

Recommendations for the establishment of a clinical simulation unit to train South African medical students

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Background. The burden of HIV and tuberculosis epidemics in South Africa (SA), Africa and developing countries in other parts of the world has an influence on the change in case mix. Shortages of beds in training hospitals and the need to train more healthcare professionals contribute to the saturation of the teaching platform. Clinical simulation as a tool to enhance the education and training of medical students in SA and recommendations in this regard were investigated.

Objective. To obtain recommendations regarding the development of simulation training, assessment facilities and programmes, and determine whether simulation training could enhance medical education and training in the developing world.

Methods. Qualitative research methods, including semi-structured interviews with international simulation experts and focus group interviews with heads of department and lecturers of the local medical school, were used to generate data.

Results. A set of recommendations regarding the introduction of simulation training at an SA medical school was developed to improve patient safety, create a better training environment, and address the healthcare education challenges in SA hospitals.

Conclusion. The incorporation of simulation into medical curricula and the development of clinical simulation training facilities for healthcare professionals in SA could bridge the gap currently experienced in health sciences education in the country. The recommendations outlined in our study may assist other medical training institutions in the developing world in setting up simulation training facilities.

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Simulation-enhanced medical education involves training where simulation is used as a valuable addition to traditional clinical experiential learning, and is a reliable and valid measurement tool to assess performance in a practice environment.^[1,2] Simulation techniques include the

following: computer-enhanced manikins, part-task trainers, computer-based virtual reality simulation, simulated patients and procedural skills simulation.^[3] For the purpose of this study, all the techniques were included. It is important to emphasise that simulation training and clinical practice must be integrated at all levels.^[4] Furthermore, simulation may sometimes be the only way to expose students to the management of less common conditions, while it also enables them and experienced practitioners to keep their skills up to date.^[5]

Patient safety is a matter of prime importance and should be addressed in the education and training of medical students worldwide.^[5] However, from a patient safety and ethical perspective, students are not frequently exposed to training in acute adult or paediatric emergencies and other conditions that require urgent and swift action.^[6] The consequences of limited training, with an anticipated high margin of error, may have disastrous outcomes for patients when students or new graduates are expected to respond to these emergency situations in the clinical arena. The need for a sustainable, feasible and affordable plan to address this shortcoming can be managed with clinical simulation. With simulation, students' training can be enhanced through experiential learning regarding the correct management of these situations, resulting in better prepared and more competent

graduates. Therefore, exposure to uncommon and rare conditions using clinical simulation may play an invaluable role in the training of healthcare students. Clinical simulation in continuing professional development (CPD) programmes may be regarded as one of the cardinal applications in keeping qualified healthcare professionals updated, and its role must not be underestimated.

The burden of HIV and tuberculosis (TB) epidemics in South Africa (SA), Africa and other developing countries, e.g. India and Cambodia, has an influence on the change in case mix. The leading causes of death in SA are HIV/AIDS, TB, interpersonal violence and road traffic injuries.^[7] The TB prevalence in SA in 2006 was 998/100 000 population, which is considerably higher than in Cambodia, the Democratic Republic of the Congo, Ethiopia and Mozambique. HIV/AIDS was estimated to be responsible for 31% of all deaths in SA in 2000, according to the revised SA national burden of disease estimates.^[7] The prevalence of HIV infection in communities in SA is approximately 30%.^[8-10] In the developing world, the HIV pandemic and associated opportunistic infections, as well as the ever-increasing burden of TB, play fundamental roles in the change in case mix. The increasing incidence of infectious and parasitic diseases from 6.3% in 1971 to 7.4% in 1982 at Groote Schuur Hospital, Cape Town, SA, reflects the change in case mix.^[11,12]

Training of medical students has to include infection-related causes of death and a wide spectrum of other conditions. With the current case mix in academic and public sector hospitals in SA and the need to train students in the largest possible range of diseases and conditions, the training platform should be expanded. This platform has shifted to primary healthcare, with a decrease

in beds at teaching hospitals.^[10-13] All these factors have a substantial effect on the number of patients available for training purposes, and ultimately on the quality and competence of healthcare professionals graduating from medical schools.^[12-14]

SA appears to lack a sufficient number of medically skilled professionals in all areas of healthcare, especially in the public sector, to meet the needs of its population. According to an article in *The Bulletin*,^[14] published by the Health Professions Council of South Africa (HPCSA), 47 669 qualified medical and dental practitioners and 14 970 medical and dental students were registered with the Council in 2012. SA has approximately 5 000 practising medical specialists, but needs 13 000; similarly, there are 13 000 practising general practitioners, but an additional 20 000 are required.^[15] To train more healthcare professionals, especially general medical doctors and specialists, medical schools have to admit more students to meet the demand.^[10,14] As increasing numbers of students enter medical schools and compete for a limited number of clinical encounters, problems regarding the provision of sufficient opportunities to train on actual patients are emerging.^[4] The case mix has an impact on the quality of training of medical students and practitioners eventually entering the workforce. The steady decline in the number of hospital beds has a considerable effect on the adequacy of the training platform.^[12] Simulation-enhanced medical education can be used to address the shortcomings resulting from the aforementioned factors. Clinical simulation training provides opportunities for students to be exposed to conditions unsafe for patients, or when high-risk, low-incidence conditions, such as Congo fever and malignant hyperthermia, are involved.

The intention at the University of the Free State (UFS), Bloemfontein, SA, is to introduce simulation training as an essential component of the medical training programme in a structured and systematic manner. In this study, a set of recommendations regarding the introduction of simulation training and assessment was developed at our medical school. The objective was to improve patient safety, create a better training environment, and address the challenges regarding saturation of the training platform and the skewed burden of disease in SA hospitals.

Methods

This is a qualitative study using elements of grounded theory to develop recommendations for the establishment of a simulation training centre and the management of simulation in medical curricula.

The study was conducted in two parts, namely (i) semi-structured interviews with international experts; and (ii) focus group interviews with heads of department and lecturers at UFS.

Approval to conduct the research was obtained from the Ethics Committee of the Faculty of Health Sciences, UFS (ETOVS 122/2010).

Semi-structured interviews

These were used to explore key international experts' attitudes towards and perceptions of simulation training. An interview guide in the form of a list of open-ended questions or topics was developed by MJL with the help of a literature review (Table 1). Occasionally, additional questions arose during the semi-structured interview process; the data were included in the research.

Target population

Directors, managers, teaching staff and technical staff members of the Society for Simulation in Healthcare (an accredited simulation centre in the USA), a simulation centre in the UK, and congress attendees at the International Meeting on Simulation in Healthcare held in New Orleans, USA, in 2011, were requested to participate in the semi-structured interviews. Written consent was obtained from the participants.

Data collection and analysis

The interviews, using the same interview guide, were conducted by MJL. All interviews were audio-recorded, transcribed by MJL and checked by an independent person who was not part of the study. Field notes contributed to the process. The qualitative data were analysed using a grounded theory approach during which there was constant comparison of data. The stages of data analysis

were coding, categorisation and theory generation.^[16] Theory was built by seeking patterns in data until saturation of data was reached.

Reliability and trustworthiness

Reliability of semi-structured interviews was ensured by using the same interview guide and researcher to conduct all the interviews in the same manner. Trustworthiness of data was determined by the researcher's ability to categorise into themes, define the categories and show the association with the interview question.

Focus group interviews

The purpose and emphasis of the focus group interviews were to obtain information on the insights, attitudes, responses and opinions of the heads of department and lecturers in the School of Medicine, UFS.

Target population

The groups were comprised as follows: heads of department were interviewed in one group and lecturers in the School of Medicine in a second group. During the focus group interviews, the opinions and attitudes of the participants were sought concerning the potential impact of a simulation centre on enhancing the education and training of medical students, and the integration of such training in the curriculum offered by the School of Medicine. The focus group interview guide was piloted by the facilitator and an independent observer, after which no changes were required.

Focus group process, data collection and analysis

A standard procedure for conducting the focus group interviews was used.^[17] The question put

Table 1. Interview guide for semi-structured interviews with international experts

Question
1. What role can simulation play as an additional mode for undergraduate medical training?
2. How can simulation be integrated into the current undergraduate medical curriculum?
3. What role can simulation play in the assessment of undergraduate medical students?
4. What lessons did you learn by using simulation as an undergraduate training tool?
5. In your opinion, what are the important factors to take into account in the planning of a simulation centre?
6. What recommendations can you make to take into account when acquiring simulators?
7. What is your advice on the financial considerations for a simulation centre?
8. Can you describe the staff requirements for a simulation centre?
9. What lessons did you learn regarding the planning and implementation of a simulation centre?

to both focus groups was: 'What is your personal opinion and attitude concerning the value that a simulation centre can have in the training of medical students in the School of Medicine, University of the Free State?'. The participants' contributions were audio-recorded and transcribed by MJL. An independent observer and the facilitator checked the transcriptions for verbatim accuracy. Participants confirmed that they were satisfied with the transcriptions. The data were analysed according to a grounded theory approach, which included a process of open, axial and selective coding, categorisation and theory generation.^[16,18] The objective was to look for trends and patterns that reappeared in a single focus group or among the two different focus groups.^[19] Data collection and analysis were continued until saturation of data was reached.

Reliability and trustworthiness

Reliability of the focus group interviews was ensured by using a consistent method during the interviewing procedure, using the same facility and facilitator for the two focus group interviews and performing data analysis and transcription of recordings as described. Trustworthiness of content analysis of the focus group interview was determined by the researcher's ability to categorise data, define categories and show the connection with the focus group question. Data analysis was controlled by the same independent researcher who controlled the data generated by the semi-structured interviews.

Results

Participants ($n=9$) in the first focus group interview were lecturers from the following clinical departments: Anaesthesiology, Family Medicine, Internal Medicine, Otorhinolaryngology, Paediatrics and Child Health, and Surgery. The second focus group ($n=7$) comprised heads of the following clinical departments: Anaesthesiology, Critical Care, Dermatology, Family Medicine, Internal Medicine, Oncology and Ophthalmology. Four focus areas emerged during the interviews.

The first focus area regarding personal opinions contributed to the topic of the development and implementation of a simulation centre. Consensus was reached that it was essential to develop a simulation unit for the School of Medicine, UFS. Because of a general lack of knowledge on simulation training, the need for information seminars to familiarise the lecturers with this tool was identified. It should be incorporated in the development process of the simulation centre.

The second area focused on the topic of personal attitudes of participants. These were mainly positive towards the establishment of a simulation training unit, although a few negative attitudes were identified that could be linked to the lack of knowledge noted in the first focus area.

The value of a simulation unit in the School of Medicine was the third focus area that emerged. The additional benefits to the current curriculum regarding patient safety and training in a non-threatening environment were highlighted, ethical aspects of training with simulators were considered, and the added value of assets and human resources was identified.

The fourth focus area concentrated on the training of medical students. The themes that emerged included the curriculum, skills development, multidisciplinary training, change in case mix, decreasing training platform, simulators and aspects of assessment.

The focus group interviews added a dimension to the research in the sense that the emphasis was on determining the ideas and feelings of

individuals with regard to certain issues relating to simulation enhancement of medical education and training.

Semi-structured interviews were conducted with international simulation experts ($n=12$), who thought that simulation training should be well planned and fully integrated in the curriculum as a required component of the different modules.

The role of clinical simulation as an addition to the current undergraduate medical curriculum was addressed with the first semi-structured interview question. The recommendations were that simulation should provide a non-threatening environment where students can improve their clinical skills and competence, receive additional training on diseases that are seldom seen, and apply theory in clinical practice. The use of standardised patients is especially useful in the training of skills pertaining to communication, and general and interdisciplinary teamwork. The improvement of patient safety is another advantage of incorporating simulation in the curriculum. The more relaxed environment where students can assess and practise acute or unusual situations will improve patient safety and equip students for real-life situations after they have qualified.

The integration of simulation as an undergraduate training tool was addressed with semi-structured interview questions two and four. Simulation should be integrated into the curriculum as a required component and not merely as an optional extra. Simulation can be used to teach components of the curriculum such as experiential learning, decision-making and clinical reasoning skills. Train-the-trainer programmes are essential for the successful integration of simulation and the simulation unit. Incorporating simulation in and aligning it with the curriculum will not be problem free and a few such difficulties were mentioned, e.g. contact hours, funding, and persuading lecturers to include simulation exercises in their curricula.

The third semi-structured interview question dealt with assessment tools and criteria for assessment of clinical competence of undergraduate medical students in a simulation unit. General aspects such as the assessment of higher levels of Bloom's taxonomy, Miller's model of competence and problems with implementation of assessment modules were discussed. Formative assessment of reasoning skills, debriefing and interpersonal skills testing were discussed. The use of simulation for qualification and recertification purposes was evaluated and considered.

The fourth semi-structured interview question dealt with simulation as a training tool, e.g. with regard to teamwork training, patient safety, psychological competence and reasoning skills. Debriefing is a crucial component of simulation training. Its use in formative assessment and the training of trainers was discussed.

Factors to consider in the development and implementation of a new simulation unit for the School of Medicine, Faculty of Health Sciences, UFS, were evaluated and semi-structured interview questions five to nine dealt with these issues. The planning of a simulation centre comprised the teaching programmes, physical spaces, technology, equipment and supplies required for the establishment of such a unit. Semi-structured interview question six evaluated all the aspects regarding the simulators and the manufacturers of the equipment. The financial aspects involving the establishment of the simulation centre were analysed with semi-structured interview question number seven. The staff requirements for a simulation centre were examined with semi-structured interview question number eight, and the last question dealt with aspects regarding the planning and implementation of such a centre.

The data gathered from the semi-structured interviews were triangulated with those of the focus group interviews and literature review to compile recommendations. The key outcome of this study was to make recommendations regarding the development of simulation training, assessment facilities and programmes to help alleviate the training platform saturation in SA. Based on the semi-structured and focus group interviews, a number of recommendations were proposed (Table 2).

When simulation is introduced as an instructional medium to enhance medical education and training, it should include (i) establishment of a clinical simulation centre; and (ii) staff development programmes.

Discussion

The key findings of this study emphasise the following: (i) recognising that the medical curriculum can be enhanced by clinical simulation; (ii) integrating simulation as a required component of the curriculum; and (iii) incorporating assessment to determine whether students have mastered the content and achieved the objectives.

Simulation training could be introduced early in the foundation phase as part of the training of basic skills to build medical knowledge, e.g. history taking, core physical examination and communication skills, followed by clinical skills training of procedures and physical examination and protocols in the preclinical phase. More advanced discipline-specific simulation is introduced in the clinical phase of the curriculum – an approach concurring with the findings of the survey conducted by the American Association of Medical Colleges on medical simulation in medical education.^[20] This mode of training should be dynamic, with students continuously moving back and forth between theoretical, simulation and clinical training, representing the vertical and horizontal integration of simulation into the curriculum. This dynamic is a unique addition, fulfilling the needs of students with different competency levels, identified in the focus group interviews and often encountered in SA medical schools. It should include train-the-trainer courses (Fig.1).

The educational needs and objectives of the curriculum should dictate the acquisition of simulators to address specific exit competencies of a technical and non-technical nature required by the HPCSA. By incorporating standardised patients and hybrid simulation into scenarios,

Table 2. Recommendations based on outcomes of semi-structured and focus group interviews

Role players
<p>The following role players were identified for involvement in the establishment of a simulation unit:</p> <ul style="list-style-type: none"> • Academic staff and technical support staff of simulation centre • Other simulation centres locally, nationally and internationally – input and collaboration • Public willing to be trained and to participate as standardised patients • University supplying a platform and an infrastructure for development of a centre • Health Professions Council of South Africa (HPCSA) and other international regulatory bodies as appropriate • Management of academic and training hospitals • Private hospitals • Pharmaceutical companies • Qualification authorities • Continuing professional development (CPD) programmes
Teaching and learning
<p>Teaching and learning recommendations to integrate simulation successfully into curricula include the following:</p> <ul style="list-style-type: none"> • Vertical and horizontal integration of simulation into the curriculum as a dynamic process • Creation of a safety culture • Ethical aspects of student training can be addressed • Cultural differences and religious affiliations can be addressed • Team training and interdisciplinary training can be addressed • Computer-based simulation will improve reasoning skills and clinical thinking • Creation of self-directed and instructor-based learning opportunities • Introduction of training sessions for hospital staff, CPD programmes and recertification programmes with simulation as additional instructional medium
Assessment
<p>Recommendations regarding the use of simulation as an assessment tool include the following:</p> <ul style="list-style-type: none"> • Define skills, choose the appropriate simulation task and select the correct simulation tool to assess selected skills • Assess the reliability of the tools • Support the validity of the test scores • Implement the correct debriefing techniques • Implement simulation as a tool for certain aspects of formative, summative, qualifying and recertification assessment
Establishing a simulation training unit
<p>Recommendations regarding the establishment of a simulation training unit include the following:</p> <ul style="list-style-type: none"> • Simulation spaces: simulation rooms for one-on-one training, multipurpose simulation rooms, high-fidelity simulation rooms, procedural simulation rooms and the accompanying control rooms • Classroom spaces: pre- and debriefing sessions, formal lectures • Administrative areas: reception, offices, storage • Electronic equipment: audiovisual equipment, computers and telephones for each simulation area • Equipment and supplies: equivalent to the equipment and supplies used in hospitals • Simulators: part-task trainers, low-, medium- and high-fidelity simulators to comply with the objectives and needs of the curriculum. Standardised patients, hybrid simulations • Staff establishment: the head of the unit should be medically trained, and the simulation co-ordinator(s) must have a healthcare background. Other personnel should include a standardised patient co-ordinator, a technical and information technology staff member, a multimedia specialist and administrative staff • Financial support from government, university, commercial companies and suppliers, and private and public hospitals, and private donations

the training of non-technical skills could add significant value to simulation training, but can pose challenges to educators. According to the CanMEDS

Framework, the following competencies and roles are required for healthcare workers: medical expert, communicator, collaborator, manager,

health advocate, scholar and professional.^[21] Students can be trained and assessed with regard to these aspects in clinical simulation exercises and standardised patients can play a very important role. The ethical aspects regarding cultural differences, language differences and religious affiliations could also be addressed with simulation. Team and interdisciplinary training in actual clinical and simulated settings should be incorporated in educational programmes, because teams make fewer mistakes.

The ability to practise without risk must be weighed against the cost of using simulation technology.^[22] Benefits of simulation and CPD training include patient safety, a safer training environment for healthcare workers, a supportive, non-threatening environment and reduced working hours as clinicians perform procedures successfully more often the first time.^[23,24]

Conclusion

Saturation of the training platform has a severe impact on tertiary medical training institutions in SA and can be attributed to several factors, e.g. bed shortages, pressure on secondary and tertiary level beds due to the high burden of HIV and TB in SA, pressure on the teaching platform and influence on the case mix that students are exposed to.^[12] More healthcare staff should be trained at all levels. With the limited growth of academic teaching facilities, the shift to primary healthcare and the revitalisation of primary level facilities, the pressure on the teaching platform in training hospitals will increase even more.^[11-13] The use of clinical simulation training addresses an urgent need with regard to the expansion of the training platform in face of the increasing student numbers, as mentioned by the SA healthcare plan and the implementation of the National Health Insurance scheme.^[10]

The development of clinical simulation facilities for the training of medical students and other healthcare professionals in SA will, it is hoped, bridge the current shortcomings in health sciences education in the country and assist other African countries in setting up similar facilities using the recommendations outlined in the current study.

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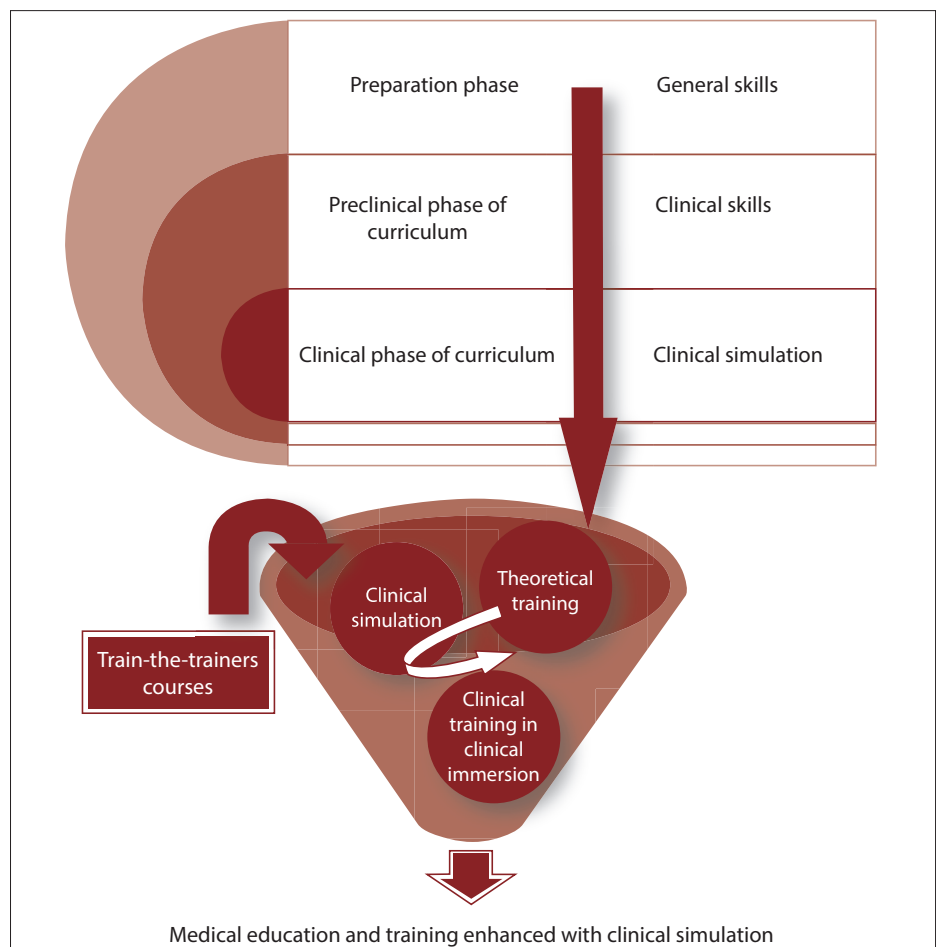


Fig. 1. Schematic model of vertical and horizontal integration of simulation in a medical curriculum.

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