WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care

Worksheet author(s)

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Clinical question.

EIT-028A - In low income countries (P) what resuscitation training interventions (I) are practical, feasible and effective (O)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention
State if this is a proposed new topic or revision of existing worksheet: New topic

Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No COI.

Search strategy (including electronic databases searched).

PubMed (Medline): resuscitation AND training AND developing countries: 65 articles: 19 relevant
resuscitation AND training AND low income countries: 8 articles: 3 repeats, 5 irrelevant
resuscitation AND training AND low AND income AND settings: 4: 2 repeats, 1 relevant

EMBASE: 33 articles found

Review of references of articles of relevance
Forward searching

- **State inclusion and exclusion criteria**

The country classification was adopted from that defined by the World Bank. "For operational and analytical purposes, the World Bank's main criterion for classifying economies is gross national income (GNI) per capita. Income group: Economies are divided according to 2008 GNI per capita, calculated using the World Bank Atlas method. The groups are: low income, $975 or less; lower middle income, $976 - $3,855; upper middle income, $3,856 - $11,905; and high income, $11,906 or more."
http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20421402~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html [Accessed 7 July 2009]

Low-income economies (43)

Afghanistan	Guinea-Bissau	Rwanda
Bangladesh	Haiti	Senegal
Benin	Kenya	Sierra Leone
Burkina Faso	Korea, Dem Rep.	Somalia
Burundi	Kyrgyz Republic	Tajikistan
Cambodia	Lao PDR	Tanzania
Central African Republic	Liberia	Togo
Chad	Madagascar	Uganda
Comoros	Malawi	Uzbekistan
Congo, Dem. Rep	Mali	Vietnam
Eritrea	Mauritania	Yemen, Rep.
Ethiopia	Mozambique	Zambia
Gambia, The	Myanmar	Zimbabwe
Ghana	Nepal	
Guinea	Niger	

Furthermore, the term “developing country” was also included for the purview of this worksheet. The qualitative, descriptive outcomes are defined as follows (Microsoft® Encarta® 2006) for the purposes of this worksheet:

“Practical”: concerned with matters of fact, real life and experience, not theory; useful: appropriate, sensible, and likely to be effective; good at solving problems: good at managing matters and dealing with problems and difficulties; suitable for everyday use: plain, functional; practising: involved in the actual work of a profession or activity.

“Feasible”: possible, plausible.

“Effective”: producing a result, especially desired or intended result; producing favourable impression: successful; actual or in practice, even if not officially or theoretically so; officially in force, operative, or applicable; ready for action, fully equipped.

Inclusion criteria: All articles relating to any resuscitation training intervention in low-income, low-resource or developing settings were considered. Papers reporting on training initiatives in newborn resuscitation and trauma were also included to reflect generic implementation of broad resuscitation training in the resource restricted context.

Exclusion criteria: Articles were limited to those dealing with resuscitation training interventions. Studies relating to labour, maternal mortality and delivery of the newborn were excluded if no aspects specifically relating to resuscitation training were involved. Single case reports, practice guideline articles and interviews were not included.

- **Number of articles/sources meeting criteria for further review:**

  After removal of duplicates, the abstracts of the remaining papers were reviewed. 36 articles met criteria for review. Of these one study was LOE 1, two were LOE 2, one LOE 3, fourteen LOE 4 and eighteen LOE 5.

Summary of evidence

Evidence Supporting Clinical Question

Good		**Moretti 2007, 458 C** **Capone 2000, 259 E10**		**Zafar 2009, 449 B, E3** **Young 2008, 271 E5** **Deorari 2001, 29 E6** **Deorari 2000, 315 E6**	**Mock 2006, 946 E9** **Urbano 2010, (in press) E5**
Fair	**Opiyo 2008, e1599 E6**		**Husum 2003, 1188 B**	**Ergenekon 2000, 225 E1** **Desalu 2006, 517 E19** **Jabir 2009, 1265, E1** **Lee 2010, 89 E17** **Kimura 2008, 511 E18** **Carlo 2009, 504 E1**	**Kingham 2009, 122 E2** **Mock 2002, 90 E20** **Tiska 2004, 237 E11** **Bergman 2008, 879 E4** **Aboutanos 2007, 714 E7** **Ali 1994, 695 E8** **Husum 2003, 142 E12**

				Trevisanuto 2007, 28 E1 **Heitmann 2008, 505 E15**	
Poor				**Olotu 2009, 69 E2** **Kumar 1994, 159 E6**	**Johanson 2002, 217 E23** **Son 2007, 1014 E9** **Quansah 2008, 2403 E16** **Kobusingyel 2005, 626 E21** **Razzak 2008, 8 E13** **Tchorz 2007, 373 E8** **Blackwell-Smyth 2004, 1184 E** **Wall 2009, S47 E14** **Suraseranivongsea 2006, 188 E22**
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = *Animal studies*

E1 = Impact of Neonatal Resuscitation Program on learning.
E2 = Situational analysis and quantification of resources.
E3 = Structured training program via logbooks documenting resuscitation – analysis of impact of training
E4 = Trauma training intervention with pre and post course knowledge, and post course simulation, assessment
E5 = Advanced Paediatric Life Support Course implementation
E6 = Neonatal resuscitation training impacting on resuscitation practice
E7 = Basic trauma course with pre and post training MCQ questionnaire and OSCE
E8 = 2-day trauma course with pre and post training intervention theory assessment
E9 = Guidelines for essential trauma care – resource needs assessment
E10 = Competency assessment following first aid and CPR training using television demonstration
E11 = Attitudinal impact assessment
E12 = Introduction of a rural rescue system run by local paramedics substantially reduces trauma mortality
E13 = Survey assessments of emergency care training and infrastructure
E14 = systematic review
E15 = descriptive study of implementation of AHA ACLS training in developing country
E16 = description of a 1-week relevant trauma CME course implementation in developing country
E17 = Comparison of a scenario-based, performance-oriented team instruction (SPOTI) and traditional ACLS course to achieve educational outcomes measured via traditional ACLS megacode examinations.
E18 = Impact assessment of small group Immediate Cardiac Life Support (Japanese course) training intervention in Vietnamese health workers
E19 = Prospective study evaluating adherence to CPR guidelines by anaesthetists in a developing country (Nigeria)
E20 = Comparison of prehospital trauma care before and after a 6-hour basic first aid course for commercial drivers and self-report efficacy assessment.
E21 = Gaps paper, positing research priorities for emergency medical systems in low- and middle- income countries.

E22 = One-year prospective audit of outcome and quality of in-hospital CPR in Thailand, according to the Utstein style, with BLS and ALS initial training, and ALERT course.
E23 = Implementation of the MOET course in Bangladesh with pre and post course knowledge questionnaire.

Evidence Neutral to Clinical question

Good					
Fair					
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation C = Survival to hospital discharge E = Other endpoint
B = Survival of event D = Intact neurological survival *Italics = Animal studies*

Evidence Opposing Clinical Question

Good		**Capone 2000, 259 E10**			
Fair					
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation C = Survival to hospital discharge E = Other endpoint
B = Survival of event D = Intact neurological survival *Italics = Animal studies*

REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

SYNOPSIS / ABSTRACTS of KEY STUDIES

There are several studies published in this area, however the quality is poor and the research focus and outcomes are broad and disparate, making comparison difficult. Many studies describe an ad hoc project that has been implemented in a low-income or developing setting, but without any meaningful, long-term evaluation of impact of the training intervention. Of all the reviewed literature, only 4 studies featured within the fist 3 levels of evidence. .

A single fair quality randomised controlled trial (LOE 1, Opiyo 2008:e1599) has shown that a simple one day newborn resuscitation training session, adapted locally from the UK Resuscitation Council, alters health worker resuscitation practices in a public hospital low-income setting in Kenya. The proportion of appropriate initial resuscitation steps represented the primary outcome. Trained providers demonstrated a higher proportion of adequate initial resuscitation steps compared to the control group (trained 66% vs control 27%; risk ratio 2.45, [95% CI 1.75-3.42], p<0.001, adjusted for clustering). In addition, there was a statistically significant reduction in the frequency of inappropriate and potentially harmful practices per resuscitation in the trained group (trained 0.53 vs control 0.92; mean difference 0.40, [95% CI 0.13-0.66], p = 0.004). Authors concluded that implementation of a simple, one day newborn resuscitation training can

be followed immediately by significant improvement in health workers' practices. However impact on long term performance or clinical outcomes can only be established by larger cluster randomised trials.

A seminal study (LOE 2, Moretti 2007:458) situated in the developing country of Brazil sought to determine the value of formal ACLS training in improving survival from in-hospital cardiac arrest. This multi-center, prospective cohort study examined patient outcomes after resuscitation efforts by in-hospital rescue teams with and without ACLS-trained personnel over a 38-month period. Primary endpoints included return of spontaneous circulation (ROSC), survival to hospital discharge, 30-day survival, and 1-year survival. Results showed the immediate success of resuscitation efforts for all patients was 39.7% (62/156) and a significant increase in ROSC with ACLS-trained personnel (49/113; 43.4%) versus no ALCS-trained personnel (16/59; 27.1%; p=0.04). Likewise, patients treated by ACLS-trained personnel had increased survival to hospital discharge (26/82; 31.7% versus 7/34; 20.6%; p=0.23), significantly better 30-day survival (22/82; 26.8% versus 2/34; 5.9%; p<0.02), and significantly improved 1-year survival (18/82; 21.9% versus 0/34; 0%; p<0.002). They concluded that the presence of at least one ACLS-trained team member at in-hospital resuscitation efforts increases both short and long-term survival following cardiac arrest.

Another study set in Brazil (LOE 2, Capone 2000:259) suggests that a significant proportion of factory workers can acquire simple life saving first aid skills through television viewing alone, except for the skill acquisition of CPR steps B (mouth-to-mouth ventilation) and C (external chest compressions) which need coached manikin practice. This evidence supports and opposes the clinical question, whether training interventions are feasible, effective and practicable.

A five-year prospective study (LOE 3, Husum 2003:1188) was conducted in North Iraq and Cambodia to test a model for rural prehospital trauma systems in low-income countries resulting in 135 local paramedics and 5 200 lay First Responders being trained to provide in-field trauma care. In the study population of 1,061 trauma victims with mean evacuation time 5.7 hours, the trauma mortality rate was reduced from pre-intervention level at 40% to 14.9% over the study period (95% CI for difference 17.2-33.0%). There was also a reduction in trauma deaths from 23.9% in 1997 to 8.8% in 2001 (95% CI for difference 7.8-22.4%), and a corresponding significant improvement of treatment effect by year. They concluded that low-cost rural trauma systems can have a significant impact on trauma mortality in low-income countries.

The remaining studies reflect LOE 4 & 5. One of these (LOE 4, Zafar 2009:449) demonstrated the use of a structured training programme in emergency care in Pakistan through the completion of logbooks documenting actual resuscitation attempts. A cross-sectional survey of health workers trained in the skills for managing maternal, neonatal and childhood emergencies as part of a system development programme called “Essential Surgical Skills–Emergency Maternal and Child Healthcare (ESS–EMCH), was conducted. Following a series of 6 five-day training courses – part of the ESS–EMCH programme – participants were provided with logbooks to document the actual use of their newly acquired skills during the resuscitation of mothers, infants and children. Researchers concluded that resuscitation logbooks can be used to assess which skills are used in emergency care, evidencing that the skills taught during the ESS–EMCH programme are indeed used by the trained health workers, thus serving as a feedback and audit mechanism to measure outcomes, feasibility and impact of the training component of this programme.

The Advanced Paediatric Life Support course was implemented in Vietnam and provides a practical and sustainable method of improving the knowledge and skills of medical and nursing staff in this area (LOE 4, Young 2008:271). Key Vietnamese personnel travelled to Australia to complete the course, undertake instructor training and gain organizational experience. Teaching materials were translated, reviewed and modified to account for local diseases and clinical practices. The process was supported by the Australian instructors until the Vietnamese instructors were confident and competent, reducing the international faculty input. The infrastructure now exists for the course to operate in a sustainable fashion within Vietnam – this demonstrates that the original resuscitation training intervention can indeed be successfully modified to provide teaching in paediatric emergency care in a developing country.

Several studies evaluated the impact of neonatal resuscitation programme (NRP) on the incidence, management and outcome of birth asphyxia. It appears that neonatal resuscitation training interventions are more common-place and are practicable, feasible and effective in many low-income and developing settings, since birth asphyxia is an important cause of preventable neonatal morbidity and mortality in developing countries. These babies can be helped, if healthcare professionals present at the time of birth are skilled in the art of neonatal resuscitation. Illustrating this, since the introduction of the Neonatal Resuscitation Programme (NRP) by the American Academy of Pediatrics and American Heart Association, organized training programmes for instructors and providers have been launched in India, under the aegis of the National Neonatology Forum (NNF) since 1990 (LOE 4, Deorari 2000:315). The initial goal was to train the trainers and provide them with the necessary equipment. The NNF created a national faculty of 150 pediatricians and nurses for NRP by conducting certification courses in various regions of the country. The certified faculty members in turn trained 12,000 healthcare professionals in various parts of India over the following 2 years. Simultaneously, in

several teaching institutions, NRP was introduced into the curricula of medical and nursing students. This programme provides a uniform, systematic and action-oriented approach to the resuscitation of the newborn. Prospective evaluation of the resuscitation programme in teaching hospitals has revealed the use of rational resuscitation practices and a significant decline in asphyxia-related deaths (LOE 4, Deorari 2001:29). Clearly this demonstrates the successful and sustainable implementation of a resuscitation training intervention in a developing milieu.

However, despite the importance and relative simplicity of neonatal resuscitation, educational programs are still not widely developed in developing countries, mostly due to limited resources and a shortage of medical staff trained for neonatal resuscitation. Turkey – one of the developing countries between Asia and Europe – has a neonatal mortality rate of 12.5/1000 and no official neonatal resuscitation education programs. A neonatal resuscitation course lasting 8 hours and completely based on the Neonatal Resuscitation book published by American Academy of Paediatrics and American Heart Association has been reported on (LOE 4, Ergenekon 2000:225). The participants in the study had not been given the Neonatal Resuscitation book nor asked to read it before the course because of limited resources, challenging the notion of requisite pre-learning for optimal instruction. Participants generally stated that they felt more comfortable with neonatal resuscitation following the course and all agreed that the course should be repeated at regular intervals to facilitate regular practise.

In another study (LOE 4, Desalu 2006:517), anaesthetists were found not to be applying proper resuscitation guidelines, the lack of organised simulation practice and continuing training in basic and advanced resuscitation resulted in deficient knowledge and skills. These are well known precepts that are generalisable to low-income settings.

The impact of training interventions on practical performances – data not usually quantified in low-income settings – was formally evaluated in clinical simulations gained by Iraqi residents following participation in the AHA NRP course (LOE 4, Jabir 2009:1265). Residents coming from a developing country (Iraq) significantly improved their knowledge attainment following participation in the NRP course; however, their performance on clinical simulations was unsatisfactory, suggesting more ongoing training and practise in that area.

A scenario-based performance-oriented team instruction (SPOTI) method to implement core ACLS skills for non-English-speaking international paramedic students (Korean) was evaluated (LOE 4, Lee 2010:89). Compared with the traditional ACLS course, where an average of 85% of the core skills were met, in the SPOTI study group an average of 93% of the core skills were met. These differences and others did not achieve statistical significance due to the small sample size, but may demonstrate that alternative approaches to traditional first-world developed countries are practical, feasible and effective to achieve competency outcomes.

Another aspect hampering effective training initiatives in developing countries is the absence very often of an official resuscitation council responsible for setting guidelines and establishing training system. An Immediate Cardiac Life Support (ICLS) course (LOE 4, Kimura 2008:511), based on the Japanese Guidelines 2005, was conducted for Vietnamese health care workers, using translators, posters translated into Vietnamese, speaking slowly to facilitate sequential translation, and modifications to the sequence of basic life support performed in Vietnam because automated external defibrillators are uncommon. The participants' responses demonstrated improvement in the following: confidence in cardiopulmonary resuscitation, recognition of the usefulness of the training in Vietnam, awareness of the importance of team dynamics, interest in being an instructor, and interest in simulation learning.

The Dominican Republic is a developing country with limited medical resources, but with a large incidence of cardiovascular disease and where advanced cardiac life support is not widely available. This study (LOE 4, Heitmann 2008:505) describes the development of Global Emergency Medicine Initiative (GEMINI), a project designed to provide instructional modules on advanced cardiac life support customized to the needs of the participants resident in developing countries. Nine one-week visits, conducting 2, 2-day courses at different locations, using 6-10 instructors to teach 28-45 students in each session; teaching and written and practical testing was in Spanish (sometimes through a medically trained interpreter). In addition, the researchers provided instructional equipment, including mannequins, airway equipment and defibrillators, the trips being sponsored by Rotary International. This once again illustrates the initial thrust is required from an external party who must drive the momentum of the training intervention, before it sustains itself, and is applicable to local needs, language and context.

The outcome of children after cardiac or respiratory arrest is better than that of adults, but in resource poor countries that outcome is very poor.

Deficiency in arrest management is one of the factors which could influence the outcome of resuscitation. In addition to knowledge on paediatric resuscitation, survival from resuscitation depends on several other factors including underlying disease, the time elapsing between arrest and the initiation of resuscitation, and the duration of cardiopulmonary

resuscitation. Increased numbers of clinicians and nurses are receiving training in Paediatric Advanced Life Support in low-income settings (LOE 4, Olotu 2009:69). Coupled with the training was the availability of more Bag Valve Masks, intubation sets and the regular supply of resuscitation equipment and drugs.

Another prospective study (LOE 4, Carlo 2009:504) evaluated the effectiveness of the American Academy of Pediatrics Neonatal Resuscitation Program (NRP) in improving knowledge, skills, and self-efficacy of nurse midwives in low-risk delivery clinics in the developing country of Zambia. Performance and self-efficacy evaluations focusing on principles of resuscitation, initial steps, ventilation, and chest compressions, were conducted before and after NRP training and 6-months later. After training, written scores (knowledge evaluation) improved from 57%+/-14% to 80%+/-12% (mean+/-SD; P< .0001); performance scores (skills evaluation) improved the most from 43%+/-21% to 88%+/-9% (P< .0001); self-efficacy scores improved from 74%+/-14% to 90%+/-10% (P< .0001). Written and performance scores decreased significantly 6 months after training, but self-efficacy scores remained high. NRP training improved educational outcomes in college-educated practicing nurse midwives and appears to have the potential to substantially improve knowledge and skills of neonatal resuscitation, evidencing support that resuscitation training interventions are effective and feasible. Although, while written, proficiency & self-efficacy scores all improved immediately post-training, these decreased significantly at 6 months, questioning the retention of knowledge and skills in the longer-term, and thus questioning impact and longer-term value and contribution.

The efficacy of a Neonatal Resuscitation Program (NRP) has been previously evaluated in developed countries, but there little evidence is available on the impact of this teaching program in developing countries. Researchers compared the knowledge gained by University of Khartoum (Sudan) and University of Padova (Italy) pediatric residents following participation in the NRP course (LOE 4, Trevisanuto 2007:28), via an pre- and post course 80-item questionnaire derived from the standard test contained in the American Heart Association and American Academy of Pediatrics Neonatal Resuscitation Manual. The percentages of correct answers significantly improved from before to immediately after the course for both Sudanese (51.9 +/- 10.5% vs 84.9 +/- 5.8%; P < 0.01) and Italian (64.3 +/- 8.1% vs 94.0 +/- 3.9%; P < 0.01) pediatric residents. During the entire study, the scores obtained by Italian pediatric residents were higher than those reached by their Sudanese colleagues (P < 0.01). The trend of the knowledge attainment of both Sudanese and Italian pediatric residents was similar after NRP course participation, leading to the conclusion that an NRP is effective in teaching neonatal resuscitation in developing countries.

Another study (LOE 5, Mock 2006:946) sought to identify affordable and sustainable methods to strengthen trauma care capabilities globally, especially in developing countries, using the Guidelines for Essential Trauma Care. These guidelines were created by the World Health Organization (WHO) and the International Society of Surgery and provide recommendations on elements of trauma care that should be in place at the range of health facilities globally. The guidelines were used as a basis for needs assessments in 4 countries selected to represent the world's range of geographic and economic conditions: Mexico (middle income; Latin America); Vietnam (low income; east Asia); India (low income; south Asia); and Ghana (low income; Africa). Findings identified gaps that could be improved, especially in low-income settings, such as shortages of airway equipment, chest tubes, and trauma-related medications; and prolonged periods where critical equipment (e.g., X-ray, laboratory) were unavailable while awaiting repairs. Rural clinics everywhere had difficulties with basic supplies for resuscitation even though some received significant trauma volumes. In all settings, there was a dearth of administrative functions to assure quality trauma care, including trauma registries, trauma-related quality improvement programs, and regular in-service training. The study identified several low-cost ways in which to strengthen trauma care globally and demonstrated the usefulness of the Guidelines for Essential Trauma Care in providing an internationally applicable, standardized template by which to assess trauma care capabilities.

Few low income countries have emergency medical services to provide prehospital medical care and transport to road traffic crash casualties. Evidence from one study (LOE 5, Tiska 2004:237) strongly supports the clinical question posed in this worksheet. In Ghana most roadway casualties receive care and transport to the hospital from taxi, bus, or truck drivers. This study describes a model for prehospital trauma training for commercial drivers in Ghana – over 300 commercial drivers attended a first aid and rescue course designed specifically for roadway trauma and geared to a low education level. The training programme has been evaluated twice at one and two year intervals by interviewing both trained and untrained drivers with regard to their experiences with injured persons. In low income countries, prehospital trauma care for roadway casualties can be improved by training laypersons already involved in prehospital transport and care. Training should be locally devised, evidence based, educationally appropriate, and focus on practical demonstrations. These recommendations reflect and reinforce common trends seen throughout this worksheet review.

It is possible that the exportation of North American and European models has hindered the creation of a structured cardiopulmonary resuscitation (CPR) training programme in developing countries. In this particular paper (LOE 5,

Urbano 2010, in press), authors described the design and results of a European paediatric and neonatal CPR training programme adapted to Honduras. A paediatric CPR training project was set up in Honduras with the instructional and scientific support of the Spanish Group for Paediatric and Neonatal CPR, and was divided into four phases: CPR training and preparation of instructors; training for instructors; supervised teaching; and independent teaching. During the first phase, 24 Honduran doctors from paediatric intensive care, paediatric emergency and anaesthesiology departments attended the paediatric CPR course and 16 of them the course for preparation as instructors. The Honduran Paediatric and Neonatal CPR Group was formed. In the second phase, workshops were given by Honduran instructors and four of them attended a CPR course in Spain as trainee instructors. In the third phase, a CPR course was given in Honduras by the Honduran instructors, supervised by the Spanish team. In the final phase of independent teaching, eight courses were given, providing 177 students with training in CPR. They concluded that the training of independent paediatric CPR groups with the collaboration and scientific assessment of an expert group could be a suitable model on which to base paediatric CPR training in Latin American developing countries.

Lack of access to surgical care is a public health crisis in developing countries. In a study in Sierra Leone (LOE 5 Kingham 2009:122), the World Health Organization's Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was used to assess surgical capacity, and findings included a paucity of electricity, running water, oxygen, and fuel at the government hospitals in Sierra Leone. There were only 10 Sierra Leonean surgeons practicing in the surveyed government hospitals. The situational analysis tool is a valuable mechanism to quantify a nation's surgical capacity. It provides the background data that have been lacking in the discussion of surgery as a public health problem and will assist in gauging the effectiveness of interventions to improve surgical infrastructure and care. Training interventions must be informed by evaluation of the current system, and its capacity to deliver.

A large proportion of trauma patients in developing countries do not have access to formal Emergency Medical Services. Another paper (LOE 5, Mock 2002:90) assessed the efficacy of a program that builds on the existing, although informal, system of prehospital transport in Ghana where the majority of injured persons are transported to the hospital by some type of commercial vehicle, such as a taxi or bus. A total of 335 commercial drivers were trained using a 6-hour basic first aid course. The efficacy of this course was assessed by comparing the process of prehospital trauma care provided before versus after the course, as determined by self-report from the drivers. Sixty-one percent indicated that they had provided first aid since taking the course. There was considerable improvement in the provision of the components of first aid in comparison to what was reported before the course: crash scene management (7% before vs. 35% after), airway management (2% vs. 35%), external bleeding control (4% vs. 42%), and splinting of injured extremities (1 vs. 16%). It appears that even in the absence of formal Emergency Medical Services, improvements in the process of prehospital trauma care are possible by building on existing, although informal, patterns of prehospital transport in developing countries. This training programme has been evaluated twice at one and two year intervals by interviewing both trained and untrained drivers with regard to their experiences with injured persons. In conjunction with a review of prehospital care literature, lessons learnt from the evaluations were used in the revision of the training model. In low income countries, prehospital trauma care for roadway casualties can be improved by training laypersons already involved in prehospital transport and care. Researchers suggest training should be locally devised, evidence based, educationally appropriate, and focus on practical demonstrations.

In a prospective study (LOE 5, Bergman 2008:879), the trauma team training (TTT) program – a low-cost course designed to teach a multidisciplinary team approach to trauma evaluation and resuscitation – was assessed for impact on trauma knowledge and performance of Tanzanian physicians and nurses. After completion of TTT, there was a significant improvement in trauma resuscitation knowledge, based on results from a validated questionnaire. Trauma team performance was excellent when assessed with a novel trauma simulation assessment tool and participants responded favourably to the course.

The advanced trauma life support course is not available or affordable to rural areas in low-income countries. A basic trauma continuing education course was created to educate physicians of rural hospitals in the jungles of Ecuador, based on local resources and location of injury, including rudimentary health posts in the jungle, rural hospitals, and definitive referral centers (LOE 5, Aboutanos 2007:714). Course effectiveness was evaluated by a comparison of test scores before and after the course. An objective structured clinical examination (OSCE), based on the course design, was also administered. Where there is no advanced trauma life support, a tailored trauma course and evaluation can be effective in educating local providers, while a well-designed competency evaluation (multiple choice questionnaire and OSCE) is helpful in identifying deficient local aspects of trauma care. The authors posit that the course design and evaluation methods may serve as a model for continuing trauma care education in developing countries.

Improvement in trauma patient outcome has been reported after Advanced Training Life Support training (ATLS) in the developing country of Trinidad and Tobago (T & T) (LOE 5, Ali 1994:695). The cognitive impact of ATLS training was assessed from pre-ATLS and post-ATLS performance of T & T physicians in multiple choice question tests and

comparison with post-ATLS test performance among Nebraska physicians. Overall, improvement between the pre-test and post-test among the T & T physicians was 22.0% +/- 2.0%. The demonstrated positive cognitive and attitudinal effects very likely contributed to the improved post-ATLS trauma patient outcome.

A prospective study (LOE 5, Husum 2003:142), the results of which can be applied and generalised to other settings, investigated training pre-hospital trauma care in low-income countries – the so-called 'Village University' experience. Health workers in Cambodia and Northern Iraq were trained and equipped to deliver low-cost life support to trauma victims. They in turn trained a network of 2800 layman village first responders. Training was done in makeshift camps at village level ('Village Universities'). A total of 813 patients were managed by the rural rescue system from 1997 to 1999. The mortality rate for trauma victims decreased from 22.6% in 1997 to 13.7% in 1999 (95% CI for difference 1.8% to 16.0%). Management by village first responders had a significant impact on in-field response times and trauma mortality. The rescue system replicated itself during the study period as an indicator of sustainability. The study showed that after trauma care training at rural makeshift training centers, non-graduate health workers can build efficient and sustainable rural rescue systems. Outcome indicators included health effects: in-field response time and trauma mortality; sustainability: capacity of local health workers to adjust and replicate the training concept according to local needs and conditions; cost-effectiveness of structural changes in the local trauma care-providing system.

Prior to the intervention, researchers found a mortality rate of 40% or higher in both study areas, based on reviews of patient files at district health centers and interviews with villagers and mine accident survivors (LOE 5, Husum 2003:142). The training consisted of three 150-hours intensive courses with working periods in between. The teaching concept of the Village University rests upon four principles: confidence: folk learn better when feeling confident and at home, troubleshooting: formal treatment protocols do not work in a chaotic and dangerous field setting with multiply injured patients. A circular approach was adopted: identify the main problem by a ‘first survey’ clinical examination; solve the main problem; examine again; identify the next main problem; take action; and so on. Learning by doing was the next principle: lectures constitute not more than 25% of the course, and practice should always follow classroom sessions. Local control was the final requisite: after three years, the students should have the capacity to perform as local instructors and set up,
adapt, run and monitor local training programs themselves. At this point professional foreign input should be superfluous, and the project is handed over to local authorities. This system neatly crystallises all the elements identified in many studies in this review for a successful implementation of a training intervention.

Moreover, a teaching manual was developed which has now been translated into Khmer, Kurdish, Farsi and Burmese, which emphasises real-life case stories from the target areas and illustrations of non-white people in a rural setting (LOE 5, Husum 2003:142). Large-size posters showing step-by-step essential BLS procedures were made locally. Locally available animals (goats, sheep, pigs, or dogs) were used for training advanced life support techniques by showing a variety of injuries that were inflicted by firearms in the anaesthetized animal before it was placed in the field. Students with their backpack medical kits trained in teams to assess, resuscitate and evacuate the ‘the patient’ under continuous monitoring. The students were equipped with compact cameras in order to photo-document injuries and treatment. A CD with photodocumentation and a 20-minute video on ATLS training at the ‘Village University’ has been produced as an educational tool.
The study (LOE 5, Husum 2003:142) shows that a low-input grassroots-training program yielded a significant reduction in mortality after severe trauma in two low-income countries. Researchers furthermore report a significant reduction in mortality by year, and regard that to be an effect of maturation of the system, underlining the importance of reallife experience and regular rehearsals—a learning-by-doing effect.

Maternal mortality is another area of research focus. The availability of skilled attendants to prevent, detect and manage major obstetric complications may be the single most important factor in preventing maternal deaths. A modern, multidisciplinary, scenario and model based training programme has been established in the UK (Managing Obstetric Emergencies and Trauma (MOET)) and allows specialist obstetricians to learn or revise the undertaking of procedures using models, and to have their skills tested in scenarios (LOE 5, Johanson 2002:217). Given the success of the MOET course in the UK, the organisers were keen to evaluate it in another setting (Armenia). This paper (LOE 5, Johanson 2002:217) demonstrates the reliability of the model based scenarios, with a highly significant improvement in obstetric emergency management. However, clinical audit will be required to measure the full impact of training by longer term follow up. Audit of delays, specific obstetric complications, referrals and near misses may all be amenable to review.

Injuries are increasingly a leading cause of death and disability in developing countries. A systematic approach to reducing the burden of injury is not yet apparent in the developing world, and yet there are great gains to be made in these populous areas where the rate of injury related death is highest. The authors in one study (LOE 5, Quansah 2008:2403) cite prohibitive startup costs for the Advanced Trauma Life Support Course (ATLS) course

precluding this option in a low-income country like Ghana. Alternate educational approaches relevant to the realities of low-income countries need to be developed to address the resource constrained environment, lack of technology and limited capabilities for referral. A locally relevant trauma CME course developed by a local university specifically addresses the critical issues of trauma care in Ghana and has improved clinical knowledge as well as the self-reported process of trauma care (LOE 5, Quansah 2008:2403). Doctors and nurses alike have participated, and a course specifically for nurses is in development. Authors recommend that stakeholders (governments, international community, others) support programs which provide continuing medical education in trauma care, such as ATLS (or variations) and/or locally developed courses such as that developed at Kwame Nkrumah University of Science and Technology.

Another study (LOE 5, Suraseranivongsea 2006:188) audited and evaluated the outcome and quality of in-hospital CPR, and factors affecting the outcome, in a 2300-bed university hospital in Thailand, via a 1-year prospective audit according to the Utstein style. In the study setting, survival to discharge was 6.9%, initial survival rate being strongly associated with being in a monitored area. Defibrillators and the critical care areas were insufficient. ALS training was mandatory for first-year residents and nurses in critical care areas. Nurses in the wards were trained in BLS only. There was no mandatory requirement for BLS and ALS recertification at that time. This study showed that ROSC in critical care areas was higher than in non-monitored areas such as the wards. Experience with a MET has shown a reduction of the incidence and mortality of in-hospital cardiac arrest. In addition, ALERT™—a multiprofessional training course in the care of the acutely ill adult patient for trainee doctors and junior ward nurses provided improved knowledge of acute care in trained doctors in this study (LOE 5, Suraseranivongsea 2006:188).

Acknowledgements:

My wife Dawn for her help and loving support.

Citation List

Aboutanos MB, Rodas EB, Aboutanos SZ, Mora FE, Wolfe LG, Duane TM, Malhotra AK, Ivatury RR. (2007). "Trauma education and care in the jungle of Ecuador, where there is no advanced trauma life support." J Trauma 62(3): 714-9.

Comment**:**
LOE 5 Quality Fair Evidence supports clinical question
Trauma training intervention, thus regarded as indirectly related to population and PICO question
A locally tailored basic trauma continuing education course to educate physicians in rural hospitals in the jungles of Ecuador)developing country), showed with pre- and post-training MCQ questionnaire test scores and OSCE, this course design and evaluation produces improved post-training intervention results. Twelve of the 26 participants were repeat test takers from a course provided 2 years earlier. These participants showed improved pretest scores compared with their highest previous test score (76.8% versus 68.5%; p = 0.0496). Compared with first-time test takers, these participants showed improved pretest (76.8% versus 68.4%) as well as post-test (81% versus 76%) scores. This suggests positive evidence of long-term impact.

Ali J, Adam R, Stedman M, Howard M, Williams J. (1994). "Cognitive and attitudinal impact of the Advanced Trauma Life Support program in a developing country." J Trauma. 36(5):695-702.

Comment:
LOE 5 Quality Fair Evidence supports clinical question
Trauma training intervention, thus regarded as indirectly related to population and PICO question
The cognitive impact of Advanced Training Life Support training (ATLS) in Trinidad and Tobago (T & T),(developing country), was evaluated via pre-ATLS and post-ATLS performance of T & T physicians in multiple choice question tests and comparison with post-ATLS test performance among Nebraska physicians. Improvement between the pre-test and post-test among the T & T physicians was 22.0% +/- 2.0%. All physicians including failures improved post-test scores, overall performance being similar for both physician groups. Attitudinal impact showed a heightened awareness of ATLS

training, and all respondents differentiated ATLS-trained physicians based on better resuscitation, more timely and appropriate consultation, greater confidence in trauma management, and improvement in trauma mortality and morbidity; all respondents recommended ATLS training for all emergency room physicians. Study demonstrated positive cognitive and attitudinal effects due to the training intervention.

Bergman S, Deckelbaum D, Lett R, Haas B, Demyttenaere S, Munthali V, Mbembati N, Museru L, Razek T. (2008). "Assessing the impact of the trauma team training program in Tanzania." J Trauma 65(4): 879-83.

Comment:
LOE 5 Quality Fair prospective study Evidence supports clinical question
Trauma training intervention, thus regarded as indirectly related to population and PICO question
A trauma team training (TTT) program – low-cost course designed to teach a multidisciplinary team approach to trauma evaluation and resuscitation – was assessed for impact on trauma knowledge and performance in Tanzanian physicians and nurses; and to demonstrate the validity of a questionnaire assessing trauma knowledge. Pre-course and post-course test, a multiple injuries simulation, and a satisfaction questionnaire was administered. Test data showed that subjects improved scores from 9 (5-12) to 13 (9-13), p = 0.0004. Team performance scores for the simulation were all >80%. Seventy-five percent of subjects were very satisfied with TTT and 90% would strongly recommend it to others and would agree to teach future courses.

Blackwell-Smyth P, Breen M, Hinshaw K.(2004) "Learning from low income countries: what are the lessons?: Hands on course may help deliver obstetric care." BMJ. 329(7475):1184.

Carlo WA, Wright LL, Chomba E, McClure EM, Carlo ME, Bann CM, Collins M, Harris H. (2009) "Educational impact of the neonatal resuscitation program in low-risk delivery centers in a developing country." J Pediatr 154(4): 504-508.e5.

Comment:
LOE 4 Quality Fair prospective study Evidence supports clinical question, but only immediately post training.
American Academy of Pediatrics Neonatal Resuscitation Program (NRP) improved educational outcomes in college-educated practicing nurse midwives in Zambian clinics. A before and after NRP training and then 6 months later series, with no control. Written, proficiency & self-efficacy scores all improved immediately post-training but decreased significantly at 6 months, questioning the retention of knowledge and skills in the longer-term, and thus questioning impact and value if little impact / application evident within short interval.

Capone PL, Lane JC, Kerr CS, Safar P. (2000). "Life supporting first aid (LSFA) teaching to Brazilians by television spots." Resuscitation 47: 259–265.

Comment:
LOE 2 Quality Good Concurrent controls without true randomisation
Evidence both supports and opposes clinical question.
Compares two groups of factory employees — 86 controls without TV exposure to LSFA and 116 exposed to brief LSFA skill demonstrations on TV. Simulated skill performance on the evaluating nurse or manikin was tested at 1 week, 1 month, and 13 months. In the control group, 1–31% performed individual skills correctly; as compared to 9–96% of the television group (PB0.001). Excellent retention over 13 months.
> 50% of TV group performed correctly 5 of 8 skills, including positioning and hemorrhage control. Television viewing increased correct airway control performance from 5 to 25% of trainees, while it remained at 3% in the control group. CPR–ABC performance, however, was very poor in both groups. Concluded that significant proportion of factory workers can acquire simple LSFA skills through television viewing alone, except for the skill acquisition of CPR steps B (mouth-to-mouth ventilation) and C (external chest compressions) which need coached manikin practice.

Deorari AK, Paul VK, Singh M, Vidyasagar D; Medical Colleges Network. (2001). "Impact of education and training on neonatal resuscitation practices in 14 teaching hospitals in India." Ann Trop Paediatr 21(1): 29-33.

Comment:
LOE 4 Quality Good No controls, pre & post intervention observation studies, impact of training intervention (NRP) in India evaluated. Evidence strongly supports clinical question.
Impact study – NRP on the incidence, management and outcome of birth asphyxia was evaluated in 14 teaching hospitals in India. System where faculty members were trained and then returned to their local hospital environment and continued the training ripple-effect. Each institution provided 3 months pre-intervention and 12 months post-intervention data. Significant shift towards more rational resuscitation practices was indicated by a decline in the use of chest compression and medication ($p < 0.001$ for each), and an increase in the use of bag and mask ventilation ($p < 0.001$). Overall neonatal mortality did not decrease, but asphyxia-related deaths declined significantly ($p < 0.01$).

Deorari AK, Paul VK, Singh M, Vidyasagar D. (2000). "The National Movement of Neonatal Resuscitation in India." J Trop Pediatr 46(5): 315-7.

Comment:
LOE 4 Quality Good Descriptive, observational audit. No controls. Impact of NRP training intervention evaluated in India. Evidence strongly supports clinical question.
A system of firstly creating a local national faculty of paediatricians and nurses, who in turn train others. Simultaneous introduction of NRP into medical and nursing curricula. Prospective evaluation of resuscitation program in teaching hospitals evidenced rational resuscitation practices and significant decline in asphyxia-related deaths.

Desalu I, Kushimo O, Akinlaja O. (2006). "Adherence to CPR guidelines during perioperative cardiac arrest in a developing country." Resuscitation 69(3): 517-20
Abstract:

Comment:
LOE 4 Quality Fair Descriptive, observational, prospective audit. No controls. Assessment of accurate implementation and impact of guidelines by Nigerian anaesthetists, who are taught resuscitation skills in under- and post-graduate exposure. Resuscitation guidelines were however not being applied, purportedly due to a paucity of organised simulation practice. Continuing basic and advanced training in resuscitation for anaesthetists is advised
Impact of NRP training intervention evaluated. Evidence supports clinical question in that the impact of training interventions are being evaluated – assessing the authentic practical application of the learning intervention, where it counts most, is crucial, as Kirkpatrick's level three evaluation suggests. The extent to which competence is translated and applied in the work setting defines the impact of the training, and feeds back into evaluation loop, informing possible changes in training and assessment approach, design and methodology.

Ergenekon E, Koç E, Atalay Y, Soysal E. (2000). "Neonatal resuscitation course experience in Turkey." Resuscitation 45(3): 225-227

Comment:
LOE 4 Quality Fair Descriptive, observational audit. No controls. Assessing degree to which NRP training intervention can impact knowledge acquisition. Evidence strongly supports clinical question.
Neonatal resuscitation course (8 hrs, completely based on the Neonatal Resuscitation book published by American Academy of Paediatrics and American Heart Association) for health care personnel working in Turkey (developing country) organised by Gazi University Hospital. Pre- and post- tests to evaluate basic knowledge of neonatal resuscitation together with a written critique of the efficacy and quality of the course. Participants had not been given the NRP book nor asked to read it before the course because of limited resources, which challenges the traditional

methodology of this course. Participants felt more comfortable with neonatal resuscitation following the course and all agreed that the course should be repeated at regular intervals. Authors posit that the performance of successful resuscitation requires regular practice.

Heitmann D, Whittakera P, Goedeckea E, Götza I. (2008). "Teaching Advanced Cardiac Life Support in a Developing Country: Problems, Pitfalls, and Potential Solutions." Annals of Emergency Medicine 51(4): 505

Comment:
LOE 4 Quality Fair Descriptive, observational audit. No controls. Assessing degree to which GEMINI training intervention can impact knowledge acquisition. Evidence strongly supports clinical question Set in Dominican Republic – developing country. Describes the development of Global Emergency Medicine Initiative (GEMINI), a project designed to provide instructional modules on advanced cardiac life support customized to the needs of the physician participants resident in developing countries. nine one-week visits, conducting 2, 2-day courses at different locations, using 6-10 instructors to teach 28-45 students in each session; teaching and written and practical testing was in Spanish (sometimes through a medically trained interpreter). Training has evolved from initial close adherence to the American Heart Association-approved format to one designed to accommodate not only the range of specialties represented in the classes, but also the wide range of background knowledge and local context. Authors faced logistical challenges – language barriers, power outages during instruction. These problems are reflected in the relatively low pass-rates achieved: practical exams 58%, written tests 30%.Trend seen in many studies - training approaches used in the United States cannot simply be transplanted; rather training must be modified to fit local conditions. Besides language issues, wide ranges in background knowledge need to be taken into account.

Husum H, Gilbert M, Wisborg T, Van Heng Y, Murad M. (2003). "Rural prehospital trauma systems improve trauma outcome in low-income countries: a prospective study from North Iraq and Cambodia." J Trauma 54(6): 1188-96

Comment:
LOE 3 Quality Fair Prospective study using retrospective controls. North Iraq and Cambodia. Evidence strongly supports clinical question.
From 1997 to 2001, 135 local paramedics and 5,200 lay First Responders trained to provide in-field trauma care. Trauma mortality rate reduced from pre-intervention level at 40% to 14.9% over the study period (95% CI for difference 17.2-33.0%), and a reduction in trauma deaths from 23.9% in 1997 to 8.8% in 2001 (95% CI for difference 7.8-22.4%), and a corresponding significant improvement of treatment effect by year. Authors concluded that low-cost rural trauma systems (with a core of paramedics and a large number of lay first responders) do indeed have a significant impact on trauma mortality in low-income countries.

Husum H, Gilbert M, Wisborg T. (2003). „Training pre-hospital trauma care in low-income countries: the 'Village University' experience." Medical Teacher 25(2): 142-148.

Comment:
LOE 5 Quality Fair LOE 5 because trauma not directly related to specific outcome of resuscitation. Using before-and-after comparisons. No controls. Good generic information that can be applied and generalised to other settings. This prospective study describes training methodology outcomes. Evidence strongly supports clinical question – this training intervention is indeed practical, efficient and feasible. A low-cost trauma training program for non-graduate village healthcare workers is sustainable. 44 health workers from mine-infested rural communities in Cambodia and Northern Iraq were trained and equipped to deliver low-cost life support to trauma victims. They in turn trained a network of 2800 layman village first responders. Training was done in makeshift camps at village level ('Village Universities').

A total of 813 patients were managed by the rural rescue system from 1997 to 1999. The mortality rate for trauma victims decreased from 22.6% in 1997 to 13.7% in 1999 (95% CI for difference 1.8% to 16.0%). Management by village first responders had a significant impact on in-field response times and trauma mortality. The rescue system replicated itself

during the study period as an indicator of sustainability. The study showed that after trauma care training at rural makeshift training centers, non-graduate health workers can build efficient and sustainable rural rescue systems.

Jabir MM, Doglioni N, Fadhil T, Zanardo V, Trevisanuto D. (2009). "Knowledge and practical performance gained by Iraqi residents after participation to a neonatal resuscitation program course." Acta Paediatr 98(8): 1265-8.

Comment:

LOE 4 Quality Fair NRP In Iraqi residents. Evidence supports clinical question. Using before-and-after standard test comparisons, and a final megacode simulation to test clinical performance. No controls. The percentages of correct answers significantly improved from before (52 +/- 14%) to immediately after the course (85 +/- 7%); p < 0.001. Mean score obtained at the final Mega code was 68 +/- 8%. Four out of 28 (14%) participants reached the minimum score required for passing the exam (80%). Residents coming from a developing country (Iraq) significantly improved their knowledge attainment following participation in the NRP course; however, their performance on clinical simulations was unsatisfactory, suggesting that this aspect needs to be improved.

Johanson RB, Menon V, Burns E, Kargramanya E, Osipov V, Israelyan M, Sargsyan K, Dobson S, Jones P. (2002). "Managing Obstetric Emergencies and Trauma (MOET) structured skills training in Armenia, utilising models and reality based scenarios." BMC Medical Education, 2:5doi:10.1186/1472-6920-2-5

Comment:

LOE 5 Quality Poor Evidence supports clinical question. Exploratory, descriptive audit of MOET in Armenia. A modern, multidisciplinary, scenario and model based training programme established in UK (Managing Obstetric Emergencies and Trauma (MOET)) allows specialist obstetricians to learn or revise the undertaking of procedures using models, and to have their skills tested in scenarios. Pre-course knowledge and practice questionnaires were compared to post-course results. All candidates showed an improvement in post-course scores. This paper demonstrates the reliability of the model based scenarios, with a highly significant improvement in obstetric emergency management. However, clinical audit will be required to measure the full impact of training by longer term follow up, similar to many studies in this worksheet.

Kimura A, Okadaa K, Kobayashia K, Inakaa A, Hagiwaraa Y, Sakamotoa T, Sugimotoa N, Nakamuraa M, Nakamuraa K, Horiuchia K, Hujiia Y, Murotaa C and Emotoa M. (2008). "Letter to the Editor. Introductory adult cardiac life support course for Vietnamese healthcare workers." Resuscitation 79(3): 511-512.

Comment:

LOE 4 Quality Fair Evidence supports clinical question.
An Immediate Cardiac Life Support (ICLS) course, based on the Japanese Guidelines 2005, was conducted for Vietnamese health care workers (5 doctors and 5 nurses from 4 different hospitals). 18 Japanese trainers and 2 Japanese–Vietnamese translators participated as teaching staff members on the course. Special considerations in order to facilitate learning included use of posters translated into Vietnamese, speaking slowly to facilitate sequential translation, and modifications to the sequence of basic life support performed in Vietnam because automated external defibrillators are uncommon. The evaluations were carried out using a pre-test and a post-test (comprising the same 20 questions), an objective structured clinical examination (OSCE) comprising a 21-item checklist that was completed twice by each group, and a questionnaire scored on a 5-point scale. Significant improvement in the results of the post-test and in the OSCE performances demonstrate the effectiveness of the training. These results not only indicated the participants' level of knowledge, skills, and capabilities as team members, but also highlighted areas that require further emphasis in the course.

Kingham TP,Kamara TB, Cherian MN, Gosselin RA, Simkins M, Meissner C, Foray-Rahall L, Daoh KS, Kabia SA, Kushner AL. (2009). "Quantifying Surgical Capacity in Sierra Leone: A Guide for Improving Surgical Care." Arch Surg. 144(2):122-127

Comment:
LOE 5 Quality Fair Evidence supports clinical question, from an evaluation and gap-analysis perspective. Description of the use of an assessment tool. The World Health Organization's Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was used to assess surgical capacity in Sierra Leone. A *paucity of electricity, running water, oxygen, and fuel at the government hospitals was found. There were few supplies at any of the hospitals, forcing patients to provide their own. There was a disparity between conditions at the government hospitals and those at the private and mission hospitals. There are severe shortages in all aspects of infrastructure, personnel, and supplies required for delivering surgical care in Sierra Leone. While it will be difficult to improve the infrastructure of government hospitals, training additional personnel to deliver safe surgical care is possible. The situational analysis tool is a valuable mechanism to quantify a nation's surgical capacity. It provides the background data that have been lacking in the discussion of surgery as a public health problem and will assist in gauging the effectiveness of interventions to improve surgical infrastructure and care.*

Kobusingye OC, Hyder AA, Bishai D, Hicks ER, Mock C, Joshipura M. (2005). "Emergency medical systems in low- and middle-income countries: recommendations for action." Bull World Health Organ. 83(8):626-31.

Comment:
LOE 5 Quality Poor However evidence and opinion supports clinical question. Qualitative, descriptive – proposing a research agenda to inform evaluation and gap-analysis in the field of emergency care; it can make an important contribution to reducing avoidable death and disability in low- and middle-income countries. Emergency care however needs to be planned well and supported at all levels — at the national, provincial and community levels — and take into account the entire spectrum of care, from the occurrence of an acute medical event in the community to the provision of appropriate care at the hospital. The mix of personnel, materials, and health-system infrastructure can be tailored to optimize the provision of emergency care in settings with different levels of resource availability. Epidemiology and intervention trials in low- and middle-income countries are a research priority in the field of emergency medical systems. Well designed, locally appropriate studies that establish local context effectiveness are required. Training interventions for strengthening emergency medical systems are indeed regarded as feasible and practicable.

Kumar R. (1994). "Effect of training on the resuscitation practices of traditional birth attendants" Trans R Soc Trop Med Hyg 88(2):159-60.

Comment:
LOE 4 Quality Poor Evidence supports clinical question. No controls, descriptive series. In India, training programs in more modern methods of birth asphyxia resuscitation were started for traditional birth attendants (TBAs). A continuing training program by the primary health center staff at 4 focal villages, for one day each month, had been in progress for several years. Two trained field workers visited the villages once a fortnight to contact child workers, TBAs and health workers, and checking the local register of vital events to record births. Family members and/or the TBA who assisted at the delivery were interviewed, and a detailed birth history was recorded for stillborn and asphyxiated babies. Both traditional and modern resuscitation methods were used in 30 cases (51%), modern methods only in 13 (22%), traditional methods in 2 (3%), and no resuscitation effort was made in 14 cases (24%). Among 21 cases delivered by the trained TBAs, mucus traps and bag-and-mask were used in 33.3% and 42.6%, respectively. Instillation of onion juice and warming of placenta were practiced in a significantly higher proportion of cases by traditionally trained TBAs than by those who had received advanced training. Adoption of modern resuscitation methods by the TBAs demonstrates that they are likely to change their practices, and thus that this training intervention is effective and practical if sustained training platforms are repetitively used.

Lee CC, Im M, Kim TM, Stapleton ER, Kim K, Suh GJ, Singer AJ, Henry MC. (2010). "Comparison of Traditional Advanced Cardiac Life Support (ACLS) Course Instruction vs. a Scenario-based, Performance Oriented Team Instruction (SPOTI) Method for Korean Paramedic Students." The Journal of Emergency Medicine 38(1): 89-92.

Comment:
LOE 4 Quality Fair Evidence supports clinical question. Advanced Cardiac Life Support (ACLS) course instruction involves a 2-day course with traditional lectures and limited team interaction. The scenario-based performance-oriented team instruction (SPOTI) method to implement core ACLS skills for non-English-speaking international paramedic students is compared to the educational outcomes for the ACLS instruction of Korean paramedic students. Thirty Korean paramedic students were randomly selected into two groups. One group of 15 students was taught the traditional ACLS course. The other 15 students were instructed using a SPOTI method. Each group was tested using ACLS megacode examinations endorsed by the American Heart Association. All 30 students passed the ACLS megacode examination. In the traditional ACLS study group an average of 85% of the core skills were met. In the SPOTI study group an average of 93% of the core skills were met. Notwithstanding the results, it is clear that the SPOTI method is an effective, feasible and practical resuscitation training intervention in the context of a low-income country.

Mock C, Nguyen S, Quansah R, Arreola-Risa C, Viradia R, Joshipura M. (2006). "Evaluation of Trauma Care capabilities in four countries using the WHO-IATSIC Guidelines for Essential Trauma Care." World J Surg 30(6): 946-56.

Comment:
LOE 5 Quality Good Evidence supports clinical question, albeit only indirectly related. Assessment of trauma care capacity in 3 low-income countries. No controls. Audit, needs assessment, descriptive. An affordable and sustainable method to strengthen trauma care capabilities globally, especially in developing countries, using the Guidelines for Essential Trauma Care, created by World Health Organization (WHO) and the International Society of Surgery and provide recommendations on elements of trauma care that should be in place at the range of health facilities globally. The guidelines were used as a basis for needs assessments in 4 countries selected to represent the world's range of geographic and economic conditions: Mexico (middle income; Latin America); Vietnam (low income; east Asia); India (low income; south Asia); and Ghana (low income; Africa). One hundred sites were assessed, including rural clinics (n=51), small hospitals (n=34), and large hospitals (n=15). Resources were partly adequate or adequate at most large hospitals, but there were gaps that could be improved, especially in low-income settings, such as shortages of airway equipment, chest tubes, and trauma-related medications; and prolonged periods where critical equipment (e.g., X-ray, laboratory) were unavailable while awaiting repairs. Rural clinics everywhere had difficulties with basic supplies for resuscitation even though some received significant trauma volumes. In all settings, there was a dearth of administrative functions to assure quality trauma care, including trauma registries, trauma-related quality improvement programs, and regular in-service training. This study identified several low-cost ways in which to strengthen trauma care globally, and the usefulness of the Guidelines for Essential Trauma Care in providing an internationally applicable, standardized template by which to assess trauma care capabilities.

Mock CN, Tiska M, Adu-Ampofo M, Boakye G. (2002). "Improvements in prehospital trauma care in an African country with no formal emergency medical services." J Trauma 53(1): 90-7.

Comment:
LOE 5 Quality Fair Evidence supports clinical question. No controls, descriptive series, self-reporting of data. Assessment of efficacy of a program that builds on the existing, although informal, system of prehospital transport in Ghana, where majority of injured persons are transported to hospital by some commercial vehicle. A total of 335 commercial drivers were trained using a 6-hour basic first aid course. Efficacy of this course was assessed by comparing the process of prehospital trauma care provided before versus after the course – self-report from the drivers. Sixty-one percent indicated that they had provided first aid since taking the course, with considerable improvement in provision of components of first aid in comparison to what was reported before the course. Even in the absence of formal Emergency Medical Services, improvements in the process of prehospital trauma care are possible by building on existing, although informal, patterns of prehospital transport. Implementation of a basic, simple training interventions is feasible and practicable in a low-income country.

Moretti MA, Cesar LA, Nusbacher A, Kern KB, Timerman S, Ramires JA. (2007). "Advanced cardiac life support training improves long-term survival from in-hospital cardiac arrest." Resuscitation 72(3): 458-65.

Comment:
LOE 2 Quality Good Evidence supports clinical question, in a developing country (Brazil). Using concurrent controls without true randomisation. Observational, cohort study. A multi-center, prospective cohort study examined patient outcomes after resuscitation efforts by in-hospital rescue teams with and without ACLS-trained personnel. Primary endpoints included return of spontaneous circulation (ROSC), survival to hospital discharge, 30-day survival, and 1-year survival. Immediate success of resuscitation efforts for all patients was 39.7% (62/156). There was a significant increase in ROSC with ACLS-trained personnel (49/113; 43.4%) versus no ALCS-trained personnel (16/59; 27.1%; p=0.04). Likewise, patients treated by ACLS-trained personnel had increased survival to hospital discharge (26/82; 31.7% versus 7/34; 20.6%; p=0.23), significantly better 30-day survival (22/82; 26.8% versus 2/34; 5.9%; p<0.02), and significantly improved 1-year survival (18/82; 21.9% versus 0/34; 0%; p<0.002). The presence of at least one ACLS-trained team member at in-hospital resuscitation efforts increases both short and long-term survival following cardiac arrest.

Olotu A, Ndiritu M, Ismael M, Mohammed S, Mithwani S, Maitland K and Newton CR. (2009). "Characteristics and outcome of cardiopulmonary resuscitation in hospitalised African children." Resuscitation 80(1), 69-72

Comment:
LOE 4 Quality Poor Evidence supports clinical question. No controls, descriptive series. In hospitalised African children. More clinicians and nurses have received training in Paediatric Advanced Life Support both as an in-house course and in other centres. Coupled with the training was the availability of more Bag Valve Masks, intubation sets and the regular supply of resuscitation equipment and drugs. Prospective study to determine the outcome and risk factors for an unsuccessful resuscitation in this hospital.

Opiyo N, Were F, Govedi F, Fegan G, Wasunna A, English M. (2008). "Effect of newborn resuscitation training on health worker practices in Pumwani Hospital, Kenya." PLoS One. 13;3(2):e1599.

Comment:
LOE 1 Quality Fair Evidence strongly supports clinical question. Simple one day newborn resuscitation training (NRT) (adapted locally from the approach of the UK Resuscitation Council) alters health worker resuscitation practices in a public hospital setting in Kenya. RCT with health workers receiving early training with NRT (n = 28) or late training (the control group, n = 55). Primary outcome: proportion of appropriate initial resuscitation steps with the frequency of inappropriate practices as a secondary outcome. Implementation of a simple, one day newborn resuscitation training is feasible, practicable and effective, and can be followed immediately by significant improvement in health workers' proficiency and practices. These authors acknowledge that however that evidence of effects on long term performance or clinical outcomes can only be established by larger cluster randomised trials.

Quansah R, Abantanga F, Donkor P. (2008)."Trauma training for nonorthopaedic doctors in low- and middle-income countries." Clin Orthop Relat Res. 466(10):2403-12. .

Comment:
LOE 5 Quality Poor Evidence strongly supports clinical question. Descriptive, audit – relates experience of locally developed trauma training intervention in low-income country – Ghana.

Trauma – week long trauma course – non-specialist Ghanaian doctors – course started in 1997 and run annually since, i.e. evidence of sustainability. Advanced Trauma Life Support Course (ATLS) course financially prohibitive.Alternate educational approaches relevant to the realities of low-income countries need to be developed to address the resource constrained environment, lack of technology and limited capabilities for referral. This locally relevant trauma CME course developed by a local university specifically addresses the critical issues of trauma care in Ghana and has improved clinical knowledge as well as the self-reported process of trauma care. Doctors and nurses alike have participated, and a course specifically for nurses is in development. Authors call for wider buy-in from all stakeholders (governments, international community, others) to support such continuing medical education programs.

Razzak JA, Hyder AA, Akhtar T, Khan M, Khan UR. (2008). "Assessing emergency medical care in low income countries: a pilot study from Pakistan." BMC Emerg Med. 3;8:8.

Comment:

LOE 5 Quality Poor. Evidence strongly supports clinical question. Quantitative pilot study, 3 separate cross-sectional assessments of convenience sample of 22 rural and 20 urban health facilities in 2 districts - Faisalabad and Peshawar - in Pakistan. Study consisted of three separate cross-sectional assessments of selected community leaders, health care providers, and health care facilities, using 3 data collection instruments, with input from existing models for facility assessment such as those used by the Joint Commission of Accreditation of Hospitals and the National Center for Health Statistics in USA and the Medical Research Council in Pakistan. Most respondents 43/44(98%), in community survey unsatisfied with emergency care provided, and would not call an ambulance in health related emergency because it does not function properly in the government system. Most health care providers 43/44(98%) were of the opinion that their facilities were inadequately equipped to treat emergencies. The majority of facilities 31/42(74%) had no budget allocated for emergency care. A review of medications and equipment available showed that many critical supplies needed in an emergency were not found in these facilities. Assessment of emergency care should be part of health systems analysis in Pakistan. Specific efforts should be directed to equip emergency care at district facilities and to organize an ambulance network. This study reflects the stark practical difficulties encountered by many low-income and developing settings – severe resource restriction.

Also, Pakistan medical school curriculum does not provide specific competencies in emergency medicine and rotations in the emergency room are not required of all medical students. The systems approach is imperative to address these issues, and all facets have to be integrated.

Son NT, Thu NH, Tu NT, Mock C. (2007). "Assessment of the status of resources for essential trauma care in Hanoi and Khanh Hoa, Vietnam." Injury. 38(9):1014-22. Epub 2007 Jul 19.

Comment:

LOE 5 Quality Poor Evidence strongly supports clinical question. Needs assessment of trauma capacity using new assessment instrument. The WHO and the International Association for Trauma Surgery and Intensive Care have published the Guidelines for Essential Trauma Care – provides recommendations for the human and physical resources needed to provide an adequate, essential level of trauma care services in countries at all economic levels worldwide. This study used this set of recommendations to assess trauma care capabilities in two locations in Vietnam and thus to identify affordable and sustainable methods to strengthen trauma care nationwide. A needs assessment tool was created that incorporated the recommendations of the Guidelines. Used to conduct in-depth, onsite evaluations of 11 health care facilities in Vietnam. Deficiencies included low level of trauma related training and shortages of supplies and equipment, congruent to other low-income settings. However capabilities had improved compared with prior evaluations. Study has identified several low-cost ways in which to strengthen trauma care in Vietnam. These include greater use of continuing education courses for trauma care and more attention to trauma related curriculum in schools of medicine and nursing. Training is thus an integral element of the system to address trauma care. Also, defining and assuring the availability of a core set of essential trauma related equipment and supplies.

Suraseranivongsea S, Chawaruechaib T, Saengsungb P and Komoltric C. (2006). "Outcome of cardiopulmonary resuscitation in a 2300-bed hospital in a developing country." Resuscitation 71(2): 188-193

Comment:
LOE 5 Quality Poor Evidence strongly supports clinical question. Study evaluated outcome and quality of in-hospital CPR, and factors affecting the outcome, in a large university hospital in Thailand, via a 1-year prospective audit according to the Utstein style. This study shows that an evaluation / audit arm is essential to any system to identify status quo and then in turn to inform any planning for subsequent improvements. The current situation must be measured, tracked and trended. In this Thailand study, survival to discharge is 6.9%. Initial survival rate was strongly associated with being in a monitored area. Defibrillators and the critical care areas were insufficient. This reinforces and reflects similar concepts from the developed well.
ALS training was mandatory for first-year residents and nurses in critical care areas. Nurses in the wards were trained in BLS only. Presently, there is no mandatory requirement for BLS and ALS recertification. The system is robust, yet still with room for improvement, interestingly reflecting exactly the same challenges as there developed counterparts.

This study showed that ROSC in critical care areas was higher than in non-monitored areas such as the wards. Prevention of cardiac arrest is as important as cardiopulmonary resuscitation. Pre-arrest conditions are usually reversible with appropriate therapy, and warning signs can trigger medical emergency team. Experience with a MET has shown a reduction of the incidence and mortality of in-hospital cardiac arrest.

In addition, ALERT™—a multiprofessional training course in the care of the acutely ill adult patient for trainee doctors and junior ward nurses provided improved knowledge of acute care in trained doctors. This final point emphasises a training intervention that is practical and feasible in a low-income setting, that is advanced relative to other studies in this review.

Tiska MA, Adu-Ampofo M, Boakye G, Tuuli L, Mock CN. (2004). "A model of prehospital trauma training for lay persons devised in Africa." Emerg Med J. 21(2): 237-9.

Comment:
LOE 5 Quality Fair Evidence strongly supports clinical question. In Ghana most roadway casualties receive care and transport to the hospital from taxi, bus, or truck drivers. This study describes a model for prehospital trauma training for commercial drivers in Ghana – over 300 commercial drivers attended a first aid and rescue course designed specifically for roadway trauma and geared to a low education level. The training programme has been evaluated twice at one and two year intervals by interviewing both trained and untrained drivers with regard to their experiences with injured persons. In low income countries, prehospital trauma care for roadway casualties can be improved by training laypersons already involved in prehospital transport and care. Training should be locally devised, evidence based, educationally appropriate, and focus on practical demonstrations. These recommendations reflect and reinforce common trends seen throughout this worksheet review.

Tchorz KM, Thomas N, Jesudassan S, Kumar R, Chinnadurai R, Thomas A, Tchorz RI, Murthy Chaturvedula P, Parks JK, Naylor RA. (2007). "Teaching trauma care in India: an educational pilot study from Bangalore." J Surg Res. 142(2):373-7. Epub 2007 May 9.

Comment:
LOE 5 Quality Poor Evidence strongly supports clinical question. In India, most trauma patients receive initial care at general practitioner-staffed hospitals. General practitioners (GPs) can improve their knowledge of trauma care after attending an educational course. A 2-day trauma course was conducted at a teaching hospital (170 bed) in Bangalore, India. Referral GPs, local surgeons and residents in training attended. A pre-course test was given to assess baseline trauma knowledge. Overall, the pre- and post- course scores improved from 70.7% +/-11.2 to 87.5% +/-8.9, P = 0.000 (95%CI 12.1, 21.2). There was an increase of mean scores: 21.4% (SD +/-13.7) for GPs and 11.3% (SD +/-8.5) for surgeons (P = 0.02). Although GPs had significantly lower pre-course scores than surgeons, at the end of the course, GPs performed as well as surgeons. These findings suggest allocation of limited educational resources for trauma care in India may be best used by GPs.
Training interventions are practicable and feasible in many settings for many different groups of people.

Trevisanuto D, Ibrahim SA, Doglioni N, Salvadori S, Ferrarese P, Zanardo V. (2007). "Neonatal resuscitation courses for pediatric residents: comparison between Khartoum (Sudan) and Padova (Italy)." Paediatr Anaesth 17(1): 28-31.

Comment:
LOE 4 Quality Fair Evidence strongly supports clinical question. Pre- and post-course questionnaire assessing impact of NRP, comparing Sudanese and Italian settings in pediatric residents. While scores obtained by Italian pediatric residents were consistently higher than those reached by their Sudanese colleagues ($P < 0.01$), the trend of the knowledge attainment of both Sudanese and Italian pediatric residents was similar after NRP course participation. An NRP is effective in teaching neonatal resuscitation in developing countries.

Urbano J, Matamoros MM, López-Herce J, Carrillo AP, Ordóñez F, Moral R, Mencía S. (2010). "A paediatric cardiopulmonary resuscitation training project in Honduras." Resuscitation [Epub ahead of print]

Comment:
LOE 5 Quality Good Evidence strongly supports clinical question and describes implementtion. Exporting North American and European models has hindered the creation of a structured cardiopulmonary resuscitation (CPR) training programme in developing countries. This paper describes the design and present the results of a European paediatric and neonatal CPR training programme adapted to Honduras, with the instructional and scientific support of the Spanish Group for Paediatric and Neonatal CPR.

System is useful and generalisable in low-income settings: programme was divided into four phases: CPR training and preparation of instructors (Honduran medical practitioners); training for instructors; supervised teaching; and independent teaching. The Honduran Paediatric and Neonatal CPR Group was formed. In the second phase, workshops were given by Honduran instructors and four of them attended a CPR course in Spain as trainee instructors. Training of independent paediatric CPR groups with the collaboration and scientific assessment of an expert group could be a suitable model on which to base paediatric CPR training in Latin American developing countries.

Wall SN, Lee AC, Niermeyer S, English M, Keenan WJ, Carlo W, Bhutta ZA, Bang A, Narayanan I, Ariawan I, Lawn JE. (2009). "Neonatal resuscitation in low-resource settings: what, who, and how to overcome challenges to scale up?" Int J Gynaecol Obstet. 107 Suppl 1:S47-62, S63-4.

Comment:
LOE 5 Quality Poor Evidence suggests consensus support for clinical question. This paper systematically reviewed evidence for neonatal resuscitation content, training and competency, equipment and supplies, cost, and key program considerations, specifically for resource-constrained settings, and found, from several observational studies, that facility-based basic neonatal resuscitation may avert 30% of intrapartum-related neonatal deaths. Very few babies require advanced resuscitation (endotracheal intubation and drugs) and these newborns may not survive without ongoing ventilation; hence, advanced neonatal resuscitation is not a priority in settings without neonatal intensive care. Of the 60 million nonfacility births, most do not have access to resuscitation. Several trials have shown that a range of community health workers can perform neonatal resuscitation with an estimated effect of a 20% reduction in intrapartum-related neonatal deaths, based on expert opinion. Basic resuscitation would substantially reduce intrapartum-related neonatal deaths. Where births occur in facilities, it is a priority to ensure that all birth attendants are competent in resuscitation. More data are required to determine the impact of neonatal resuscitation, and its pre-requisite training interventions, particularly on long-term outcomes in low-income settings.

Young S, Hutchinson A, Nguyen VT, Le TH, Nguyen DV, Vo TK. (2008). "Teaching paediatric resuscitation skills in a developing country: introduction of the Advanced Paediatric Life Support course into Vietnam." Emerg Med Australas 20(3): 271-5.

Comment:

LOE 4 Quality Good Evidence strongly supports clinical question. Advanced Paediatric Life Support course in Vietnam – to ascertain whether this course would provide a practical and sustainable method of improving the knowledge and skills of medical and nursing staff in this area. Congruent to other studies and implementation models, key Vietnamese personnel travelled to Australia to complete the course, undertake instructor training and gain organizational experience. Teaching materials were translated, reviewed and modified to account for local diseases and clinical practices while maintaining the fundamental principles of the parent course. Ten courses were initially conducted by Australian and Vietnamese instructors, training 239 doctors and nurses from a wide variety of clinical backgrounds. As skill and confidence of the Vietnamese instructors grew, the number and responsibilities of the international faculty reduced, moving from directive support to a non-directive, self-driven momentum to develop infrastructure in sustainable manner. Authors believe this demonstrates that the course can be successfully modified to provide teaching in paediatric emergency care in a developing country.

Zafar S, Hafeez A, Qureshi F, Arshad N and Southall D. (2009). "Structured training in the management of emergencies in mothers, babies and children in a poorly resourced health system: Logbooks to document skill use." Resuscitation. 80(4): 449-452.

Comment:

LOE 4 Quality Good Evidence strongly supports clinical question. Descriptive, audit. Cross-sectional survey of all tiers of health care settings across all regions of Pakistan – assessing emergencies as part of a system development programme called "Essential Surgical Skills–Emergency Maternal and Child Healthcare (ESS–EMCH). Following a series of 6 five-day training courses developed as part of the ESS–EMCH programme, participants were provided with logbooks to document the actual use of their newly acquired skills during the resuscitation of mothers, infants and children.1123 resuscitation attempts were documented and received from 63 of the 120 participants (response rate 53%; number of forms 4–22 per participant). Seventy-six percent (858/1123) of documented cases were received from doctors and 24% (265) from nurses.

This is a novel way to track and trend data in a resource-limited milieu. Resuscitation logbooks can be used to assess which skills are used in emergency care. Analysis provides some evidence that the skills taught during the ESS–EMCH programme are used by the trained health workers. Individually held and completed logbooks should continue to act as a feedback and audit mechanism to measure outcomes, in conjunction with other methods of evaluating the impact of the training component of this programme. This represents excellent instructional design, concepts should be strongly advocated.