ANAESTHESIA, PAIN & INTENSIVE CARE
www.apicareonline.com

EDITORIAL VIEW

Technological advances in medical education in intensive care

Marija V. Sholjakova, MD, BMS, PhD

Specialist of Anesthesiology & Reanimation, University Clinic of Anesthesiology, TOARIL, Skopje, Republic of Nord Macedonia, retired. Currently; Professor of Anesthesiology, Department for Doctoral Studies, Faculty of Medicine, "Ss Cyril and Methodius" University, Skopje, Republic of Nord Macedonia

Correspondence: Prof. Marija Sholjakova, Bul. Marks i Engels 1/5-16, 1000 SKOPJE, Republic of Nord Macedonia. E-mail: marijasoljakova@yahoo.com

ABSTRACT

The rapid development of advances in technology made a deep impact to the medical education causing changes in teaching. Technological advances in medicine, especially in intensive care settings, opened new opportunities and challenges to ensure quality training education of residents.

The laws in most of the countries in the world do not allow practicing new skills on patients, which compel the trainees in use of technical support to enhance medical practical knowledge and skills. With the aim to increase the efficiency and safety, technological tools become integral part of intensive care educative process.

There are numerous technological advances that may be used as educational tools in intensive care, as Computer-aided learning, Virtual Patients Human and Patient Simulation.

As part of a multimodal concept, simulator-based training may facilitate an improvement of quality of care and patient safety.

Key words: Medical education; Educational technology; Patient simulation; Trainee; Patient safety

Citation: Sholjakova MV. Technological advances in medical education in intensive care. Anaesth. pain & intensive care 2019;23(2):119-123

The last millennium is distinguished by a rapid expansion of technical novelties and advances in technology which are widely used in medical education. Educators and trainees in Intensive Care were deeply impacted by the changes in teaching, where the focus was on the use of technological tools, which caught them surprised them and unprepared.

It is obvious that today's generation of trainees have different needs and know-how. They are a "digital" generation, in which computing and similar technological advances are much closer in their everyday life. The fact that traditional medical education couldn't answer to the contemporary challenges, led to radical changes to be able to keep up with the technological advances.[1] Anesthesiology and intensive care is a leader among the medical specialties in the use of technical support to enhance medical practical knowledge and proficiency in technical skills. Technological advances in medicine, especially in intensive care settings, opened new opportunities and challenges to ensure quality training education of residents.[2]

The main dilemmas of educators were how to amalgamate all those technological advances and how to catch up to all novelties. Today's residents are not any more ordinary readers of manuals, books and guidelines. Internet access offered by residents created new type of learners, with a need for new approaches in education. Their expectations are to be educated by easy learning, with the preambles of easy to understand, to be interesting, to be easy to remember and repetitive, to be safe for the patients and be possible for practice.[3]

Over many years the medical authorities concluded that the use of technology in medical education, particularly in skillful specialties, as in Critical care and Emergency medicine, is necessary. The use of

advanced technology in medical education increased, which resulted with the publishing of numerous articles, open debates, symposia and conferences concerning this topic.[4]

Following the concept that "the education must respond to the new medical demands and challenges", in 2007, with the purpose for effective use of educational technology in medical education, the Association of American Medical Colleges edited the Recommendations and Guidelines for Medical Educators. It was the result of a panel of experts whose mission was to provide advice to the educators how to select, develop, and use the most appropriate technologies for current problems.[5]

The laws in most of the countries in the world do not allow practicing new skills on patients, which puts the trainees in a challenging situation. Intensive Care is a clinically demanding field, with many challenges. During the curative period in ICU, patients are more prone to develop complications, even to death. The readiness of the physician's working in the ICU and their abilities for quick diagnoses and reactions are crucial for most of the critical events of the patients in Intensive Care Unit and are responsible for the adverse patient outcomes.[6] For this reason, the residents in ICU must be very well trained and skilled, to be able to overcome with success life-threatening events.

In most of the medical schools in the world, parallel with the curricula, "Educational centers" are being developed which are units designed as real hospitals.

This approach produced changes of the educative environment, the trainees moved from the traditional hospital setting to Educative Lab's equipped with educative tools needed to provide care to all critically ill and injured patients. This educative process took place in a safe, controlled environment, which eliminated all risks to patients. The training of the skills necessary for care of critical patients such as how to provide a difficult airway (intubation, laryngeal mask, tracheotomy), nasogastric tube insertion, intravenous and intraosseous cannulation, CVK approach, thoracocentesis, bronchoscopy and others, became more accessible and in a shorter period. However, these new approaches in education led to several changes. The documentation of the progress of the trainees and the records of the level of skillfulness became digital. The personalities of the trainees were changed, they became more self-confident and prepared to respond to the expectation of the society for "better education and more safety for patients".[7]

There are numerous technological advances that may be used as educational tools in intensive care. It is considered that the most appropriate and predominant in education in ICU are: Computer-aided learning, Virtual Patients Human and Patient Simulation.[5]

Computer-aided learning is applicable in the form of Web-based learning, online materials, E-Learning, multimedia or as the technology in audience participation.

This way of education permits the use of valuable different on-line manuals for resident trainees. For example, Boston Medical Center offers "Residents Critical care hand book" whose goal is to facilitate learning of critical care medicine. Similar to this the Society of Critical Care Anesthesiologist – SOCCA for ICU residents offers Guide, 2014 edition, "Introduction to learning in the ICU" or the College of Medicine Chicago presents in electronic form its "ICU Guidebook". These types of manuals are very practical and can be used in an easy and simple way, they are always available - in the pocket, mobile or Pad - to help the residents in quick decision making.

E-Learning is a flexible method of learning with an interactive participation of the computer and the trainees. Several applications exist, where the trainee could enhance the knowledge, use it for self-assessments or simple interface. It is very popular and practical for continuing education. It allows the trainees to participate in rare and complex medical scenarios and learn skills but also offers superiority in cost-effectiveness, learner satisfaction, and self-directed pace and focus.[8] Procedures are an integral part of rotation of residents in Intensive Care. The trainees, by using multimedia, on-line procedure videos and images from the resources for each topic can accelerate their learning.

In the "Learning Lab" the medical education is further enhanced with interactive teaching and learning tools. For improvement of the instructions and skills Virtual Reality and Simulations are used.

Virtual Reality: Virtual Patients Human Virtual Patients (VP).

This is a specific type of computer-based program that simulates real-life clinical scenarios. The trainee and the learners have the roles of patient or health care providers. Through real scenarios the resident is taught to obtain history, conduct a physical exam, and make diagnostic and therapeutic decisions. It is very practical for decision making.

Simulations: Human Patient Simulation (HPS)

The term "Simulation" is complex. It indicates that, for educative and training purposes, simulators could be used but in different modalities, settings, target groups and many other aspects. Simulation includes, during the teaching of the trainees, the use of manikins, human cadavers, animals, virtual reality, and standardized patients, where the risks of performing an error is minimal. The use of

mannequins or models serves to teach trainees about assessment, instructions and specific procedures.

In early 1975, as precursors to nowadays computer-based simulators, Resusci-Anne (Leardal) was developed, which was specifically designed for practice skills in CPR. From those days until now, several types of simulators were constructed: Harvey, for skills in cardiac diagnosis and later CASE, CRM and ACCESS (Anesthesia Computer Controlled Emergency Situation Simulator) for basic clinical skills and diagnosis in anesthesia. In 1990s, in Herlev University Hospital in Copenhagen, Denmark a Danish simulator for anesthesia was developed. Since they it plays a central role in simulation training and funding of the first Institute for simulation training. Medical Education Technologies Inc. (METI) – developed highly sophisticated simulators which are used to train doctors and emergency workers.[9]

Since 1990, the use of simulators has become an integral part of the educative process in anesthesiology and intensive care. The main concepts are currently enabling changes in medical education with the aim to increase the efficiency and patient safety.

The simulator-aided training is a complex performance that enables a highly realistic clinical surrounding and the simulator, with vital signs monitors, creates a high authenticity of training. The introduction of practical education on different types of mannequins provides an educational setting where residents and specialists can acquire skills and develop expertise necessary to recognize and manage many of these high-risk conditions.[10]

Several researches have shown that simulator-based training can enhance the transfer of technical and non-technical skills into clinical practice, and effectively supports the changes of attitude and behavior of the trainees, what is very necessary for ICU staffs.[11] As part of a multi-modular concept, simulator-based training may facilitate an improvement of quality of care and patient safety.[12]

The main benefit of the use of simulation in medical education of Intensive Care is that it allows a risk-free repetitive training of technical skills, its validation and dissemination.

Simulators for airway management are particularly used in education of trainees in anesthesia, intensive care and emergency. The training on simulators in airway management enables further education of difficult, rare and life-threatening scenarios without endangering patients and improves trainee perceived procedural confidence and ability. Some simulators are capable of simulating normal airways with breath sounds and chest wall excursions as well as a range of difficult airways.[13]

In one prospective study, the experiences of the residents who could practice, with instructor guidance, the invasive airway procedures on embalmed cadavers (percutaneous cricothyrotomy, retrograde intubation, and fiberoptic intubation) was presented. The results of the study showed improvement in the confidence of residents in performing percutaneous cricothyrotomy and retrograde intubation.[14]

To insure the confidence in use of fiberoptic bronchoscope of the trainees, different models are being developed. It was shown that practicing manipulating the fiberoptic bronchoscope through a specified syringe barrel in combination with the covered wooden model under fiberoptic vision was successful to complete the task.[15]

With the aim of enhancing safety in medicine utilizing advanced simulation technologies and to improve the outcomes Society for Academic Emergency Medicine published the document "Act of 2007. HR#4321, December 6, 2007". In the study maintained by McLaughlin et al. it was found that simulator training increased the knowledge and self-confidence of trainees and it concluded that simulation-based training was useful.[16]

Guze PA in 2015 in his publication defined the challenges of medical education. He stressed that, in focus first, is the changing of the healthcare environment and changing of the curricula. The societal expectations for patient safety, ethics and high competencies of doctors, emphasize the need for life-long learning.[7]

The AAMC Institute for improving medical education in 2006 organized a one-day colloquium of experts in educational technology to identify the advantages and disadvantages of these educational approaches. They concluded that educational technologies are advantageous in providing: a safe, controlled environments that eliminates risk to patients; enhanced, realistic visualization; authentic contexts for learning and assessment; documentation of learner behavior and outcomes; instruction tailored to individual or group needs; learner control of the educational experience; repetition and deliberate practice; uncoupling of instruction from place and time; standardization of instruction and assessment; perpetual resources and new economies of scale.

Among the disadvantages there were: limitation of interactivity, limited fidelity, high cost of simulators and space requirement and the difficulties in maintenance and engineering of the simulators.[5]

In 2006 Aggarwal R. and Darzi A. published an article in which they elaborate about the Technical-Skills training in the 21st Century. They emphasized that the skills with perception and hand–eye coordination can produce changes in the brain in completing a technically demanding procedure. This can be used

as a method for choosing future residents to enter technically demanding specialties.[17]

The ICU specialty is one of these with many responsibilities where humanity, knowledge and skillfulness are of great importance. The educators teach the trainees how to deliver a high-quality patient care to critically ill patients, to be prepared for very skillful procedures, how to apply them, for clinical decision-making and difficult situations. Some of these situations, like touching the patient to give compassion, the communication with the families and announcement of bad news, couldn't be educated in the Lab. However, besides all the technological advances in medical education, the ICU learning environment will stay as a most challenging for trainees.[3]

It is a fact, that all educators are not equally adept and comfortable with technology. For an efficient advancement in education in ICU, the learning-assisting technologies are necessary to be enriched with specific scenarios. To better improve patient care in contemporary times, continual innovative efforts between educators and trainees remain essential for fully exploiting the technology's potential.[8]

The future prospects will show how education-based technologies could improve or hinder the learning experience of medical trainees in ICU. Undoubtedly, technical advances have a strong, positive impact on healthcare. Education on simulation and simulators lower the risk to patients during training. It provides learning of critical care processes, skills, rapid reaction, team work and collaboration within the clinical workforce.[18]

In conclusion, the technological advances in medical education allow for realistic training and exposure to a large spectrum of authentic scenarios in intensive care and emergency medicine.

In the future, Critical care simulator courses will have to be tailored to specific target groups to meet their educational demands and optimally support integrated training of technical and non-technical skills.

Conflicts of Interest: None to declare

REFERENCES

1. Jaques H. Meeting the biggest challenges in medical education. BMJ 2013; 346:f1721 doi: https://doi.org/10.1136/bmj.f1721
2. Carayon P, Weinger MB, Brown R, Cartmill R, Slagle J, Van Roy KS, at al. How do residents spend their time in the Intensive care unit? Am J Med Sci 2015; 350(5): 403-8 [PubMed] [Free full text]
3. Santosh L, Jain S, Brady A, Sharp M, Carlos WG. Intensive care unit educators: a multicenter evaluation of behaviors residents value in attending physicians. Ann Am Thorac Soc. 2017 Apr;14(4):513-516. doi: 10.1513/AnnalsATS.201612-996BC. [PubMed]
4. Wah RM. 3 ways technology is changing medical education. AMA 2015 October 6. Available at: https://www.ama-assn.org/advocacy/leadership-viewpoints/3-ways-technology-changing-medical-education
5. AAMC Institute for improving medical education. Colloquium on educational technology: Recommendations and Guidelines for Medical Educators (Association of American Medical Colleges.). [Free full text]
6. Wilson ME, Beesley S, Grow A, Rubin E, Hopkins RO, Hajizadeh N, et al. Humanizing the ICU. Crit Care 2019;23(1):32. DOI: 10.1186/s13054-019-2327-7 [PubMed] [Free full text]
7. Guze PA. Using technology to meet the challenges of medical education. Trans Am Clin Climatol Assoc 2015; 126:260–70 [PubMed] [Free full text]
8. Moran J, Briscoe G, Peglow S. Current technology in advancing medical education: perspectives for learning and providing care. Acad Psychiatry. 2018 Dec;42(6):796-799. doi: 10.1007/s40596-018-0946-y [PubMed]
9. Cooper JB, Taquet VR. A brief history of the development of mannequin simulators for clinical education and training. Qual Saf Health Care 2004;13(Suppl 1):i11–i18. doi: 10.1136/qshc.2004.009886 [PubMed] [Free full text]
10. Murray DJ, Boulet JR, Avidan M, Kras JF, Henrichs CB, Woodhouse J, at al. Performance of residents and anesthesiologists in a Simulation-based skill assessment. Anesthesiology 2007; 107:705–13 [PubMed]
11. Dieckmann, P, Krage R. Simulation and psychology: creating, recognizing and using learning opportunities. Curr Opin Anaesthesiol. 2013;26(6): 714-20 doi: 10.1097/ACO.0000000000000018 [PubMed]
12. Sholjakova M. Simulation in pediatric anesthesia. Book of proceedings I-st Balkan States days of anesthesiology.
13. Hesselfeldt R, Kristensen MS, Rasmussen LS. Evaluation of the airway of the SimMan™ full-scale patient simulator. Acta Anaesthesiol Scand 2005; 49:1339—45 [PubMed]
14. Hatton KW, Price S, Craig, Grider JS. Educating anesthesiology residents to perform percutaneous cricothyrotomy, retrograde intubation, and fiberoptic bronchoscopy using preserved cadavers. Anesth Analg 2006;103(5):1205-08 doi: 10.1213/01.ane.0000237328.94837.62 [PubMed]
15. Graeser K, Konge L, Kristensen M S, Ulrich AG, Hornbech K, Ringsted C. Airway management in a bronchoscopic simulator based setting: an observational study. Eur J Anaesthesiol 2014; 31 (3):125-30 doi: 10.1097/EJA.0b013e328364395a [PubMed]
16. McLaughlin S, Fitch MT, Goyal DG, Hayden E, Kauh CY, Laack TA, et al. Simulation in graduate medical education. 2008: a review for emergency medicine. Acad Emerg Med. 2008 Nov;15(11):1117-29. doi: 10.1111/j.1553-2712.2008.00188.x. [PubMed]
17. Aggarwal R, Darzi A. Technical-skills training in the 21st century. N Engl J Med 2006; 355:2695-6 DOI: 10.1056/NEJMe068179 [PubMed]
18. Gaba DM. The future vision of simulation in health care. Qual Saf Health Care 2004;13:i2–i10. doi: 10.1136/qshc.2004.00987 [PubMed] [Free full text]

★★★★★