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Realistic Simulation Methodology in Brazil's New Medical Education Curriculum: Potentialities

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***Abstract*—**Introduction: Brazil's new national curriculum guidelines (NCG) for medical education were published in 2014, presenting active learning methodologies as a cornerstone. Simulation was initially applied for aviation pilots' training and is currently applied in health sciences. The high-fidelity simulator replicates human body anatomy in detail, also reproducing physiological functions and its use is increasing in medical schools. Realistic Simulation (RS) has pedagogical aspects that are aligned with Brazil's NCG teaching concepts. The main objective of this study is to carry on a narrative review on RS's aspects that are aligned with Brazil's new NCG teaching concepts. Methodology: A narrative review was conducted, with search in three databases (PubMed, Embase and BVS) of studies published between 2010 and 2020. Results: After systematized search, 49 studies were selected and divided into four thematic groups. RS is aligned with new Brazilian medical curriculum as it is an active learning methodology, providing greater patient safety, uniform teaching, and student's emotional skills enhancement. RS is based on reflective learning, a teaching concept developed for adult's education. Conclusion: RS is a methodology aligned with NCG teaching concepts and has potential to assist in the implementation of new Brazilian medical school's curriculum. It is an immersive and interactive methodology, which provides reflective learning in a safe environment for students and patients.

***Keywords*—**Curriculum, high-fidelity simulator, medical education, realistic simulation.

I. Introduction

MEDICAL school has undergone major changes in recent years. The new NCG were published in 2014, establishing principles and medical education's purposes in Brazil. The traditional Flexner educational model is essentially hospital-centered and promotes early academic specialization [1]. The new NCG guides to a generalist, humanistic and critical profile, based on skills development. NCG describes in detail priority training environments and desired technical skills. Such changes in medical school's curriculum require incorporation of new learning methodologies with potential to collaborate with NCG purposes.

Active learning methodologies application raised in recent years. One of these methodologies, RS inserts student in a controlled environment, where situations related to future professional life are simulated. Simulators' use provides greater fidelity to simulated scenarios, allowing participant's emotional involvement and make the experience as accurate as real life [2]. High-fidelity simulators reproduce human body anatomy and physiological functions in details [3]. Modern educational concepts support RS as a methodology with potential in assisting to change the traditional medical education paradigm [1].

Simulation methodology was initially introduced for civil aviation pilots' training in 1929. In the United Kingdom, in the 1950s, simulation started to be used for health professionals' training [4]. The first medical high-fidelity simulator was developed in the 1960s, reproducing heart and lung sounds. Currently, simulators are used in different scenarios, with emphasis on models applied in urgency and emergency scenarios.

RS is associated with cognitive, technical, and emotional skills development [5]. Training with simulators does not restrict to the exercise of imitating manual procedures, it must be planned to generate action and reflection within performance's context. It is essential that instructors understand simulator's technology and mechanics, and also comprehend learning methodology's concepts applied [6]. Previous studies identified four RS's pedagogical aspects that are aligned with Brail's new NCG teaching concepts, namely: active learning methodology, patient safety, uniform teaching, and emotional competence [7]-[10]. To make a narrative review on RS's pedagogical aspects that dialogue directly with NCG teaching concepts is the main objective of this study.

II. Methodology

A qualitative research was carried out based on narrative review of scientific literature [11]. Search was conducted in three databases (PubMed, Embase and BVS), with the following medical subjects heading (MeSH): "High fidelity simulation training" and "medical education", associated with the Boolean logical operator "AND", among years 2010 and 2020. Studies published in English, Spanish and Portuguese were considered.

Four thematic groups were pre-stablished, regarding to RS's teaching characteristic (active learning methodology, patient safety, uniform teaching, and emotional competence). After abstracts' reading, if an approach was identified with any of the thematic group, study was selected to full text reading.

III. Results and Discussion

Database research returned a total of 709 studies. None of them cited the NCG in title or abstract. Of 709 initial studies, after excluding duplicates, and abstracts reading, 78 were selected for full text reading. At the end of the reading, 49 studies were selected, 46 in English, 1 in Spanish and 2 in Portuguese. The list of selected studies divided by thematic

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group is shown in Table I.

TABLE I
SELECTED STUDIES BY THEMATIC GROUP

Thematic group	Total studies	Study ID
Active learning methodology	20	[13] – [32]
Patient Safety	12	[35] – [46]
Emotional competence	12	[47] – [58]
Uniform teaching	5	[59] – [63]

Qualitative analysis was carried out, being presented according to thematic group. A description of the RS's teaching concepts aligned with NCG, and its potentialities in being applied in the context of the Brazilian new medical schools' curriculum guidelines were also carried out.

A. Active Learning Methodology

Change in medical education paradigm is a main purpose in NCG. Medical graduation lasts for a few years, while professional activity lasts for decades. This way it is essential to adopt methodologies for a liberating educational practice, geared towards the formation of a professional capable of self-managing his continuous educational process. NCG presents active learning methodologies as priority in Brazilian medical schools' curriculum. Medical education dialogues directly with andragogy, a science related to adult education [12]. RS is recognized as an active learning methodology, and in addition to andragogy, it encompasses reflective learning concepts [13], [14]. Regardless concepts considered, RS's central role is subject's learning process centrality [15], [16].

Active methodologies are based on autonomy's principle and allow different relationships establishment between facts and objects, triggering resignifications and individual's ability in using contents in real situations [17], [18]. RS's triggering elements are simulated health problems that must be faced in professional practice [19]. Frequently cited aspect is that high-fidelity simulator does not occupy process's centrality, but serves to assist in the recreation of real environment [20]-[22].

RS promotes improvement of technical and cognitive skills, crisis management, leadership, teamwork and clinical reasoning [23], [24]. RS allows cognitive and motor skills simultaneous mobilization, while providing a highly stimulating learning scenario [25]-[27]. RS promotes integration of theoretical contents, technical skills, and attitudes, encouraging student to coordinate simultaneously all competencies involved in the simulated situation [28]-[30]. RS is associated with greater theorical content retention [31], [32]. Previous study showed that reading provides learning retention of 5%, oratory 10%, audio visual 20%, group discussion 50%, and practical performance led to content retention close to 90% [33].

B. Patient Safety

Studies indicate that up to 50% of recently graduated health professionals are involved in patient safety adverse events [34]. Patient safety, as well as student's ethic performance, are NCG's purposes. In this review, studies are consistent that RS training increases real patient's safety [35], [36].

In traditional medical school, academic performs certain procedures on volunteers or cadavers [37]. Procedures training can put patient's safety at risk, especially when considering medical student's lesser experience [38], [39]. New strategies for such training procedures are imperative in the new model proposed by NCG.

Simulated scenario offers a controlled environment for student's skill improvement before contact with real patient. It is described that RS is related to a self-perception of greater patient's safety [40]. When performing a real procedure, academic had simulated it beforehand, so now he can perform it more accurately, and with greater compliance to safety parameters. Any technical unconformity identified during simulation can be corrected before student contact with patient, providing the latter safety [41].

RS training contributes positively to patient's safety, and also to health team itself, since it allows better working process understanding, especially in emergency scenarios [42]. Emergency demands quick professional's decision-making and according to [43], RS allows professional to adopt greater compliance with safety parameters during events such as cardiorespiratory arrest [43]. Training with simulators improves fast decision-making, ensuring greater compliance with safety protocols, particularly during unplanned situations [44].

Training on simulators allows patient's individuality and privacy preservation. According to [45], RS offers an appropriate scenario for discussing ethical dilemmas. Debriefing carried out during simulated scenarios represents a unique moment for dialogic debate of topics related to patient safety and bioethics [46].

C. Emotional Competence

NCG advocates medical graduation on a competency-based model. Competency is understood as the ability to mobilize knowledge, skills, and attitudes, generating actions capable of solving challenges that arise in professional practice. Ability to manage emotions and simultaneously remain motivated is an essential issue recognized by the NCG.

When introduced to RS methodology some academics experience fear and insecurity, especially when they realize that they may have their technical non-conformities identified during training [47]. However, especially after debriefing, these feelings tend to decrease [48]-[50]. Simulation allows the error to be a unique opportunity for academic's learning and improvement.

Undergraduate teaching currently fails to prepare academics to deliver end-of-life communication [51]. Study carried out by Goldberg [52] reports that simulation with permissive failure, leading to simulated death, improves student's emotional performance. Simulation failure allows recognition of self-performance limits, leading to less stress during professional practice [53].

Emotional stability acquired after RS training is pointed out as a fundamental competence in professional practice [54], [55]. Reflections on these feelings and attitudes are essential for students skills' improvement, like empathy and solidarity

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[56]. Emotional stability competence, improved after simulation, is a factor associated with greater theorical content retention and safety parameters follow-up throughout professional career [47], [57], [58].

D. Uniform Teaching

NCG presents several scenarios for training practice, in addition to traditional hospital-based setting. In medical graduation other environments are recognized for learning practice, like the RS laboratory [59].

In traditional practice, academic conducts his training in offices and wards, with collaboration of real people. In this model, students do not always have access to uniform educational experiences, experiencing what is possible at that moment and scenario. Authors agree that RS allows access to more uniform practice scenarios, ensuring that essential topics and skills to be worked out uniformly by everyone [60]. Real practice is an essential aspect of medical graduation, and RS does not present as an opposition, but as an auxiliary strategy, providing greater educational experiences uniformity.

NCG describes desirable technical skills in each professional scenario, from office to intensive care unit. Students' contact with all procedures presented in NCG is a major task, considering limited volunteers' availability in real practice and concerns about patient's safety. In RS, laboratory teaching can be planned according to students and teachers' demand, ensuring uniform and safety access to all planned procedures for everyone [59].

According to [61], RS delivers excellent results for orotracheal intubation procedure training. Jenkins [62] mentions difficulty in offering uniform training to anesthesiologists, suggesting RS as a strategy to solve this question. Simulation replicates and amplifies real experiences, in a controlled environment, with well-defined learning objectives and skills, which allows it´s use in Brazilian new NCG context [63].

IV. Conclusion

High-fidelity simulators' use is increasing progressively in medical schools [18]. RS is an active learning methodology, which incorporates educational theories strongly related to adult education, as well as concepts of reflective learning. High-fidelity simulators perform better for teaching when such learning concepts are considered for simulated scenarios elaboration.

NCG outlined a new profile for graduated from Brazilian medical schools, a more reflective professional, committed to bioethics, and capable to self-managing his continuing education. RS has pedagogical characteristics that are strongly aligned with NCG teaching concepts and have great potential to contribute for medical education in Brazil (Fig. 1).

As an active methodology, RS places student at the learning process's centrality, allowing self-reflection, aided by instructor's guidance, contributing to professional skills' improvement. Fears and insecurities are revealed during simulation, allowing academic to recognize and seek necessary emotional balance for good professional practice performance. Any technical nonconformity detected during simulation does not have consequences to real patient. In addition, RS provides uniform training for undergraduate students. These are potentialities presented by RS methodology that are aligned with teaching concepts presented in Brazilian NCG for medical education.

Fig. 1 RS potentialities in Brazil's new NCG

Simulators' acquiring and maintenance high-cost plus the lack of capacitated instructors are cited as barriers in introducing RS methodology. Besides that, some authors cite simulators cost reduction, in case of future spread of the method in medical schools [26], [64]. Additional concern is the "training syndrome". The simulator training environment is lightly different of real world, and sometimes student may not identify the limit between one scenario and the other [65]. This way, student may not respond appropriately in events that are not commonly simulated.

RS is an innovative methodology, which expands relationship between theory and practice, in a safe environment, contributing simultaneously to patient safety, and formation of a medical profile aligned with new NCG. A classic quote attributed to Confucius (551 BC), Chinese thinker and philosopher, does not appear in the systematized search carried out, however, it briefly and elegantly summarizes the potential of using high-fidelity RS in Brazilian medical schools' curriculum: "*What I hear, I forget. What I see, I remember. What I do, I learn*".

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