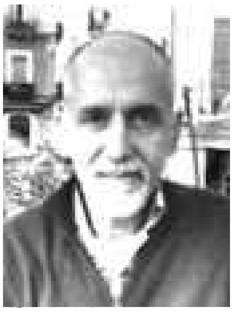
MOVING FROM "LEARNING BY DOING" TO SIMULATION

THE EDUCATIONAL CHALLENGE IN ANAESTHESIA AND INTENSIVE CARE



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Historically, medical education has focused on the autonomy of healthcare providers, who are expected to take care for a patient on their own. Consequently, issues related to teamwork, multidisciplinary and multi-professional interactions have not been explicitly and formally included in medical curricula. In addition, the hierarchical organisation of medicine, mainly expressed by a communication philosophy following a chain of command, has strongly contributed to discouraging teamwork-based patient care.

Healthcare providers are mainly trained as individuals, yet work almost exclusively as teams, showing a big difference between education and reality. Poor communication has been identified as the primary root cause in more than 70% of perinatal sentinel events recorded by the Joint Commission on Accreditation of Health Care Organizations (2004) that suggested simulation training as an effective way to improve teamwork as one of the means to improve patient safety (Kohn et al. 2000). Stress, poor communication, failure to identify and correct errors, and the culture of blame, often lead to undesired outcomes in patients' care.

Evidence is increasing that traditional approaches to anaesthesia and intensive care training are no longer acceptable in the current ethical and professional context.

Alternatives to "learning by doing" in a clinical context are currently available from recent developments in simulation and virtual reality.

Simulation, which includes scenarios or environments designed to closely resemble real-world situations, offers a safe environment within which learners can repeatedly practise a range of clinical skills without endangering patients. Simulation techniques have been used to teach all aspects of medical care, including knowledge, technical and non-technical skills. In addition, simulation teaching has been identified as the optimal instrument to control human factors and prevent medical errors.

Simulation is now widespread in many fields of human endeavour and its history stretches back over centuries. The modern aviation industry has developed high-fidelity flight simulation and has led on improving the non-technical skills of teams through crew resource management programmes. Crew Resource Management (CRM) and Human Factors (HF) are acronyms used by airlines designed for safety training and educational systems for high-risk industries. The basic concept and mission of these training programmes are to reduce mistakes or errors, resulting in safer and more efficient workplaces from fewer incidents and accidents.

Anaesthesiology was one of the first medical specialties to demonstrate the impact of human factors. Indeed, in the early 1990s, David Gaba and colleagues, at Stanford University, designed a mannequin-based simulator to systematically tackle such challenges during anaesthesia crisis situations (Gaba et al. 2001). This group, led by David Gaba, developed the concept of anaesthesia crisis resource management (ACRM), which addressed human factors in the operating room setting (Gaba et al. 2001). Since then, several centres around the world have implemented simulation-based crisis resource management training. As the concept extended into different domains and specialties, it was called crew resource management (CRM) (Reader et al. 2006).

Communication, teamwork, decision making and situation awareness, in addition to medical knowledge and practical skills, have been well defined in medical literature as categories of competencies that are necessary for a team to operate effectively. Medical teachers should be aware of two main types of skills: technical (psychomotor) and non-technical (Reader et al. 2006); the latter includes significant skills that deserve specific mention like decision-making, flexibility, assertiveness, mutual respect, identifying priorities, situational awareness and fixation errors management. All these skills can be effectively thought through and practised by simulation. Overwhelming compelling evidence highlights the importance of simulation-based training as a method to improve teamwork for patients' safety.

Centre for Simulation, Hospital A. Gemelli

The Teaching Hospital "A. Gemelli" is located in Rome, and incorporates several postgraduate schools of medicine, including the School of Anaesthesia, Intensive Care and Pain Management. The training plan is competency-based and subject to satisfactory training progress and assessment over a five-year programme; recently, the Centre for Simulation and continuous medical education has been created and simulation-based training has been added to the students' curriculum. Serving both students and practising healthcare professionals from anaesthesia and intensive care disciplines, the Centre is a central resource

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The use of simulation-based training provides safe and effective procedures for the practice and acquisition of clinical skills needed for patient care. Medical education is required for the learning and training period in order to ensure patient safety especially in ICU. Artificial respiration education and proper setting of mechanical ventilation modes is primordial before application to the patient. The training necessitates the use of realistically simulated patients in order to prepare to a variety of real scenarios. The latter are limited when using mechanically lungs or animal-based training.

TestChest®, the physiologic controlled lung, provides a breakthrough in respiratory training and has the CE marking. It was developed by experts in mechanical ventilation and respiratory physiology and is manufactured by Organis GmbH (Landquart, Switzerland) for worldwide distribution.

The simulation of human cardio-respiratory system is extremely realistic and thus makes animal experiments for teaching purposes unnecessary. It can be used as stand-alone skill training station by easily connecting an intubation head for realistic respiratory simulation (intubation, NIV). It can also be easily connected with a complete human body simulator.

The respiratory flight simulator combines high-end technical design and mathematical modeling to create a complete solution for optimized learning of basic and advanced artificial respiration. It is the ultimate training tool for anesthesiologists, intensive care physicians and nurses. Through a variety of preconfigured scenarios and spontaneous breaths, the simulation of acute and chronic lung diseases is possible and real-time experience is guaranteed. TestChest® realistically replicates pulmonary mechanics (resistance, non-linear compliance), gas exchange and hemodynamic responses. It has a programmable FRC and allows the simulation of different types of spontaneous breathing to severely diseased lungs with operator-adjustable respiratory rate and occlusion pressure (P0.1).

Figure 1.

Figure 2.

Figure 3.

Figure 4.

Figure 1. The simulator consists of two bellows system driven by a linear motor. A large volume ensures the simulation of a real human lung with realistic FRC and vital capacity. A basic control software created by AQAI Simulation Center (Mainz, Germany) allows the control of the motor and the setup of the artificial lung parameters.

Figure 2. The motor realizes nonlinear S-shape of the pressure-volume loop, recruitment and collapse of the lungs.

Figure 3. TestChest® includes sensors for alveolar pressure, airway pressure, and environmental pressure as well as an oxygen and temperature sensors. It is compatible with wet gases and it is equipped with a mass flow controller for CO_2 production, which together with an adjustable dead space permit the generation of realistic capnograms.

Figure 4. An artificial finger allows the simulation of oxygen saturation curves. The variation of pulse amplitude according to different intravascular fillings model heart-lung interactions supporting the testing of most advanced closed-loop ventilation modes. The flight simulator offers for its pilots (healthcare professionals) a realistic training environment to ensure the safety of patients.

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that provides state-of-the-art facilities and equipment to support a variety of educational resources. ranging from basic psychomotor skills training to advanced, full-scale immersive simulation. The central idea is to integrate simulation immersion into the education of future anaesthesiologists as well as medical students and healthcare professionals in other specialties.

Simulation and CRM-based programmes have been developed in the following areas and disciplines:

- Anaesthesia and Operating rooms scenarios
- Intensive Care Medicine
- Obstetrical Emergencies
- Paediatric and Neonatal Emergencies
- In-Hospital trauma care
- Cardiopulmonary resuscitation and acute cardiac emergency care
- Rapid response systems
- Transport of critically ill patients
- Organ transplantation
- Clinical toxicology
- Disaster Medicine.

Simulation resources include a full scale simulation centre as well as an in situ Simulation Programme by means of a fully self-sufficient wifi mannequin. Simulations can be performed in any real clinical environment (operating rooms, A&E rooms, post-operative intensive care etc).

Sharing critical points raised during teaching sessions is essential for learning in medical education settings. This is particularly true in simulation-based medical education (SBME), which potentially creates high levels of stress in both instructors and trainees.

Debriefing has been shown to be an essential part of the simulation-based learning process. Savoldelli et al. (2006) demonstrated that simulation without debriefing is ineffective, because errors can be repeated if team members have not been informed that they were making mistakes.

In the last 20 years, the judgmental approach to debriefing, mainly based on the "shame-and-blame" method, has been strongly criticised and discouraged because of its severe costs in terms of humiliation, frustration and depressed motivation (Leape 1994a; 1994b).The non-judgmental model to debriefing has been widely practised using different strategies and approaches, such as the Socratic model (leading questions and "easing in") (Argyris et al. 1985) or the sandwich model (good things followed by points of improvement in a rigid sequence) (Weisinger 1989; Weisinger 2000).

Albeit the non-judgmental approach has the significant advantage of not hurting trainees' feelings, it has some important weaknesses. First of all, it fails to openly disclose major problems felt by both the teacher and the student. In other words, always giving priority to positive aspects is often felt as artificial especially when a critical point engages the trainee's attention. In poor trainee performances, showing a relentless optimism may convey the embedded message that mistakes are not able to be discussed, or possibly shameful.

"Reflective practice" is a term coined by Donald Schön (1983) to describe a method to improve personal and interpersonal effectiveness of professionals by examining the values, assumptions and knowledge base that drives one's own actions. Research in cognitive science (Torbert 1972; Senge 1990) and on reflective practice provides a conceptual model that guides teachers on how to discover the mental models that were used in guiding trainees' actions during the teaching session. Trainees' actions have always a logical sense if framed in the cognitive model used to get a result. According to this, mistakes are always or mainly caused by meaning-making systems of the trainees, such as their frames, assumptions, and knowledge. Using reflective debriefing the focus widens to include not only the trainees' actions, but also their mental models that ultimately determined the final result. Mistakes are not a source of shame and blame any more but a precious learning resource to be openly acknowledged and discussed.

"Optimal to control human factors and prevent medical errors"

Transparent talk about trainees' mistakes can be achieved by a three-step approach:

1. **Observation/description:** the teacher observes and describes the trainee's action;
2. **Comment/opinion:** the teacher offers his/her ideas;
3. **Mental model disclaimer:** the teacher shows his/her interest (curiosity) to discover the mental model that framed the student's action.

Reflective debriefing increases the chances that the student will be able to accept the teacher's feedback without being defensive and feeling psychologically safe. It provides trainees with a clear message about the instructor's point of view while reducing the background noise of misunderstandings and defensiveness that can be associated with judgmental and nonjudgmental approaches. ■

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