

**Review Article**

# Simulation Based Training in Basic Life Support for Medical and Non-medical Personnel in Resource Limited Settings

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**Abstract:** Medical and non-medical personnel commonly encounter victims of life threatening injuries inflicted by various causes in diverse settings. More than 90% of global deaths and disability adjusted life-years (DALYs) lost because of injuries reportedly occur in low-income and middle-income countries (LMICs). The degree of readiness and competence to manage victims of accidents is likely to vary among individual care givers for knowledge, skill and confidence which would also depend on their training status. It would thus be justified that training in basic life support and other emergency clinical skills be administered to enhance competences in resuscitating the accident victims. Whatever the scale of a mass casualty incident, the first response will be carried out by members of the local community-not just health care staff and designated emergency workers, but also many ordinary citizens. Therefore, both medical and non-medical personnel should be targeted to receive training in basic life support (BLS). In medical training, the traditional (didactic) approach has been suggested to be an efficient and well-experienced training method while 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. Similarly, the use of simulation based training in BLS would not only reduce the procedural associated risks but also benefit more participants from the public domain than would be the case if the training was conducted on human subjects. Compared with the developed world set-up simulation based training in resource constrained settings may not be that well established. This paper will therefore seek to examine the role of medical simulation as a necessary advancement and supplementary method of training in basic life support for medical and non-medical personnel in resource limited settings.

**Keywords:** Basic Life Support, Medical, Non-medical, Resource Limited, Simulation, Simulators

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## 1. Introduction

Medical and non-medical personnel commonly encounter victims of life threatening injuries inflicted by various causes in diverse settings. More than 90% of global deaths and DALYs lost because of injuries reportedly occur in low-income and middle-income countries (LMICs), with death rates being three-to-four times greater in LMICs than in high-income countries [1-7]. Accidents and their resultant

injuries which may range from a few to mass casualties require well trained personnel to administer emergency care in order to minimize avoidable loss of lives. Research has further shown that the prevalence of cardiovascular diseases, mainly because of sudden cardiac arrest (SCA) has been and is expected to continue increasing [8, 9]. SCA is a medical emergency that, if not treated without delay, it causes sudden death [10]. However, with fast and appropriate medical care like high quality chest compression and defibrillation,

survival is possible [11]. The degree of readiness and competence to manage victims of accidents is likely to vary among individual care givers for knowledge, skill and confidence. Disparities in training status may suggest why competences are generally likely to differ among individuals required to administer basic life support. It could also be true that competences in emergency care among health workers who have received some form of training may vary depending on the type of training or orientation status and teaching methods used.

It would thus be justified that training in basic life support and other emergency clinical skills be administered to enhance the competences in resuscitating the accident victims. Whatever the scale of a mass casualty incident, the first response will be carried out by members of the local community-not just health care staff and designated emergency workers, but also many ordinary citizens [12]. According to medical science it is opined that the first 4–8 minutes in sudden collapse is the most crucial period in which resuscitation intervention is most needed in saving victims life [8, 13]. In this regard it is expected that any bystander should be ready to offer life support without delay in order to save life. Many non-trained people show hesitation and lack of self-confidence when facing cardiac arrest situations [14, 15]. It has been suggested that social status and group membership seem to play a role in team building and administration of helping tasks [16–18]. Similarly medical personnel who are not part of a special rescue team undergo a comparable experience when faced with a cardiac arrest [19]. However, faced with a severe situation the time span between noticing an emergency and taking action by beginning chest compression is very much longer in non-trained persons [15]. Both medical and non-medical personnel should therefore be targeted to receive training in basic life support.

In medical training, the traditional (didactic) approach has been suggested to be an efficient and well-experienced training method; on the other hand, 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 [20-23]. In one experimental study, the impact of simulation based first aid training was assessed by subjecting a group of students to a scenario based learning and compared their performance with a control group. The study revealed that scenario-based training appears to be an effective method for students, and that they would like this method to be used more often. In addition, the results showed that students from the experimental group who were exposed to scenario-based learning during first aid training showed a higher level of knowledge in comparison with students from the control group [24]. In other prior studies SBMT for advanced cardiac life support (ACLS) training was found to be a more efficient method when compared to traditional medical training alone. SBMT was studied not only on medical students but also on medical residents, nurses, respiratory therapists and dental students in ACLS training [25-28]. In one Kobras et al study,

the impact of short lessons in BLS to improve self-assurance in performing cardiopulmonary resuscitation was examined. This study investigated the outcome of a new form of in-hospital cardiopulmonary resuscitation (CPR) training with special focus on changes in self-assurance of potential helpers when faced with emergency situations. The study showed that participants experienced a significant improvement in self assurance, compared with their remembered self-assurance before the training. The conclusion was that short lessons in CPR have an impact on the self-assurance of medical and non-medical personnel [14].

The use of simulation based training in BLS would not only reduce the procedural associated risks but also benefit more participants from the public domain than would be the case if the training was conducted on human subjects. Compared with the developed world set-up simulation based training in resource constrained settings may not be that well established. Therefore, the objective of this paper is to examine the role of medical simulation as a necessary advancement and supplementary method of training in basic life support for medical and non-medical personnel in resource limited settings.

The relevant literature reviewed was mainly based on sources from a Google scholar and Pub Med database. The keywords applied in the search where, basic life support, medical, non-medical, resource limited, simulation and simulators.

## 2. Simulation Based Training in Basic Life Support

### 2.1. Simulation

Simulation has been defined as an instructional process that substitutes real patient encounters with artificial models, live actors, or virtual reality patients with the goal of replicating patient care scenarios in a realistic environment for the purposes of feedback and assessment [29-30]. 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 [31]. Systematically designed simulations have been employed since ancient times in those pursuits where training and testing in the real world have been too dangerous (e.g., war games), too expensive (e.g., aviation), or simply unfeasible (e.g., space exploration) [32, 33]. As may be the case for most developed world educational settings, simulation in our setting has not been completely new. Simulation based training is commonly administered in nursing schools, surgery, obstetrics & gynecology and anesthesia for example. However, simulation based training programs in BLS designed to equip the medical and non-medical personnel with knowledge and clinical skills to ably handle emergencies from accidents scenes are lacking in the developing world setting.

### 2.2. Basic Life Support and Simulation

The term basic life support has been defined as maintaining

an airway and supporting breathing and the circulation. The elements in BLS include; initial assessment, airway maintenance, expired air ventilation (rescue breathing, mouth to mouth ventilation) and chest compression while the term cardiopulmonary resuscitation (CPR) is used to suggest their combination. The purpose of BLS is to maintain adequate ventilation and circulation until a means can be obtained to reverse the underlying cause of the arrest. It is therefore a "holding operation", although on occasion, particularly when the primary pathology is respiratory failure, it may itself reverse the cause and allow full recovery [34]. First Aid which is a closely related concept has been defined as the immediate care given to victims of accidents before trained medical workers arrive. Its goal is to stop and, if possible, reverse harm. It involves rapid and simple measures such as clearing the air passageway, applying pressure to bleeding wounds or dousing chemical burns to eyes or skin [35]. A study has shown that approximately 70% of all cases of cardiac arrest occur out of hospital, often in the victim's home [34, 36]. Similar findings have been revealed suggesting that in cases of cardiac arrest, defibrillation administered within four minutes yields survival rates of 40 to 50%, versus less than 5% if given later [35]. These findings do support the suggestion that early intervention by a bystander-calling for the emergency services and initiating CPR can materially improve eventual outcome [37] and that the sooner that BLS can be instituted the better is the outcome [34, 38]. In a review article seeking to find information on the effectiveness of simulation in terms of knowledge and skill regarding basic life support among non-medical faculty (participants), the method has been found to be effective for acquiring skill and knowledge for BLS [39]. The article examined a number of studies in controlled and uncontrolled experiments involving medical and non-medical personnel. The conclusion was that Systematic review and meta-analysis evaluating simulation technology for resuscitation training recommend that simulation-based training for resuscitation is highly effective. The findings further suggested a significant change in mortality rate outside hospital cardiac arrest thus being an effective method for acquiring skill and knowledge for BLS and that the intervention should therefore be encouraged for non-medical faculty [39].

In a non-randomized controlled trial involving medical students learning by teaching BLS was found to be an effective methodology of learning besides allowing the dissemination of knowledge. This study was designed to assess whether teaching Basic Life Support would increase students' learning. The study concluded that the BLS teaching activity was a viable and effective method to increase students' knowledge and skills, more effectively than lessons associated with feedback simulation. It was also deduced that the feedback after the practical assessment, without the act of teaching, was not enough to improve BLS skills [28].

### 3. Simulation Models in BLS Training

The development of cardiopulmonary resuscitation (CPR) manikins for healthcare professionals dates as far back as the

1960 when a model called Resusci Anne was introduced. Since then a variety of other CPR manikins catering for all age ranges of adults, children and infants have been developed. These have been tailored towards the teaching of CPR among both healthcare professionals and lay communities [41].

Patient simulation has been suggested as an ideal tool for teaching in this new generation of learners, allowing them to engage actively in their learning process while doing no harm to their patients. Review of literature shows that to get optimal outcome of resuscitation, simulation training is essentially needed not only for adult patients but also for pediatric patients [29]. Medical simulator models include full-body mannequins, part-task trainers, screen-based simulators, virtual reality simulators, low-resource simulators, and hybrid simulation.

Simulators can be classified according to their resemblance to reality into low-fidelity, medium-fidelity and high-fidelity simulators [42, 43]. 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. 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. 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.

The Resusci-Annie which is an example of a low-fidelity simulator is a part-task simulator which was developed from the need for a realistic model for training in basic cardiopulmonary resuscitation. It is currently used for basic life support and advanced cardiac life support training internationally [29, 42]. The advantages of simulation based training are such that: It provides trainees with increased clinical experience because rare but devastating events can be simulated and practiced many times. It is convenient as trainees can schedule simulation sessions at times that fit into their schedules. It decreases the use of hospital resources by reducing the time spent teaching in expensive clinical environments. It is also much safer to train on patient simulators than on real patients [29].

In the author's own experience following a site visitation of one of the simulation centers in Russia, the Botkin Simulation Center, the role of simulation in the management of emergencies is depicted in a broader perspective than the training in CPR alone. The Botkin Simulation Center is a hospital based simulation facility also serving as a trauma center in Moscow. It is a well-developed facility comprising the state of the art infrastructure and simulation equipment ranging from physical assessment tools, radiological and operative catering for various disciplines such as medical, surgery, obstetrics, pediatrics and the surgical-medical subspecialties to mention but a few. It is an internationally renowned simulation center receiving local and international learners both from the public and professional domains for orientations and trainings in emergency care by simulation. It also houses studios in which a virtual catastrophic situation requiring emergency response is depicted. One such situation

observed was in the form of a road traffic accident, an explosion at a night club and train accident in the subway. In this vein the facility is able to train various categories such as medics, paramedics, nurses, firefighters, the police and military among others. It was also reported that although most of the infrastructure is used for the sole purpose of simulation, the facility is designed in such a way that it can revert to function as a trauma center providing emergency care services to real patients whenever need arises. At the Copper belt University, School of Medicine in Zambia, we have made advances towards the set-up of a Simulation Centre in a proposed tri-phased approach as follows:

*Phase 1:* a. Procurement of training resources, training of trainers and of personnel to maintain the training resource.

b. Provisional space required to accommodate the Simulation Centre and the identification of the site for the construction of a future Simulation Centre.

*Phase 2:* Construction of the Simulation Centre and continuation of training activities in Phase 1.

*Phase 3:* Upon the completion of the construction of the Simulation Centre, the introduction of advanced training in simulation shall commence.

## 4. Conclusion

Simulation based training is a useful instructional process applicable to the training of both medical and non-medical personnel with knowledge and clinical skills required to competently administer basic life support in various emergency settings. Simulators in BLS can enable learners to interact with, assess and perform a variety of procedures on a simulated patient repetitively thereby assuring the acquisition and retention of emergency clinical skills while also promoting safety for patients. Finally, simulation based programs for BLS and First Aid should not only target medical personnel but also key service providers such as the fire fighters, the police, red cross and members of the public, which investment is expected to save many lives in the developing world set-up and globally.

## Author Contributions

Nyirenda devised the theme and content of the manuscript. All the co-authors contributed to the writing of the manuscript.

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