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How Many Goats Does a Mannequin Cost? Community-engaged Design of Layperson First Responder Training Materials in Low-resource Settings

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Brief Report

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Abstract

Objectives: Simulation materials for layperson first responder (LFR) trainings used in high-resource settings are prohibitively expensive for use in low- and low-middle income countries. To date, no structured approach to community-engaged design in identifying accessible and acceptable simulation materials for LFR trainings has been developed.

Methods: We conducted 2 workshops with male (18) and female participants (10) in a rural village in the Centre-Est region of Burkina Faso using principles of community-engaged research to define solutions for improvised LFR training materials.

Results: Participants reported a range of reactions to the use of live trainees and animal models for LFR training including considerations around gender sensitivity, use of animals for training purposes in regions of food insecurity, and religious and cultural barriers to consumption of meat after use for training purposes. A range of locally available options for training materials was identified by participants.

Conclusions: Significant sociocultural variability exists across low-resource environments with implications for the acceptability and availability of improvised materials for LFR training. Affected communities should be engaged in the selection and design of improvisation strategies to ensure context-appropriate adaptation.

The majority of global trauma-related deaths occur in low- and low-middle income countries (LMICs).[1] Of these, a significant proportion (up to 80%) occur in the prehospital setting.[1] Yet, in many LMICs, formal prehospital emergency care systems are limited and consequent delays to care result in unquantified preventable death and disability. To address this gap, layperson first responder (LFR) trainings have been developed to strengthen community capacity to provide lifesaving first aid in the absence of formal trauma care systems (e.g., Stop the Bleed and the World Health Organization [WHO] Community First Aid Responder [CFAR]) training).

In 2023, the World Health Assembly adopted the WHO resolution, "Integrated emergency, critical and operative (ECO) care for universal health coverage and protection from health emergencies" (ECO resolution 76.2).[2] The ECO resolution emphasizes the integrated nexus of services and stakeholders required for effective emergency care systems from the community to the health facility level. Within its package of ECO interventions, the WHO developed the CFAR training to strengthen LFR capacity to respond to health emergencies, including trauma.

Simulation is an approach frequently used in medical and trauma care trainings to increase engagement of trainees and replicate conditions as similar as possible to the real-life scenarios where the transferred skills will be applied. Simulation materials for LFR trainings used in high resource settings such as mannequins and combat application tourniquets (CAT) are prohibitively expensive for use in LMICs (Table 1). In high-resource settings the use of mannequins for resuscitative training (including with laypersons) is common-place, yet the use of sophisticated versus simple mannequins has not been demonstrated to yield an advantage in effective training.[3,4] In general, high-fidelity simulation materials have not been shown to be superior to low-fidelity simulations.[5] To ensure the sustainability of LFR trainings in low-resource environments it is necessary to identify locally available, inexpensive, and socioculturally acceptable simulation materials. Low-resource settings vary widely in many aspects including sociocultural norms and

Table 1. Skills and simulation needs: high-resource materials and low-resource alternatives[a]

Skills by category	Simulation need	High-resource simulation materials	Cost (USD)	Low-resource simulation materials	Cost (USD)
1. Scene Safety					
1a. Didactic, N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
2. Triage					
2a. Didactic, N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
3. Personal protective equipment (PPE), universal precautions					
3a. Demonstrate awareness of barrier precautions	Body fluids, unresponsive casualty	Gloves	$20 per box of 100[b]	Plastic bags	$2 per box of 100
4. Activating emergency medical system					
4a. Alert health personnel of incoming casualty	Unresponsive casualty, emergency health system activation number	Phone, "911" emergency system	N/A	Mobile phone, radio	N/A
5. Patient transport and positioning					
5a. Recovery position	Unresponsive casualty	Mannequin	$1200[c]	Trainees/live participants; locally made mannequin (materials include wood, discarded water bottles, modified with marker and cut-out holes, cardboard box with tongue depressors or pieces of wood with cloth taped over them)	$0
5b. Cervical spine stabilization	Unresponsive casualty	Cervical collar	$12[d]	Cardboard, towel, blanket, jacket	<$2
5c. Log roll maneuver	Unresponsive casualty	Mannequin	$1200[a]	Trainees/live participants; locally made mannequin (materials include wood, discarded water bottles, modified with marker and cut-out holes, cardboard box with tongue depressors or pieces of wood with cloth taped over them)	$0
5d. Hypothermia prevention	Unresponsive casualty	Warming blanket	$25[d]	Blanket, scarf, clothing	$3
5e. Casualty transport	Unresponsive casualty	Mannequin	$1200[a]	Trainees/live participants; locally made mannequin (materials include wood, discarded water bottles, modified with marker and cut-out holes, cardboard box with tongue depressors or pieces of wood with cloth taped over them)	$0
6. Hemorrhage control					
6a. Direct manual pressure	Blood, extremity wound, venous bleeding	Mannequin and plastic models, bandages, combat gauze, fake blood	1200[a]	*Bissap*/hibiscus tea for blood; goat limbs; clean cotton cloth in lieu of gauze; tree trunk with holes in it, Styrofoam or egg carton for wound packing	$60 including entire goat
6b. Wound packing					
6c. Appropriate tourniquet application	Extremity wound with arterial/pulsatile bleeding	Combat Application Tourniquets	$32[d]	Scarf, torn blanket, torn pantleg, cloth, stick for windlass	<$2
6d. Tourniquet conversion	Extremity wound with tourniquet in place				
7. Airway maneuvers					
7a. Opening of airway (head tilt, chin lift)	Unresponsive casualty	Mannequin	$1200[a]	Trainees/live participants; locally made mannequin (materials include wood, discarded water bottles, modified with marker and cut-out holes, cardboard box with tongue depressors or pieces of wood with cloth taped over them)	$0
8. Injury temporization					
8a. Fracture immobilization	Broken extremity	Vacuum splint	$230[d]	Branches, towels, cardboard, tape, or torn cloth to secure	<$2

(*Continued*)

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Table 1. (*Continued*)

Skills by category	Simulation need	High-resource simulation materials	Cost (USD)	Low-resource simulation materials	Cost (USD)
8c. Pelvic binder placement	Casualty with simulated pelvic injury	Commercial pelvic binder	$135[d]	Sheet, blanket, modified pant leg, sticks to secure	<$2
First aid kit	N/A	Combat gauze, CAT tourniquet, gloves, sterile gauze, emergency blanket, trauma shears	$105[d]	Blanket, scissors, clean cotton cloth, gauze, gloves or plastic bags, permanent marker, duct tape, torch, cardboard splinting material	$10

[a]CAT – combat application tourniquet; N/A – not applicable; PPE – personal protective equipment; USD – United States Dollars
[b]Rescue Essentials Tactical Emergency Medical Supplies. www.rescue-essentials.com. https://www.rescue-essentials.com/
[c]Medical Simulators & Anatomy Models. GTSimulators.com. https://www.gtsimulators.com/
[d]The organization People for the Ethical Treatment of Animals has previously donated simulator mannequins to Advanced Trauma Life Support courses in LMICs. However, these are not widely available.

resource availability. Yet to date, no structured approach to community-engaged design and context-specific adaptation of simulation materials for LFR trainings has been developed.

To address this gap, we conducted two workshops among community members in a rural village in a low-resource conflict setting. The purpose of this workshop was to evaluate local perceptions of improvised first aid training materials and create a toolkit for other investigators to conduct similar exercises in their study area. Increased community engagement in the design of LFR trainings and planning of improvisation materials holds potential to improve the context-appropriateness of such interventions.

Methods

Study Setting

Burkina Faso is a low-income country in the Sahel affected by protracted humanitarian crisis related to conflict, violent extremism, poverty, and food insecurity with over 2 000 000 internally displaced persons.[6,7] The threat of improvised explosive devices has increasingly affected the study region, leading to a need for LFR trainings. As part of a contextual analysis to ensure context-appropriateness of LFR trainings among affected communities, we held two workshops (one for male participants, one for female participants) in a rural village located in the Centre-Est region of Burkina Faso to gauge community perceptions of locally available improvisation materials.[a]

Study Design and Procedures

A convenience sample of consenting male and female participants with interest in participating in LFR trainings was recruited by a local community liaison officer. Workshops were held separately with men and women due to local cultural norms. Each workshop was held in a single setting and lasted approximately one hour. Workshops were held in the local language (Bissa) with community liaisons and facilitators bilingual in Bissa and French. Workshop guide development was conducted in accordance with principles of community-engaged research.[8] Such principles included building on existing knowledge and resources within the community, involvement of the community in co-design of research throughout the phases of an intervention, and iterative processes of research design based on community input.[8] The WHO CFAR curriculum was used to define domains within the workshop guide by skill/topic. Each domain was paired with associated simulation materials based on commercial materials used in high-resource settings and contrasted with potential options for improvised materials for use in LMICs (Table 1, Supplement 1). Community members were then consulted to develop prompts to elicit suggestions from workshop participants regarding context-appropriate, locally available materials (Supplement 1). Due to sensitivity of the study context, audio recordings of the workshop were not obtained. Workshop facilitators took manual notes throughout the session to document participant responses. Based on participants' feedback (i.e., questions that did or did not work well to elicit information regarding improvised materials for LFR trainings) during the workshop, the facilitator's guide was refined to develop a toolkit for use by investigators in other study contexts.

Ethical Procedures

Ethical approval was granted by the University of Washington Human Subjects Division (STUDY00020569) and the Comité d'Éthique pour la Recherche en Santé of Burkina Faso. Research was conducted in collaboration with the Department of Public Health at the University of Joseph Ki-Zerbo (Ouagadougou, Burkina Faso) with approval from the Minister of Health of Burkina Faso. Verbal informed consent was obtained from participants in their primary language by trained study personnel. Permission was granted by the chiefs of surrounding villages.

Results

Study Participants and Prior Training

Two workshops designed to elicit participant engagement in the design of context-appropriate improvised materials for LFR training were conducted. The first workshop (W1) consisted of 10 individuals: nine women representatives of community health clubs led by a local community health club facilitator. The second workshop (W2) consisted of 18 individuals: 16 local Country Defense Volunteers (Volontaires pour la défense de la patrie) and two local facilitators with previous training in qualitative research methods. W1 participants were familiar with other community health activities including sanitation and hygiene as well as prevention of infectious diseases but had not received first aid training for trauma. W2 participants had previously received basic first aid training through their requirements to become Country Defense Volunteers. Participant-generated suggestions for locally available materials are presented in Table 1. No significant divergence in participant responses was observed between W1 and W2.

[a]Village name withheld for security considerations.

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Use of trainees as live models

W1 and W2 participants independently proposed the use of trainees as live models. Participants reported that in their community, it would only be acceptable for women to practice with other female trainees and men with male trainees, and further specified that the training facilitators would also need to be of the same sex. For example, even if a male facilitator only explained the skills and did not demonstrate on women or touch women participants, it would not be acceptable for women to practice on other female participants in the presence of a male facilitator due to religious reasons.

Use of animal models

A range of opinions regarding the acceptability of animal models was reported by W1 and W2 participants, varying even within each group. Responses were participant-dependent. Some participants reported that if a live or recently slaughtered animal (e.g., goat) were used for training purposes, they felt they would be unable to consume the meat afterwards. Though no strict religious or cultural taboo was cited, personal distaste/aversion to hygiene and meat handling were provided as reasons for this opinion. Given the resource scarcity in the study context, it was considered socioculturally unacceptable to use an animal solely for training purposes. Other participants reported that if the animal were properly slaughtered according to custom they would consume the meat following training activities. Some participants reported special measures that could be taken to increase the acceptability of consuming the meat of an animal that had previously been used for LFR training purposes, including removing the skin after manipulation, and removing parts of the animal for training (e.g., legs for wound packing and tourniquet use) and pre-designating others for consumption.

Improvised materials

Participants were astonished to learn the cost of commercial simulation materials. Participants estimated that even the least expensive commercially available mannequin would cost the same as at least four goats. A range of ideas for locally available materials were generated by participants (Table 1). Proposed options for mannequin design were diverse and included sacks of grain or eucalyptus wood for the torso with improvised head and mouth made from a modified empty water bottle. Participants reported that they would be unlikely to cut down viable or edible plants such as banana trees, but that scrap wood would be an acceptable material for improvisation. For moulage and hemorrhage control simulations, *bissap* (hibiscus) tea was recommended as an inexpensive and locally available red liquid to simulate blood. A carved-out piece of wood or mattress foam was proposed for skills such as manual pressure and wound packing. Improvised tourniquets could be made from scarves and blankets, taking into account concerns about removing headscarves for Muslim women not wearing any covering underneath. Similar materials (i.e., clothing, scarves) and empty grain sacks were recommended for fashioning pelvic binders. Costs of options proposed by participants generally ranged from 6-20 times less expensive than commercial options used in high-resource settings (Table 1).

Discussion

This brief report presents a toolkit to facilitate workshops to engage affected communities in the design of improvised materials for LFR trainings (Supplement 1). While certain solutions for improvisation of simulation models may be universally acceptable (e.g., the use of plastic bags to replace gloves), other solutions may be associated with nuanced sociocultural considerations that are highly context-dependent and some risk being ineffective for use in an emergency. Community-engaged research and contextual analysis prior to trainings can ensure the acceptability and availability of proposed materials.

Use of live trainees and animal models

There is a lack of qualitative research regarding sociocultural perceptions of LFR trainings in LMICs, including contextual variation in acceptability of using live trainees and animals to model first aid skills. Community perceptions and prohibitions on mixed training of male and female participants would have implications for training implementation, including the need to ensure pre-planned ratios of male and female trainers corresponding to the anticipated trainee cohort composition. Beyond context-specific cultural limitations, live trainee models also have obvious restrictions in regard to invasive procedure skill teaching (e.g., deep wound packing) and safety considerations (e.g., risk of injury during patient movement or tourniquet placement).

With respect to the use of animal models for training purposes, participant opinions varied. Barriers to the use of animal models were both sociocultural (e.g., respect for the subsistence value of meat, religious considerations regarding appropriate method of slaughtering) and personal factors (i.e., innate aversion, concern for hygiene). These beliefs and preferences are likely to vary across settings. For example, live animal models were used during trauma trainings organized by the Village University program of the Tromsø Mine Victim Center for laypersons as well as prehospital providers in rural landmine-contaminated regions of LMICs including Iraq and Cambodia.[9] While extensive debate has been held in high-resource environments regarding the ethics of "live tissue training," in the context of military trauma systems and during conflict, there is a lack of published literature regarding sociocultural perceptions of the use of animal models in trauma trainings in LMICs.[10,b]

Improvised materials

Participants proposed numerous strategies for improvisation of all LFR training materials ranging from mannequins to tourniquets to pelvic binders, including inventive solutions like the use of hibiscus tea for moulage (Table 1). A wide range of improvised materials for each of these purposes have been reported.[11,12] As with commercial options, concerns exist regarding safety and variable efficacy of improvised techniques based on setting and trainee proficiency.[11,12] Multiple options are appropriate for improvisation while others are high-risk (e.g., rope, wire, or other overly narrow materials for improvised tourniquet). Ensuring that lowest-risk options for improvisation are selected, high-quality training in methods of application and first aid principles regardless of material type is essential. For example, improvised pelvic binders whether this be constructed with a sheet or pant trouser must be appropriately placed (i.e., centered over the greater trochanter and avoiding pressure over the knees which can cause peroneal nerve palsy). The safety and efficacy of improvised tourniquets are likewise dictated

[b]The organization People for the Ethical Treatment of Animals has previously donated simulator mannequins to Advanced Trauma Life Support courses in LMICs. However, these are not widely available.

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more by appropriate placement (i.e., ensuring arterial occlusion to avoid creation of a venous tourniquet, placement only when indicated and bleeding uncontrolled by other measures such as direct manual pressure or wound packing, placement no more proximally than indicated unless in a combat or tactical situation, ensuring adequate contact surface area to minimize tissue damage).[12] Methods to secure the windlass of an improvised tourniquet are critical to ensure that the construct does not loosen during unsupervised transport.

Conclusion

Simulation materials used for layperson first responder trainings in high-resource settings are prohibitively expensive in LMICs. Significant sociocultural variability exists across low-resource environments, and further research is needed to collate a range of practical solutions. Affected communities should be engaged in the selection and design of improvisation strategies as well as planning phases for LFR trainings.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/dmp.2025.69.

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