RESEARCH ARTICLE

Short- and long-term results of low cost trauma training in a low-income resource-poor country [version 2]

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Abstract

This article was migrated. The article was marked as recommended.

Introduction: Malawi is among the world's least developed countries. There are 2.1 physicians per 100 000 people and a high trauma-related mortality and morbidity. The lack of healthcare resources requires essential high capacity trauma training at a low cost.

Methods: A one-week trauma course was conducted at the Kamuzu Central Hospital in Lilongwe, Malawi. 15 students (13 interns and 2 chief nurses) attended the course. They were trained in initial trauma care, triage and basic practical procedures. Thereafter, evaluated through an identical multiple-choice exam, pre- (PRE) and post-course (POE), following a similar exam 6 months post-course (6MPOE). Prior to, and after the course a confidence-based questionnaire was completed.

Results: The participants presented significantly higher test-scores after the course in both POE (26.2±3.2 vs. 21.8±3.1; p>0.001) and 6MPOE (25.7±2.4 vs. 21.8±3.1; p 0.003). We also identified the nurses to improve significantly after the course. The highest score of improvement was 27.3%. Higher confidence scores were noticed after the course.

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version 1 20 Sep 2018	view	view			

1. **Bengang Qin**, The First Affiliated Hospital of Sun Yat-sen University
2. **P Ravi Shankar**, American International Medical University
3. **Ken Masters**, Sultan Qaboos University
4. **Richard Hays**, James Cook University
5. **Trevor Gibbs**, AMEE

Any reports and responses or comments on the

Conclusion: This study shows that any healthcare personnel in a low-income setting could benefit from a designed course in trauma management. Thus, we emphasize that healthcare staff undertake similar course to orient towards correct management and assessment of initial trauma patients.

Keywords
Trauma in Africa, Trauma training, Sub-Saharan Africa, Trauma team training

article can be found at the end of the article.

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Introduction

Today there are over 4 million injury-related deaths each year worldwide, where 90% of the injuries occur in low and middle-income countries (Wesson *et al.*, 2014). Trauma related deaths are almost three times the number of deaths from HIV/AIDS, malaria, and tuberculosis combined (Kotagal *et al.*, 2014). According to the Global Burden of Disease, injuries cause 11.2% of all disability adjusted life years worldwide (Kotagal *et al.*, 2014). The incidence of trauma-related morbidity and mortality is increasing and the highest injury trauma-related mortality is seen in sub-Saharan Africa (MacLeod *et al.*, 2011). Africa has, due to the high volume of surgical disease, the highest percentage per head of surgical disability adjusted life-years (DALYs) in the world (Lavy *et al.*, 2011).

Depending on the countries economical standard one finds differences in probability of survival. Studies shows that a severely injured patient with mid-range Injury Severity Score has six-times higher risk of mortality in a low-income country, like Ghana, compared to a high-income country, like USA (Mock, Joshipura and Goosen, 2004).

Malawi is one of the poorest countries in the world with 65% of the population living below 1 US dollar per day (van Amelsfoort *et al.*, 2010) and 93 US dollars in total expenditure per capita on healthcare in 2014 (World Health Organization, 2018). Like many low-income countries there is paucity of skilled healthcare providers with 2 physicians and 59 nurses per 100 000 people (World Health Organization, 2008; Qureshi *et al.*, 2013).

Due to the shortage of healthcare workforce in Malawi, surgeons have started to educate clinical officers (non-physician clinicians). To improve clinical care, surgeons invested in both regional surgical education but also collaboration with different international partners (Qureshi *et al.*, 2013).

In Malawi, like in many developing countries about half of the injured patients are within the reproductive ages, in other words; the economically productive segment of the society (Schultz *et al.*, 2007). Injuries result in a financial burden for the individual as well as the society. However conversely, prior studies have shown young people are most likely to gain full recovery if they receive the correct management and care. Reduction in injury mortality rates in low and middle-income countries to the level of high income countries through better trauma care could save over 2 million lives per year worldwide (Kotagal *et al.*, 2014). A reduction in mortality rate has also been demonstrated when training pre-hospital trauma care situated in Assyria (todays northern Iraq) and Cambodia, provided the training is given in conjunction to the local needs (Husum, Gilbert and Wisborg, 2003). A reduction in mortality rate in severely injured patients has also been seen, in a capital hospital in Rwanda, after initiating focused trauma education courses (Petroze *et al.*, 2015). Therefore, the training of hospital staff in trauma management is even more crucial in a setting where there is high trauma-related morbidity/mortality and a resource poor staff restricted environment. A recent study also suggest implementation of a cost-effective and appropriate trauma training curriculum for resource-poor environments (Anderson *et al.*, 2018).

In high-income countries the Advanced Trauma Life Support (ATLS) has been used to standardize and improve trauma care (Quansah, Abantanga and Donkor, 2008). ATLS, which is managed by the American College of Surgeons, has been spread over more than 80 countries, educating more than 1 million providers so far (ACS, 2018). The start-up cost for an ATLS course is about 80 000 US dollars, which is not favourable in a poor setting (Quansah, Abantanga and Donkor, 2008). The ATLS course is also designed with a high technology hospital in mind. In low technology and resource constricted hospitals with limited referral possibilities there is a need for alternative educational approaches (Nolan, 2005). Several studies of trauma training among healthcare staff in low-income countries have shown positive results (Schultz *et al.*, 2007; Quansah, Abantanga and Donkor, 2008; Douglas *et al.*, 2010; MacLeod *et al.*, 2011; Kurdin *et al.*, 2018). However, there is a need for follow-up to assess the gained knowledge long term. Here we demonstrate the effectiveness of low cost trauma training to improve healthcare providers trauma management abilities long term.

Methods

We conducted a one-week initial trauma management and triage course in May 2012 at Kamuzu Central Hospital (KCH), Lilongwe, Malawi. KCH is an 800-bed hospital that serves the central region of Malawi with a population of about 5 million (Samuel *et al.*, 2010).

Thirteen interns from the surgical department and two Surgery Emergency Room (S-ER) nurses attended the course. The group was homogeneous consisting of 53% female participants and an age ranging from 20-30 years. The inclusion criteria for the participants were all the interns undergoing their surgical rotation at that time due to the current situation in the local setting. At the request of the hospital administration, we also included the two responsible S-ER nurses who served as managers for the emergency room. Before the inclusion they all accepted to take part in the course and the study.

The course was based on ATLS trauma care principles and practical manoeuvres. These covered topics in the standard Airway/neck immobilization (A), Breathing (B), Circulation (C), Disability (D) and Exposure (E) format. The course

lectures in ABCDE were held through collaboration with the local staff and expatriate doctors working in Malawi. Patient triage was held as group seminars with discussion of trauma related cases, where every participant was involved.

We incorporated the theoretical parts with practical procedures and went through fundamental practical procedures such as neck stability, insertion of chest tubes (on goat cadaver), and immobilization of extremities, vascular access and suturing techniques. X-ray interpretations were adapted to the local resources and facilities. Extra attention was given to paediatric injuries and burn management because of the high amount of paediatric trauma related injuries and burns in the region.

The participants were then evaluated through an identical 33 multiple choice exam pre- (PRE) and post-course (POE) and made a pre/post-course questionnaire for confidence assessment. We were also able to examine them 6 months post-course (6MPOE) with a new 33 multiple-choice exam to evaluate their gained knowledge over time. Unfortunately, we were not able to examine all 15 students as a result of rotations in different district hospitals, insufficient means of communication like no addresses etc., and thus only 11 were examined 6 months post-course (6MPOE).

Statistical analysis

IBM SPSSversion 23 wasusedforstatisticalanalysis. Dataarepresentedasmeanand standard deviation. Paired-samples T test was used for statistical analysis comparing PRE to POE and 6MPOE. Statisticalsignificance was set at $p < 0.05$.

Results/Analysis

A total of 15 students, 13 doctors and 2 nurses, returned the multiple-choice exam with 33 questions pre- and post-course but also 6 months post-course. Only 11 doctors participated the 6 months post-course.

The interns had significantly higher test scores after the course in both POE (26.2±3.2 vs. 21.8±3.1; p>0.001) and 6MPOE (25.7±2.4 vs. 21.8±3.1; p 0.003), which is equivalent to previous studies [3]. The improvement range was from 0-27.3% pre- to post-course and 6MPOE from -3 to 21% (Table 1).

One of the nurses improved her knowledge with 18% and had similar POE-score as some of the interns. In similar studies like this the highest gain of scores was in the group with the lowest pre-course results and in our setting, this applied to the two nurses.

Table 1. Students (n = 15) exam results; pre-course (PRE), post-course (POE) and six months post-course (6MPOE).

	PRE	POE	6MPOE
1	18	24	
2	23	26	27
3	21	28	21
4	13	19	
5	20	29	25
6	24	25	25
7	24	26	25
8	24	28	
9	24	27	23
10	25	29	29
11	23	27	25
12	24	30	29
13	21	21	26
14	22	24	
15	21	30	28

The confidence score of the participants was increased by 12% after the course. The written course evaluation showed that all were satisfied with the course and recommended that we should include all the interns and even nurses for future courses (Table 2; Table 3).

The total expenditure on this course was calculated to about 800 US dollars, including material, food and beverage. As the lecturers were mostly local (including the foreign lecturers working at KCH at the moment) there were no expenditures on the salaries. The two Swedish lecturers responsible for the course had salaries from their own employer. This amount is therefore 9 times less the amount of money payed for the two foreign doctors to travel from Sweden to Malawi and arrange the course, and its over 100 times less than setting up an ATLS course (Figure 1).

Discussion

This study shows that healthcare providers in low-income countries can benefit from trauma training catering to their situation. It is important to include different professional cadres since trauma care is complex and all staff involved should

Table 2. Self-assessment Survey (score 1-7).

1.	I'm certain that I can understand the most difficult concepts that are being presented during the course.
2.	I'm certain that I can understand basic terms and facts being brought up during the course (understanding the meaning of the lectures/stations).
3.	I'm certain that I can understand the most complex procedures being taught.
4.	I'm certain that I will succeed at the skills stations.
5.	I'm certain that I will master the skills taught during the course (succeed with the exercise).

Table 3. Self-assessment test score: overall test score (n = 15), pre- and post-exam score.

Question	Pre-exam	Post-exam
1	5.8	6.8
2	6.5	6.8
3	5.6	6.6
4	6.3	6.7
5	6.5	6.8

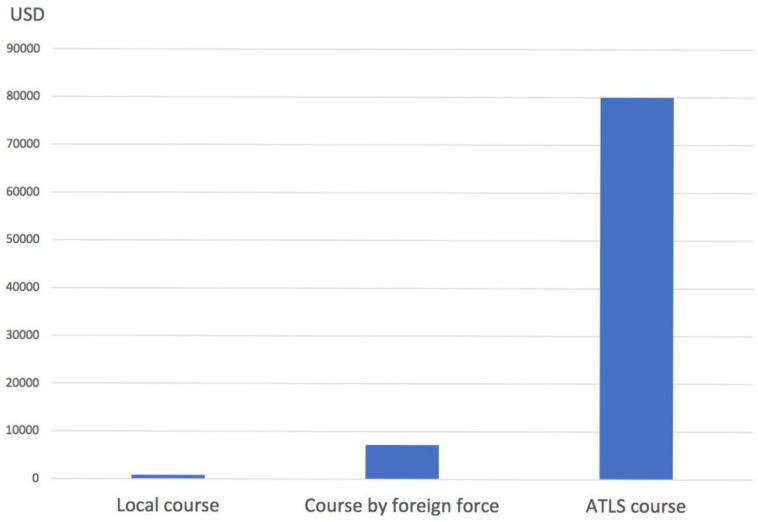

Figure 1. The course expenditures in USD.

have the same goal in initial management and understand the flow in this chain. In a resource poor setting, staff is required to fill roles they may not fill in a resource rich setting due to the lack of adequate manpower.

Interestingly, the two nurses in this study were in the group who gained the most knowledge, although, no major conclusions can be drawn with such a low sample, it shows that staff healthcare providers with less previous trauma experience are more likely to gain the most knowledge. Therefore, it is important to include nurses as well as clinical officers, who serve as non-physician in bigger parts of sub Saharan Africa.

Most importantly, participants retained the knowledge 6 months later. This study was unique in the sense that we could evaluate the participants also after 6 months. This indicates that short-term training can have a long-term effect.

The confidence scores correlate with increased performance of new skills. The participants had high scores in general and showed increased confidence after the course. Unfortunately, as a cause of economic issues and lack of staff we couldn't extend the group of students. It's also difficult for the department to stay without some of their staff for a whole week. For future studies we have to be aware of these types of problems and consider a different strategy to gather a bigger group of staff.

The next step is to incorporate more local lecturers into the course and make it part of the intern/nursing curriculum at KCH. It would be most interesting to see if the trauma-care improves over time at KCH as well as at the referring district hospitals by regular trauma training of the interns. We need to start placing injury prevention as a major goal for public health management and adjust trauma training to the local settings. There is a need for general improvement in trauma management for all medical staff regardless of degree.

Limitations The limitations of this study are the low number of participants, and also the relatively high number of drop-out rate (27%) due to difficulties reaching them for the 6 months follow up (6MPOE). For future studies it would be more beneficial to include more participants or conduct a multi-centre study.

Conclusion

This course is similar to an ATLS course covering initial management of trauma patients but in contrast to ATLS it was adjusted to the local settings. By using mainly local doctors instead of international doctors as lecturers the course could be given at a lower cost.

All participants thought the course should include all the interns at KCH as well as be given at an earlier stage of the internship.

Take Home Messages

- Healtcare providers in low-income countries can benefit from trauma training without increasing expenses.
- Educating trauma management to the whole team and not only doctors leads to better patient care.
- The participants showed increased confidence after the course.
- Short-term training can have a long-term effect.

Notes On Contributors

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Declarations
The author has declared that there are no conflicts of interest.

Ethics Statement
Malawi does have an ethics committee; Malawi National Health Research Council (NHRC) however, we did not require ethics approval as the study only looked at improving providers knowledge base and did not directly affect patients.

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This article has not had any External Funding

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Bibliography/References

ACS (2018) *ACS Advanced Trauma Life Support. In: Surgeons ACo editor.* Available at:
Reference Source (Accessed: 10 September 2018).

van Amelsfoort, J. J. C., *et al.* (2010) **Surgery in Malawi - the training of clinical officers.** *Tropical Doctor.* **40**(2), pp. 74–76.
Reference Source

Anderson, G. A., *et al.* (2018) **Development of a Comprehensive Trauma Training Curriculum for the Resource-Limited Environment.** *Journal of Surgical Education.* **75**(5), pp. 1317–1324.
Reference Source

Douglas, R. J., *et al.* (2010) **Improving trauma care in India: a recommendation for the implementation of ATLS training for emergency department medical officers.** *International Journal of Emergency Medicine.* **3**(1), pp. 27–32.
Reference Source

Husum, H., Gilbert, M. and Wisborg, T. (2003) **Training pre-hospital trauma care in low-income countries: the "Village University" experience.** *Medical Teacher.* **25**(2), pp. 142–148.
Reference Source

Kotagal, M., *et al.* (2014) **Health and Economic Benefits of Improved Injury Prevention and Trauma Care Worldwide.** *PLoS One.* Edited by A. Mahal. **9**(3), p. e91862.
Reference Source

Kurdin, A., *et al.* (2018) **TEAM: A Low-Cost Alternative to ATLS for Providing Trauma Care Teaching in Haiti.** *Journal of Surgical Education.* **75**(2), pp. 377–382.
Reference Source

Lavy, C., *et al.* (2011) **State of Surgery in Tropical Africa: A Review.** *World Journal of Surgery.* **35**(2), pp. 262–271.
Reference Source

MacLeod, J. B. A., *et al.* (2011) **Evaluation of Trauma and Critical Care Training Courses on the Knowledge and Confidence of Participants in Kenya and Zambia.** *World Journal of Surgery.* **35**(1), pp. 9–16.
Reference Source

Mock, C., Joshipura, M. and Goosen, J. (**2004**) **Global strengthening of care for the injured.** *Bulletin of the World Health Organization.* 2004(**82** (4)), p.1.

Nolan, J. P. (2005) **Advanced trauma life support in the United Kingdom: time to move on.** *Emergency Medicine Journal.* **22**(1), pp. 3–4.
Reference Source

Petroze, R. T., *et al.* (2015) **Can Focused Trauma Education Initiatives Reduce Mortality or Improve Resource Utilization in a Low-Resource Setting?** *World Journal of Surgery.* **39**(4), pp. 926–933.
Reference Source

Quansah, R., Abantanga, F. and Donkor, P. (2008) **Trauma training for nonorthopaedic doctors in low- and middle-income countries.** *Clin Orthop Relat Res.* **466**(10), pp. 2403–2412.
Reference Source

Qureshi, J. S., *et al.* (2013) **Addressing Malawi's surgical workforce crisis: A sustainable paradigm for training and collaboration in Africa.** *Surgery.* **153**(2), pp. 272–281.
Reference Source

Samuel, J. C., *et al.* (2010) **Hospital-based injury data in Malawi: strategies for data collection and feasibility of trauma scoring tools.** *Tropical Doctor.* **40**(2), pp. 98–99.
Reference Source

Schultz, C. R., *et al.* (2007) **Development of a Hospital-Based Trauma Registry in Haiti: An Approach for Improving Injury Surveillance in Developing and Resource-Poor Settings.** *The Journal of Trauma: Injury, Infection, and Critical Care.* **63**(5), pp. 1143–1154.
Reference Source

Wesson, H. K. H., *et al.* (2014) **The cost of injury and trauma care in low- and middle-income countries: a review of economic evidence.** *Health Policy and Planning.* **29**(6), pp. 795–808.
Reference Source

World Health Organization (2008) *WHO country cooperation strategy at a glance: Malawi, Institutional Repository for Information Sharing.* Available at:
Reference Source (Accessed: 10 September 2018).

World Health Organization (2018) *WHO International.* Available at:
Reference Source (Accessed: 10 September 2018).

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Version 2

Reviewer Report 08 May 2019

https://doi.org/10.21956/mep.20232.r31350

Trevor Gibbs
AMEE

This review has been migrated. The reviewer awarded 4 stars out of 5

Delivering high quality and up-to-date informative courses within difficult circumstances is very difficult and a sensitive issue. I feel that the authors should be congratulated on their efforts here. They have tried to adapt their input to the local needs and also used local resources to keep down costs. I particularly feel that the longer term evaluation shows the true value of the course, even though it was a relatively short course. I would recommend this paper to all concerned with the delivery of such courses in resource constrained countries.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 15 March 2019

https://doi.org/10.21956/mep.20232.r31348

Richard Hays
James Cook University

This review has been migrated. The reviewer awarded 4 stars out of 5

This paper reports a nice example of adapting a successful international course to a local situation, using local resources wherever possible to make the course possible. The outcome is good and I particularly

like the evaluation after 6 months, which is more meaningful than the more commonly used end-of-course evaluation. Are further evaluation strategies planned, including looking at patient outcomes?

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 08 March 2019

https://doi.org/10.21956/mep.20232.r31349

Ken Masters
Sultan Qaboos University

This review has been migrated. The reviewer awarded 4 stars out of 5

This is a well written version of the paper, and the author have addressed the previous reviewers' concerns. The problems of delivering good medical care under these circumstances is well described, and the need for such a course is clearly explained.The standard Pre- and Post-test indicated the short-term impact of the course; I liked the fact that this was followed up with another test 6 months later (the fact that not all candidates could take the later test is unfortunate, but to be expected, especially given the circumstances). Combining a test with the confidence evaluation is particularly useful, as only one or the other would not complete the picture.Figure 1 is probably not entirely necessary, but it does serve to emphasis the massive cost savings for those readers who are unfamiliar with the financial situation of the area.I look forward to seeing papers dealing with further iterations of this course. If the authors do follow up with further courses and papers, it might be useful if they were to supply, as an appendix, a course outline/curriculum.

Competing Interests: No conflicts of interest were disclosed.

Version 1

Reviewer Report 04 October 2018

https://doi.org/10.21956/mep.19117.r27582

P Ravi Shankar
American International Medical University

This review has been migrated. The reviewer awarded 4 stars out of 5

Thanks for the invitation to review this interesting article. The authors must be commended for their efforts to deliver low-cost trauma training in a resource-constrained setting. I have previously read about clinical officers. The authors can briefly describe the role of these individuals in Malawi's healthcare system. The authors did not include any clinical officers in their program. What modifications to the ATLS program did the authors carry out which contributed to the substantial reduction in the cost? As the authors correctly point out the sample size was low and the number of nurses was only two. I notice that the study was conducted in 2012. Were there any reasons for this long delay in publishing their findings? I would be interested in knowing if the authors have conducted similar workshops during the period from 2012 to 2018? I and my colleagues had conducted low-cost workshops in Nepal. We were successful in conducting these at a fraction of the cost of official workshops. Language corrections could be carried out in a few places. Educators from developing regions will find this manuscript of special interest.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 21 September 2018

https://doi.org/10.21956/mep.19117.r27583

Bengang Qin
The First Affiliated Hospital of Sun Yat-sen University

This review has been migrated. The reviewer awarded 3 stars out of 5

Thank you for inviting me to evaluate the article titled "Short- and long-term results of low-cost trauma training in a low-income resource-poor country". This is a very interesting and significant paper. Up to now, the population of developing country account for 84 percent of the world population. So, the topic is appropriate to medical education of developing country.1. The abstract is brief and concise description of the information in the manuscript.2. The aim of the paper is clear and practical. the introduction supplies enough background to the paper.3. The methods adequately described to the point. However, it would be better if the paper gives the details and mark the cite of the pre- (PRE) and post-course (POE).4. The result are displayed logically and understandably, however, the author doesn't mention the statistical method.5. In the first paragraph of the discussion, the sentence "the two nurses in this study were in the group who gained the most knowledge, showing that staff healthcare providers with less previous

trauma experience are more likely to gain the most knowledge.” is arbitrary as the samples are not enough. 6. The conclusion is tedious and need to be brief and concise. It recommends placing the paragraph in the conclusion part “The next step is to.....” to the discussion part. 7. The following references may be beneficial for the manuscript: (1) Husum H1, Gilbert M, Wisborg T. Training pre-hospital trauma care in low-income countries: the 'Village University' experience. Med Teach. 2003 Mar;25(2):142-8.https://doi.org/10.1080/0142159031000092526(2) Anderson GA, Kayima P, Ilcisin L, Benitez NP, Albutt KH, Briggs SM, Nehra D. Development of a Comprehensive Trauma Training Curriculum for the Resource-Limited Environment. J Surg Educ. 2018, 75(5):1317-1324.https://doi.org/10.1016/j.jsurg.2018.02.014

Competing Interests: No conflicts of interest were disclosed.