rd March 2019, in Amrita Institute of Medical Sciences (AIMS), Poison control centre, Kochi, we have Bottom figure 7. Caption, add space to the bottom para below on page 71medicine and toxicology. conducted ISTOLS workshop successfully by training 25 resident doctors, NRHM Rural Medical Officers of Kerala and consultants in critical care, emergency, forensic medicine and toxicology.

Fig. 8: Toxic smell simulation by common household substances, like shoe-polish (aromatic Nitrobenzene), Napthalene balls, Perfume scents (poison lily, jasmine), turpentine oil (Organophosphates), rotten egg (Hydrogen Sulphide), almond oil (Cyanide), Burnt Rope (Cannabis), Poppy seeds (Opium), Ketotic odour (fruit juice), Tobacco (snuff), Camphor, Alcohol (Handrub), Arsenic/ Phosphorus (actual Garlic bulb from kitchen garden). Last year, we have conducted ISTOLS course on 24th-25th June 2018 in Medanta-the Medicity successfully by training 21 resident doctors, NRHM Rural Medical Officers (RMO) of Haryana, Rajasthan and Delhi NCR consultants in critical care, emergency, forensic medicine and toxicology.
On 13th January 2019, in Victoria Hospital, Bengaluru, we have conducted ISTOLS workshop successfully by training 55 resident doctors, NRHM Rural Medical Officers of Karnataka and consultants in critical care, emergency, forensic medicine and toxicology.

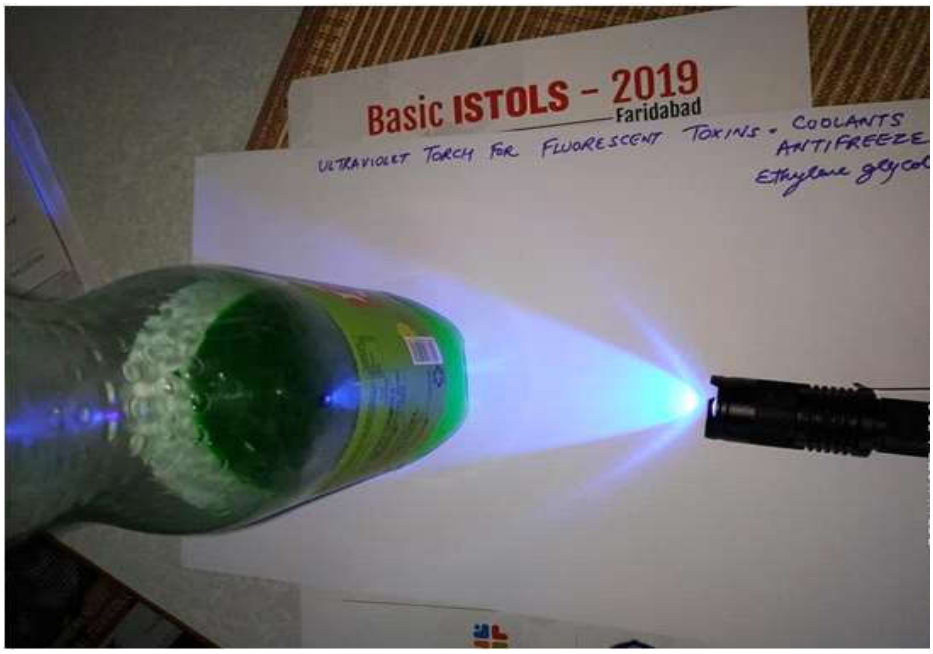

Fig. 9: Ultraviolet fluorescence of Car AC coolant- ethylene glycol- toxic alcohol (glows in UV torch) for on-spot diagnosis Last year, we have conducted ISTOLS on 24th-25th June 2018 in Medanta-the Medicity successfully by training 21 resident doctors, NRHM Rural Medical Officers of Haryana and consultants in critical care, emergency, forensic medicine and toxicology.
Last year, we have conducted ISTOLS course on 24th-25th June 2018 in Medanta-the Medicity successfully by training 21 resident doctors, NRHM Rural Medical Officers (RMO) of Haryana, Rajasthan and Delhi NCR consultants in critical care, emergency, forensic medicine and toxicology.

Fig. 10: Grey coloured cement powder simulating celphos powder of Aluminium phosphide

We have similarly conducted another ISTOLS on 7th April 2018 in SMIMSSikkim Manipal Institute of Medical sciences, Gangtok, Sikkim successfully by training 37 resident doctors in critical care, emergency, forensic medicine and toxicology, pharmacology, internal medicine and NRHM Rural Medical Officers posted in peripheries of Sikkim State.

Fig. 11: Raw mango (from Garden) simulating look alike, Cerbera odollam suicide tree fruit.

We took pre-test and Post-test for all the RMOs and observed during above mentioned ISTOLS trainings in States of Sikkim, Karnataka, Kerala, Haryana, Rajasthan, Uttar Pradesh and RMOs internationally, posted in our neighbour country Nepal that, Rural Medical Officers who received high fidelity training on a human patient simulator performed significantly better on the advanced life support, in written examination, in medicolegal documentation of right antidotes indicated to right patient, in right dose, frequency and by right route in right manner; as well as improved selfconfidence of RMOs in handling mass casualties by toxic disasters during a mock resuscitation. Pre-test and posttest analysis reported improvement in overall performance by doctors after implementation of simulator training sessions. Figure No. 12. **Bar Diagram** showing impact of simulation teaching on participant's scores of Pre-test and Post-test by simulation training of RMOs

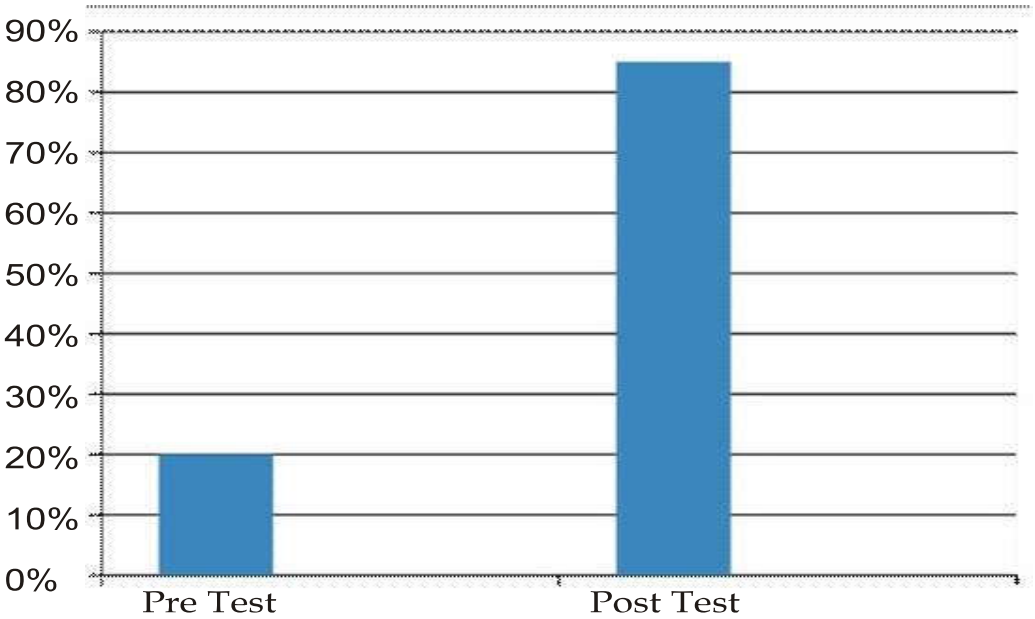

Fig. 12: Bar Diagram showing impact of Toxicology simulation teaching on overall scores of Pre-test and Post-test of Rural Medical Officers posted in Kerala, Karnataka, Haryana, Rajasthan, DelhiNCR, Uttar Pradesh, Sikkim and Nepal.

We observed that 94% of RMOs benefitted from increased confidence and perceived technical and non-technical skills during toxicological emergencies following simulation based learning. These novice learners in clinical toxicology demonstrated improved triage and intervention scores after each virtual reality toxidrome drill. RMOs who received human patient simulator training in addition to advanced life support showed significantly higher adherence to international standards as compared with those who received basic life support alone. It was observed that the prior simulation training positively impacted their clinical skills during the resuscitation, including rapid problem recognition, correct choice and dosage of specific therapy, and coordination of team efforts. The differences of percentage in RMO's responses towards life support skills with and without the implementation of simulation practice were calculated and recorded. After the implementation of simulation training, RMOs showed more anticipation in the implementation of simulation training by hands-on practice on manikins and there was an increase from 63.89% to 89.44%. Among RMOs, 65.35% of them liked life support skills as a subject even before the simulation training were implemented. After the application of the simulation in training, 95.49% of RMOs were interested to learn life support skills in managing poisoning patients. There was an increase of 30.14% of RMOs, who had developed their liking towards life support skills in management of toxicological emergencies.

We compared 'low-fidelity' versus 'high-fidelity' simulation on RMO's ability to successfully perform nasogastric lavage and endotracheal tube placement. The low-fidelity mannequin consisted of a relevant body part model that allowed for tube insertion, in contrast to the high-fidelity simulator (anatomically correct mannequin that reacts to tube insertion with physical responses such as change in vital signs, gagging/coughing sounds, etc). RMOs who received high fidelity training scored significantly higher than residents trained by the low-fidelity simulator.

RMOs were subsequently evaluated on their peripheral line placement technique on manikins. The 'trained' RMO group outperformed the 'untrained' RMO group on the majority of clinical aspects of venous catheterization, including fewer attempts to find the vein, identification of anatomical landmarks, and total overall performance score. The 'trained' RMO group also scored higher on a post-test, supporting a correlation between knowledge gain and improved clinical performance. Before the training, the RMOs used to undermine themselves: 'we know nothing about clinical toxicology.' Moreover, the RMOs felt that they were not capable of managing without a critical care expert. After the training, it was quite evident that RMOs have a very clear role to perform, while managing poisoning cases in emergency. Every RMO learned to contribute their important role to the team work in resuscitation of a dying patient due to fatal poisoning.

The participating RMOs' positive feedback for the overall training program indicated that 95% of RMOs were satisfied with the training program and believed that skills learned could be applied well in their field of work. The RMOs' positive response directly correlated to their post-training evaluation undertaken by trainers, which positively signified effective learning of skills during the training intervention. Learning features, such as training in teams, skills training, and realistic repeated scenarios with consecutive debriefing for reflective learning, including a systems approach to human error, were crucial for enhanced teamwork during bedside toxidrome drills on high fidelity manikins. Developing clear communication and teamwork were found to be the key learning principles guiding their practice. The most important findings from the RMOs' group discussions were the importance of team training as learning feature, and the perception of improved ability to use a teamwork approach to toxidrome diagnosis and management.

Conclusion

There is ample evidence that simulationbased educational interventions in training in Toxicology to Doctors working in Emergency and Intensive Care Units, increases their retention of knowledge for cardiopulmonary resuscitation, Antidote management, trauma and toxicology care, airway management, procedural skills, team-training, and toxic disaster management.

Conflict of interest: Nil

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