European Journal of Clinical and Biomedical Sciences
2021; 7(1): 1-5
http://www.sciencepublishinggroup.com/j/ejcbs
doi: 10.11648/j.ejcbs.20210701.11
ISSN: 2575-4998 (Print); ISSN: 2575-5005 (Online)

Review Article

Simulation Based Training in Internal Medicine as an Essential Adjunct to Conventional Medical Education in a Developing World Setting

Christopher Nyirenda[1, *], Kennedy Gondwe[2], Moono Silitongo[3], Samuel Phiri[4]

[1]Department of Internal Medicine, Ndola Teaching Hospital, Copper Belt University, Ndola, Zambia
[2]Department of Internal Medicine, Kitwe Teaching Hospital, Copper Belt University, Kitwe, Zambia
[3]Department of Anatomy, Copper Belt University, Ndola, Zambia
[4]Arthur Davison Children's Teaching Hospital, Copper Belt University, Ndola, Zambia

Email address:
kelvinyirenzm@gmail.com (C. Nyirenda), gondwekennedy@yahoo.com (K. Gondwe), moonosilitongo@gmail.com (M. Silitongo), samuelphiri1943@gmail.com (S. Phiri)
[*]Corresponding author

To cite this article:
Christopher Nyirenda, Kennedy Gondwe, Moono Silitongo, Samuel Phiri. Simulation Based Training in Internal Medicine as an Essential Adjunct to Conventional Medical Education in a Developing World Setting. *European Journal of Clinical and Biomedical Sciences*. Vol. 7, No. 1, 2021, pp. 1-5. doi: 10.11648/j.ejcbs.20210701.11

Received: October 23, 2020; **Accepted**: November 26, 2020; **Published**: January 12, 2021

Abstract: Medical training has over time significantly evolved globally. Plausibly, this may have been motivated by the need to produce qualified human resource in order to match the ever increasing demand on health services in the face of population growth and the associated rise in disease burden. The growing number of medical training institutions coupled with the increasing number of students enrolled in these institutions in the face of limited qualified human resource, infrastructure, equipment and patient subjects may pose a threat to the quality of medical training expected to be delivered and the caliber of graduates to be produced. However, this may also be an opportunity for the affected medical training institutions to come up with ways of supplementing the traditional methods of teaching in order to overcome the challenges met with delivering to huge numbers of students using the traditional approach alone. In this case simulation based training can be considered and applied in medical schools in the hope of enhancing training in clinical skills. The simulation based approach in training has been commonly used in faculties such as nursing, surgery, obstetrics and gynecology but less so, though now increasingly becoming the practice in Internal Medicine and Pediatrics training. Medical simulation can be defined as the use of a device or series of devices to emulate a real patient care situation or environment for the purposes of training, evaluation and/ or research. It is a mode of medical training that can enhance clinical skills in the students while also promoting patient safety. This paper will seek to examine the various simulation based methods and there applicability in medical training. The paper will further seek to analyze the role of simulation based training in the setting of medical education in Internal Medicine.

Keywords: Internal Medicine, Medical Training, Medical Simulation, Simulators

1. Introduction

The increasing demand on health services in the face of population growth and the accompanying rise in disease burden globally, necessitates increasing student enrollments and the number of medical training institutions in order to commensurately produce qualified and competent human resource. This growing number of training sites and student enrollments in the face of limited qualified human resource, infrastructure, equipment and patient subjects may pose a threat to the quality of medical training expected to be delivered and the caliber of graduates to be produced if not well harmonized. In Zambia for instance medical education has significantly evolved over the past decade. For about four decades from inception, the country only had one medical training institution which was founded in 1968 [1]. To date, there are at least nine medical schools of which four are public and five private institutions.

The number of students enrolling under the program in these institutions has also significantly increased. The author's institution of affiliation for example is currently hosting on average about 200 students per clinical year of study in contrast with the about 40 students registered at inception for the first clinical year. Against this status of enrolment is the need for these medical schools to meet the required proportions of staff to effectively teach the students in order to maintain acceptable standards for medical training even as may be stipulated by the regulatory bodies [2]. Where high student enrolments are involved, there may also be a potential to mismatch infrastructural capacity in terms of space for practicals on the wards, clinics, theatre and emergency with the recommended number of students expected to be hosted and to ensure quality training. Patient safety may also be under threat given that students in medical training are expected to conduct physical assessments and procedures most of them repeatedly in order to acquire the necessary clinical skills as an essential learning outcome [3, 4]. It is in this light that some medical schools prescribe the application of a simulation based approach in training to supplement the traditional method.

The traditional approach of medical education is to continually reduce healthcare tasks to simpler or smaller components, such as facts and simple skills, for the purpose of teaching. It is however, suggested that healthcare tasks frequently vary with the need to adapt to particular situations and that learners taught in this manner may not be able to grasp the dynamics of variation and adaptation to integrate or link the various components in a way that is clinically meaningful and relevant [5, 6]. To overcome problems of compartmentalization and fragmentation, modern educators adopt a holistic approach and make use of authentic tasks to promote integrated learning [7]. Authentic tasks are obviously available in the real clinical environment, but simulation is suggested to be a useful adjunct to learning with real patients for a number of reasons to be considered latter in this review.

Simulation can be defined as a situation in which a particular set of conditions is created artificially in order to study or experience something that is possible in real life; or a generic term that refers to the artificial representation of a real world process to achieve educational goals via experimental learning [4, 8]. A simulator is defined as a device that enables the operator to reproduce or represent under test conditions phenomena likely to occur in actual performance. Compared with the simulation based medical training (SBMT), the traditional (didactic) approach has been suggested to be an efficient and well-experienced training method. However, with the advances in technology, the use of simulation-based medical training (SBMT) is increasing since SBMT provides a safe and supportive educational setting, so that students can improve their performance without causing adverse clinical outcomes [9, 10].

In this article, we will review medical training methods and examine the role of medical simulation when applied as a supplement to the conventional methods of medical education in Internal medicine. The relevant literature reviewed was mainly based on sources from a Google scholar and Pub Med database. The key words applied in the search where, Internal Medicine, medical training, medical simulation and simulators.

2. Simulation Based Training in Internal Medicine

The history of simulation based training in medicine dates back to as far as 7 decades ago. Anesthesia was an early adopter of simulation; a first simulator appeared in the 1960s, which could reproduce some physiology, respond to drugs, and teach basic airway management. Since then, medical simulation has expanded across all disciplines of medicine [11, 12]. In particular, internal medicine residencies are increasingly making use of simulation to teach their house-staff, mediate deficiencies, and maintain proficiency in key areas of practice [13].

Educational simulations are analogous to the play of any species. By allowing imitation, the participant can explore, make mistakes, and incorporate corrective feedback as a guide for future action [14, 15]. As may be the case for most developed world educational settings, simulation in our setting has not been completely new either. Simulation based training is commonly administered in nursing schools, surgery, obstetrics & gynecology and anesthesia for example. They seem to be less common in pediatrics and internal medicine perhaps due to the relatively lesser practical component embedded in these curricula. However, with the growing number of student enrolments against limitations for space, instructors and the number of patient subjects the need to use simulators to enhance the student's practical component of their training is becoming inevitable in these departments as well.

Internal medicine programs are incorporating simulation into their curriculum because it serves the dual functions of training and competency assessment. Residents learn with simulation, and it has been demonstrated to improve patient outcomes [11]. It is also suggested that Simulation exercises are most successful when they become part of the standard curriculum and not an extra-ordinary, additional component [16, 17], and that determining which components of a curriculum are enhanced using simulation-based education, and incorporating the exercises into the existing model, result in a more goal directed and sustained use of the tool [18].

The acquisition of appropriate clinical skills is key to health education; however, students sometimes complete their educational programs armed with theoretical knowledge but lack many of the clinical skills vital for their work [4]. Studies have shown that clinical skills competencies including communication skills, history-taking, professional attitudes, awareness of ethical basis of healthcare, physical examination, procedural skills, clinical laboratory skills, diagnostic skills, therapeutic skills, resuscitation skills, critical thinking, clinical reasoning, problem solving, team-work, organization skills, management skills, and information technology skills should be part of the core undergraduate curriculum [4, 19]. The traditional way of training requiring students to spend quality time conducting history taking, physical assessments and procedures as part of their training in clinical skills is becoming increasingly challenging in the face of high student numbers against a fewer number of patients. This situation has the potential to compromise the quality of training in clinical skills for the students and the safety standards for the patient subjects.

In this light some studies have suggested several advantages of medical simulation as a teaching and assessment tool over traditional patient encounters as follows [14]: First, events can be scripted so that specific curricular objectives are experienced at the same time by all of the trainees. This is possible for both common and rare scenarios [20]. Second, events can be observed in real time and allowed to unfold. Mistakes can occur without endangering patient safety [20, 21, 22-25]. Third, trainees can be placed under significant pressure where ethical decision-making, cultural awareness and communication skills must be employed. Finally, clinical simulation allows the opportunity for practice and repetition until a skill is mastered [21, 20, and 25]. It is further suggested in this setting that the competency of the trainee can be observed and documented. Omissions in the curriculum can be identified. Remediation and practice is possible, until the desired outcome for each trainee can be obtained [14].

3. Models for Simulation

The medical simulation utilizes multiple diverse modalities to teach learners in internal medicine [11, 12]. For example, scenarios with standardized patients are often used to assess interpersonal skills and communication; while task trainers, cadavers and animal models are employed to replicate procedures without putting patients at risk; [26] and medical emergencies are simulated with interactive software, virtual reality, and high fidelity mannequins which have led to improved patient survival in some cases [12, 27, 28]. Debriefing, which occurs at the end of the simulation, is a key aspect of learning, soliciting learner self-reflection, and uncovering the ways they think about and approach medical problems [13, 25].

Simulators can be classified according to their resemblance to reality into low-fidelity, medium- fidelity and high-fidelity simulators [4, 30]. Low-fidelity simulators are often static and lack the realism or situational context. They are usually used to teach novices the basics of technical skills. Example of a low-fidelity simulator is the intravenous insertion arm. Moderate fidelity simulators give more resemblance of reality with such features as pulse, heart sounds, and breathing sounds but without the ability to talk and they lack chest or eye movement. They can be used for both the introduction and deeper understanding of specific, increasingly complex competencies. An example of a moderate fidelity simulator is the “Harvey” cardiology simulator.

High fidelity simulators combine part or whole body manikins to carry the intervention with computers that drive the manikins to produce physical signs and feed physiological signs to monitors. They are usually designed to resemble the reality. They can talk, breathe, blink, and respond either automatically or manually to physical and pharmacological interventions. A good example of a high-fidelity simulator is the METI Human Patient Simulator (HPS) which is model driven [4, 30].

In one study conducted by Shanks D, et al that examined the use of simulator-based medical procedural curriculum from the learner’s perspectives, a 26-item survey was constructed to assess the optimal use of simulators for the teaching of medical procedures in an internal medicine residency curriculum. Survey domains were generated independently by two investigators and validated by an expert panel (n = 7). Final survey items were revised based on pilot survey and distributed to 128 internal medicine residents. The outcome revealed that most responders felt that simulators should be used to learn technical skills (94%), refine technical skills (84%), and acquire procedural teaching skills (87%).

Respondents felt that procedures most effectively taught by simulators include: central venous catheterization, thoracentesis, intubation, lumbar puncture, and paracentesis. The majority of learners felt that teaching should be done early in residency (97%). With regards to course format, 62% of respondents felt that no more than 3-4 learners per simulator and an instructor to learner ratio of 1:3-4 would be acceptable. The majority felt that the role of instructors should include demonstration of technique (92%), observe learner techniques (92%), teach evidence behind procedural steps (84%) and provide feedback (89%). Commonly cited barriers to procedural teaching were limitations in time, number of instructors and simulators, and lack of realism of some simulators. The conclusion was that that residents valued simulator-based procedural teaching in the form of small group sessions and that simulators should be an integral part of medical procedural education [31].

In another study conducted by Barsuk JH and others, they assessed internal medicine residents ‘procedural skills before and after simulation-based mastery learning on a paracentesis simulator. In this study a team with expertise in simulation and procedural skills developed and created a high fidelity, ultrasound-compatible paracentesis simulator. Fifty-eight first-year internal medicine residents completed a mastery learning-based intervention using the paracentesis simulator. Residents underwent baseline skill assessment (pretest) using a 25-item checklist. Residents completed a posttest after a 3-hour education session featuring a demonstration of the procedure, deliberate practice, ultrasound training, and feedback. The results showed that Residents’ paracentesis skills improved from an average pretest score of 33.0% (SD 5 15.2%) to 92.7% (SD 5 5.4%) at posttest (P,.001). After the training intervention, all residents met or exceeded the minimum passing score. The training sessions and realism of the simulation were rated highly by learners. The conclusion was that the study demonstrated the ability of a paracentesis simulator to significantly improve procedural competence [32].

In terms of a synergistic role of the traditional and simulation based methods of teaching, a scenario based evaluation study was conducted by Sanri E and others to assess the additional ımpact of simulation based medical training to traditional medical training [TMT] alone in advanced cardiac life support. In this study, they compared the efficacy for the combination of SBMT and TMT, with TMT alone in advanced cardiac life support (ACLS) training in an ACLS scenario. The primary outcomes of the study were successfully completed CPR cycles and scenarios.. In this study, a significant improvement in CPR quality after SBMT was documented.

The results revealed that combining SBMT with TMT improves CPR quality significantly and provides medical students with the fundamental knowledge and required skills that can be used accurately in real life situations. It was further suggested that combining SBMT and TMT appeared to be an effective training method in ACLS courses since SBMT has an additional impact on improving CPR quality [9].

A basic principle in simulation education is that the more the student believes they are in the real situation (suspension of disbelief with associated strong face validity) the better will be the education experience. It is further suggested that the simulation experience by itself is not sufficient. To maximize its impact it must be accompanied by feedback and debriefing.

This may be a face to face encounter with a clinical teacher or it may be a computer generated score and directed tutorial [33]. It is also said that the greatest benefit of simulation-based education is the ability to provide an experience by immersing and engaging learners in an artificial environment that captures their attention and exposes them to important contextual characteristics relevant to their performance [34].

The mastery of simulation is however not without challenges especially for the order scholars who may not be well versed with advances in technology. Further, technological limitations may also make it difficult to produce realistic physical characteristics and clinical signs in the mannequin, such as changes in skin colour and facial expression, as well as an inability to respond accurately after clinical interventions [5]. For example, advanced as the METI HPS and other high fidelity simulators may be, they may still be limited in their capacity to fully mimic the pathophysiologic mechanisms and clinical signs that may be exhibited for several conditions in real patient subjects. They are also not likely to engage in any constructive typical doctor to patient conversation seeking to address an ailment except where they may already be programmed to do so. They may be unlikely to take up instruction to enable the examiner elicit certain signs requiring specified maneuvers. These may include techniques for demonstrating conjunctiva pallor, jaundice, oropharyngeal examination (adequately open mouth), tongue lifting or protrusion, eye movements in various specified directions, coordination of limb movements and other like physical assessments. Current practices, however, indicate that fidelity may not be a major obstacle in simulation of common clinical events. Progressive advances in technology allow greater diversity and choices of realistic simulation modalities, and improvements in innovative instructional designs will further facilitate complex training scenarios, as witnessed in the gaming industry [5].

4. Conclusions

Simulation techniques in medical training can be beneficial in supplementing the conventional methods of medical education in the face of relatively high student enrolments against the limited patient subjects, human and infrastructural training resource. Medical simulation can be a cost-effective way of training to enhance clinical skills in the medical students and to improve patient safety especially where the risk of deteriorating patient's condition may be high in the presence of high student numbers assigned to conduct patient oriented procedures.

Medical simulation is a relatively efficient way of training students on rare clinical conditions and as such can enable the instructors to plan clinical cases based on students' need rather than the availability of the patient subject.

Although simulation has the potential to enhance knowledge and skill in the trainees and qualified medical personnel, it has limitations in mimicking the natural patient processes fully and as such should not be taken as a complete substitute to traditional approaches and for real medical practice. This review therefore highlights evidence of the applicability and beneficial role of simulation based training as an adjunct to the traditional training methods and should be considered in current medical education curricula.

Conflict of Interest

The authors declare that they have no competing interests.

Author Contributions

Nyirenda devised the theme and content of the manuscript. Nyirenda, Moono, Gondwe and Phiri all contributed to the writing of the manuscript.

Acknowledgements

We would like to acknowledge the following for their support towards the undertaking of a training in medical simulation: The Vice Chancellor Prof. Ngoma, the Dean of the School of Medicine Prof. Siziya, the Head of Clinical Sciences Dr Kawimbe and the Head of Basic Sciences Dr. Chisompola all of the Copper belt University in Zambia. Special thanks also to Dr. Zalim Balkizov-Director Simulation Center, the facilitators and demonstrators at RUDN University Russia.

References

[1] Sims P. A medical school in Zambia. Journal of Public Health Medicine. 1997 Vol. 19, No 2, pp 137-138.

[2] HPCZ orders CBU to stop offering medical courses. Lusaka times.com. November 9, 2018.

[3] Smith SR, Dollas R. AMEE Guide No 14: Outcome-based education: Part 2- Planning, implementing, and evaluation of competency-based curriculum. Med Teach. 1999; 21: 15–22.

[4] Al-Elq A H. Simulation-based medical teaching and learning. J Family Community Med. 2010 Jan-Apr; 17 (1): 35–40.

[5] So HY, Chen PP, Wong GKC, Chan TTN. Simulation in medical education. J R Coll Physicians Edinb 2019; 49: 52–7.

[6] Bandaranayake RC. *The Integrated Medical Curriculum.* London: Radcliffe; 2011.

[7] van Merriënboer JJG, Kirschner PA. *Ten Steps to Complex. Learning.* 3rd Ed. New York: Routledge; 2018.

[8] Flangan B, Nestel D, Joseph M. Making patient safety the focus: Crisis resource management in the undergraduate curriculum. Med Edu. 2004; 38: 56–66 [PubMed: 14962027].

[9] Sanri E, Karacabey S, Eroglu SE, Akoglu H, Denizbasi A. The additional ımpact of simulation based medical training to traditional medical training alone in advanced cardiac life support: a scenario based evaluation. SIGNA VITAE 2018; 14 (2): 68-72S.

[10] Eng. AJ, Namba JM, Box KW, Lane JR, Kim DY, Davis DP, et al. High-fidelity simulation training in advanced resuscitation for pharmacy residents. Am J PharmEduc 2014; 78 (3): 59.

[11] Oman SP, Simon LV. Past Present and Future of Simulation in Internal Medicine. StatPearls Publishing; 2020 Jan.

[12] Rosen KR. The history of medical simulation. J Crit Care. 2008 Jun; 23 (2): 157-66 [PubMed: 18538206].

[13] Mathai SK, Miloslavsky EM, Contreras-Valdes FM, Milosh-Zinkus T, Hayden EM, Gordon JA, Currier PF. How we implemented a resident-led medical simulation curriculum in a large internal medicine residency program. Med Teach. 2014 Apr; 36 (4): 279-83 [PubMed: 24495251].

[14] Paul E. Ogden, MD, Lauren S. Cobbs, MD, Martha R. Howell, MEd, Stephen J. B. Sibbitt, MD, Donald J. DiPette, MD. Clinical Simulation: Importance to the Internal Medicine Educational Mission. The American Journal of Medicine, Vol 120, No 9, September 2007.

[15] Instructor training. *Presented Institute for Medical Simulation as a Teaching Tool at Harvard Medical School.* October 4-6, 2006.

[16] Issenberg SB, Mcgaghie WC, Petrusa ER, Gordon DJ, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: A BEME systematic review. Med Teach 2005; 27: 10–28.

[17] McGaghie WC, Issenberg SB, Petrusa ER, Scalese RJ. 2010a. A critical review of simulation-based medical education research: Med Educ 2003-2009; 44: 50–63.

[18] Ivette Motola, Luke A. Devine, Hyun Soo Chung, John E. Sullivan & S. Barry Issenberg (2013) Simulation in healthcare education: A best evidence practical guide. AMEE Guide No. 82, Medical Teacher, 35: 10, e1511-e1530, DOI: 10.3109/0142159X.2013.818632.

[19] Ledingham McA, Harden RM. Twelve tips for setting up a clinical skills training facility. Med Teach. 1998; 20: 503–7.

[20] Vozenilek J, Huff J, Rezneck M, Gordon J. See one, do one, teach one: advanced technology in medical education. *Acad Emerg Med*. 2004; 11: 1149-1154.

[21] Kneebone R, Scott W, Darzi A, Horrocks M. Simulation and clinical practice: strengthening the relationship. *Med Educ*. 2004; 10: 1095-1102.

[22] Dalley P, Robinson B, Weller J, Caldwell C. The use of high fidelity human patient simulation and the introduction of new anesthesia delivery systems. *Anesth Analg*. 2004; 6: 1737-1741.

[23] Fried M, Satava R, Weghorst S, et al. Identifying and reducing errors with surgical simulation. *Qual Saf Health Care*. 2004; 13 (Suppl 1): i19-i26.

[24] Patow C. Improving patient safety through simulation technology. *AHIP Cover*. 2004; 3: 74-77.

[25] Friedrich MJ. Practice makes perfect: risk-free training with patient simulators. *JAMA*. 2002; 288: 2808-2812.

[26] Dawson S, Gould DA. Procedural simulation's developing role in medicine. Lancet. 2007 May 19; 369 (9574): 1671-3 [PubMed: 17512839].

[27] Griswold S, Ponnuru S, Nishisaki A, Szyld D, Davenport M, Deutsch ES, Nadkarni V. The emerging role of simulation education to achieve patient safety: translating deliberate practice and debriefing to save lives. Pediatr. Clin. North Am. 2012 Dec; 59 (6): 1329-40 [PubMed: 23116529].

[28] Oak SN. Medical simulation: a virtual world at your doorstep. J Post grad Med. 2014 Apr-Jun; 60 (2): 171-4 [PubMed: 24823516].

[29] Rudolph JW, Simon R, Dufresne RL, Raemer DB. There's no such thing as "nonjudgmental" debriefing: a theory and method for debriefing with good judgment. Simul Healthc. 2006 Spring; 1 (1): 49-55 [PubMed: 19088574].

[30] Seropian MA, Brown K, Gavilanes JS, Driggers B. Simulation: Not just a Manikin. J Nurs Educ. 2004; 43: 164–9 [PubMed: 15098910].

[31] Shanks D, Wong RY, Roberts JM, Nair P, Ma IWY. Use of simulator-based medical procedural curriculum: the learner's perspectives. BMC Medical Education 2010, 10: 77. http://www.biomedcentral.com/1472-6920/10/77.

[32] Barsuk JH, Cohen ER, Vozenilek JA, O'Connor LM, McGaghie WC, Wayne DB. Simulation-Based Education with Mastery Learning Improves Paracentesis Skills. Journal of Graduate Medical Education, March 2012.

[33] Murphy JG, Cremonini F, Kane GC, Dunn W. Is simulation based medicine training the future of clinical medicine? European Review for Medical and Pharmacological Sciences 2007; 11: 1-8.

[34] *Scaled Worlds: Development, Validation and Applications.* Schifl ett SG, Elliott LR, Salas E, Coovert MD, editors. New York: Routledge; 2017.