

Emergency medical care in developing countries: is it worthwhile?

Junaid A. Razzak¹ & Arthur L. Kellermann²

Abstract Prevention is a core value of any health system. Nonetheless, many health problems will continue to occur despite preventive services. A significant burden of diseases in developing countries is caused by time-sensitive illnesses and injuries, such as severe infections, hypoxia caused by respiratory infections, dehydration caused by diarrhoea, intentional and unintentional injuries, postpartum bleeding, and acute myocardial infarction. The provision of timely treatment during life-threatening emergencies is not a priority for many health systems in developing countries. This paper reviews evidence indicating the need to develop and/or strengthen emergency medical care systems in these countries. An argument is made for the role of emergency medical care in improving the health of populations and meeting expectations for access to emergency care. We consider emergency medical care in the community, during transportation, and at first-contact and regional referral facilities. Obstacles to developing effective emergency medical care include a lack of structural models, inappropriate training foci, concerns about cost, and sustainability in the face of a high demand for services. A basic but effective level of emergency medical care responds to perceived and actual community needs and improves the health of populations.

Keywords Emergency medical services/organization and administration; Delivery of health care; Health services accessibility; Primary health care; Triage; Transportation of patients; Cost of illness; Evidence-based medicine; Health care surveys; Developing countries (*source: MeSH, NLM*).

Mots clés Service médical urgence/organisation et administration; Délivrance soins; Accessibilité service santé; Programme soins courants; Orientation patients; Transport sanitaire; Coût maladie; Médecine factuelle; Enquête système de santé; Pays en développement (*source: MeSH, INSERM*).

Palabras clave Servicios médicos de urgencia/organización y administración; Prestación de atención de salud; Accesibilidad a los servicios de salud; Atención primaria de salud; Triage; Transporte de pacientes; Costo de la enfermedad; Medicina basada en evidencia; Encuestas de atención de la salud; Países en desarrollo (*fuentes: DeCS, BIREME*).

Bulletin of the World Health Organization 2002;80:900-905.

Voir page 904 le résumé en français. En la página 904 figura un resumen en español.

Introduction

Historically, global health policy emphasized multiple, vertically oriented programmes that concentrated on maternal and child health and the control of communicable childhood diseases (1). This resulted in major public health agencies focusing their support on selective programmes that address priority diseases and activities (2). Unfortunately, vertical programmes do not encourage the development of strong and efficient health care delivery systems. The weakness of this approach is most apparent during crises, such as medical emergencies or incidents involving large numbers of casualties.

Fortunately, experts in global health are beginning to take a more comprehensive view of health, including the provision of emergency medical care, than was traditionally the case. Thus the World Bank's minimum package of health services includes six cost-effective interventions, one of which is a series of non-specialized interventions for emergencies, known collectively as limited care (3). WHO and UNICEF are placing substantial emphasis on the strengthening of triage

and emergency care within the context of the integrated management of childhood illnesses (4).

Some governments are attempting to provide a basic package of emergency services. For example, shortly after independence in 1979, Mozambique made emergency care one of its four priority areas in health (5). One of the elements of the Health Investment Fund Project in the Republic of Moldova, funded by the World Bank, is the development of basic emergency care services (6). In Romania, the Health Sector Reform Project, supported by the World Bank, aims to improve emergency medical services as a key component of the overall health programme (7).

We make the case in the following paper for developing a simple but comprehensive approach to emergency medical care in developing countries.

Emergency medical care

The purpose of emergency medical care is to stabilize patients who have a life-threatening or limb-threatening injury or illness. In contrast to preventive medicine or primary care,

¹ Assistant Professor, Section of Emergency Medicine, Department of Surgery, Yale University School of Medicine, New Haven, CT, USA; and Research Fellow, Department of Public Health, Karolinska Institute, Stockholm, Sweden. Correspondence should be addressed to this author at the Section of Emergency Medicine, Department of Surgery, 464 Congress Avenue, Suite 260, New Haven, CT 06512, USA (email: Junaid.Razzak@yale.edu).

² Professor and Chairman, Department of Emergency Medicine, Emory University School of Medicine; Director, Center for Injury Control, Rollins School of Public Health, Atlanta, GA, USA.

Ref. No. 01-1521

emergency medical care focuses on the provision of immediate or urgent medical interventions. It includes two major components: medical decision-making, and the actions necessary to prevent needless death or disability because of time-critical health problems, irrespective of the patient's age, gender, location or condition.

Emergency medical care and health system performance

The three fundamental functions of a health system are to improve the health of the population, respond to people's expectations, and provide financial protection against the costs of ill-health (8). Emergency medical care can contribute positively to these functions. There are no empirical data on the number of lives or disability-adjusted life-years (DALYs) saved through emergency medical care. Nevertheless, it is clear that many of the conditions that contribute to the burden of disease in low-income and middle-income countries can be mitigated through prompt treatment (Table 1).

Enhancing a health system's responsiveness to people's expectations leads to improved utilization of services and better outcomes (8). Access to medical care for urgent or life-threatening conditions is a key expectation in many communities. A study conducted in rural Nepal revealed that people used their primary health care centre more often for medical emergencies than for preventive services, such as family planning or prenatal care. The population perceived a strong need for accessible emergency medical and surgical services throughout the district (9). A survey conducted in two communities in Sri Lanka revealed that people expected to receive emergency care from the primary care system. In most instances they used traditional home remedies for minor ailments but turned to primary care medical facilities for acute complaints or when a child seemed seriously ill (10). In southern Nigeria, many women expressed a lack of faith in modern medical care for complications of pregnancy. However, they frequently sought hospital treatment for medical emergencies not amenable to cure by traditional methods. When asked to identify their health service priorities, they mentioned better training of health centre staff and the provision of ambulances for emergencies (11).

The role of emergency medical care in providing financial protection against the costs of ill health is complex. The onset of an acute illness or injury forces individuals and families to choose between risking financial ruin because of medical expenses or risking death or lifelong disability attributable to a lack of medical care. Both outcomes can have a catastrophic long-term impact. Prompt access to care during an emergency is essential, irrespective of whether the system gives financial protection through prepayment options, government provision of health care, or other insurance schemes.

Core components of emergency medical care

Emergency medical care has three components: care in the community; care during transportation, which is related to the question of access; and care on arrival at the receiving health facility. It is designed to overcome the factors most commonly implicated in preventable mortality, such as delays in seeking care, access to a health facility, and the provision of adequate care at the facility (12).

Emergency medical care in the community

The outcome of acute illness or injury is strongly influenced by early recognition of its severity and the need for medical intervention. Since most emergencies start at home, any system to promote the early recognition of emergency conditions should be based in the community. In order to save the lives of pregnant women it is important to reduce delays in accessing health care (13). In Zimbabwe a significant proportion of maternal deaths is caused by avoidable factors, including the failure of health workers to identify serious complications and to refer promptly women who are seriously ill to higher levels of care (14). Similarly, prompt referral of severely ill children to health services can reduce child mortality. In Mexico the training of mothers and first-level health care workers in the basic principles of triage led to care being sought more promptly and significantly reduced child mortality: deaths attributed to respiratory and diarrhoeal illness among children under 1 year of age decreased by 43% and 39%, respectively. Among children aged under 5 years, mortality caused by these conditions fell by 36% and 34%, respectively (15).

There are few data on the ability of lay persons and community health workers to learn to recognize life-threatening emergencies other than maternal and paediatric conditions. However, it is reasonable to assume that if a health worker can be trained to recognize severe blood loss in a postpartum woman, or breathing difficulty in an infant, he or she can also be trained to recognize severe blood loss in a trauma victim or breathing difficulty in an asthmatic adult. Many of the benefits of pre-hospital emergency care could be realized by teaching community volunteers simple but vital interventions, e.g. establishing and maintaining a patent airway, controlling external bleeding, and immobilizing fractures by means of local materials and resources (16).

Emergency medical care and transportation

An absence of emergency medical transport is a common barrier to care. This may arise because of any of several factors, including the lack of appropriate vehicles, the absence or inadequacy of roads, and the inability to pay for transport services. The consequences of a lack of transport can be grave. In urban Guinea-Bissau, 20 of 125 acutely ill children died either on their way to hospital or while waiting in the reception area of an outpatient clinic (17). In Malaysia a team assessing the value of the risk-coding system in pregnancy concluded that better communications, a more effective transport system, and better emergency care in hospitals were needed in order to reduce maternal mortality (18).

There is empirical evidence that providing emergency transport saves lives. In Sierra Leone, investment in a vehicle and an improved communication system led to a doubling of the utilization of emergency obstetric services and a 50% reduction in case fatalities (19). In Monterrey, Mexico, an increase in the number of sites of ambulance dispatch from two to four and the provision of basic skills training in trauma care reduced deaths among patients en route to hospital (20).

Disease-based interventions in emergency medical care can produce generalized benefits for populations. In Nigeria, for example, an emergency obstetric transport system transferred 29 women to higher levels of care over a period of two years. During the same period the system transported 27 men and children affected by other medical emergencies (21).

Table 1. Leading causes of deaths and disability-adjusted life-years (DALYs) in middle-income and low-income countries

Causes of deaths ^a	% of total deaths	Causes of DALYs	% of total DALYs
1. Ischaemic heart disease	11.5	1. Lower respiratory infections	6.8
2. Cerebrovascular disease	8.9	2. Perinatal conditions	6.7
3. Lower respiratory infections	7.3	3. HIV/AIDS	6.6
4. HIV/AIDS	6.1	4. Meningitis	4.6
5. Perinatal conditions	5.1	5. Diarrhoeal diseases	4.6
6. Chronic obstructive pulmonary disease	4.7	6. Unipolar depressive disorders	4.0
7. Diarrhoeal diseases	4.4	7. Ischaemic heart disease	3.5
8. Tuberculosis	3.4	8. Malaria	3.0
9. Road traffic accidents	2.4	9. Cerebrovascular disease	2.9
10. Malaria	2.3	10. Road traffic accidents	2.8
11. Hypertensive heart disease	1.7	11. Tuberculosis	2.6
12. Measles	1.6	12. Congenital anomalies	2.3
13. Trachea, bronchus, lung cancers	1.6	13. Chronic obstructive pulmonary disease	2.3
14. Self-inflicted injuries	1.5	14. Measles	2.0
15. Cirrhosis of the liver	1.4	15. Cirrhosis of the liver	2.0

^a The causes of death for which evidence for saving lives with early intervention is available are shown with dark green background.

The prevailing models of emergency medical transport used in North America and Western Europe are quite costly and would be impractical for most low-income countries. Severe resource constraints, the poor condition of roads or trails, and a lack of fuel may dictate the utilization of a wider range of options. In the United Republic of Tanzania, for example, modes of emergency transportation include motor-boats, canoes, bicycles with trailers, tricycles with platforms, tractors with trailers, reconditioned vehicles, and ox carts (22).

Emergency medical care at first-contact and referral facilities

The ready availability of treatment on arrival at a formal health care facility is the third component of emergency medical care. Health care facilities differ widely in respect of equipment, staff and resources, and they consequently possess varying capacities to provide emergency care. For this reason the level of care which can reasonably be expected at a primary care centre is significantly lower than that available at a tertiary care hospital. Nevertheless, some capacity to provide emergency care should be available at every level of a country's health care system.

A health care facility's capacity is determined by both human and structural factors. Human factors include the number and mix of health care workers and their level of training. Structural factors include space, medications, supplies and specialized equipment. The level of demand placed on the facility by the surrounding population may also dictate which services are offered and whether they can be accessed at short notice.

Health care facilities of poor quality produce poor outcomes (23–27). Initial triage and treatment constitute one

of the weakest links in the system. A study in Malawi revealed that the condition of many seriously ill children arriving at clinics had not previously been recognized. Instead of receiving immediate emergency care they were kept waiting for long periods before being given proper treatment. This resulted in avoidable deaths and disability (28). In Mexico, verbal autopsies of 132 children who died revealed that the majority had been seen by a physician within three days of death. Poor selection of medications and late referral to tertiary care were judged to be important contributory factors in more than half the deaths (29). A qualitative study of 21 hospitals in seven developing countries found that poor triage of incoming patients and inadequate provision of emergency care jeopardized the lives of arriving patients (30). Fourteen of the facilities (including 10 of 13 district hospitals) did not have an adequate triage system. A comprehensive review of the management of 131 children treated at these facilities found evidence of inappropriate or delayed triage in 8% of cases, poor clinical assessments in 41%, and potentially harmful delays in treatment in 19%.

Several international health projects aimed at improving initial triage and treatment have been instituted at district health care facilities. Most focus on the strengthening of maternal and child health. One such project produced guidelines for emergency triage and treatment (28). An evaluation of these guidelines demonstrated that they significantly decreased the time required to assess children in need of urgent medical attention (31).

In Sierra Leone a health care facility was upgraded in order to enhance its ability to provide prompt medical and surgical treatment to women with complications of pregnancy. The annual number of obstetric procedures rose from 2 to 38 over a period of five years. During the same period the

number of unscheduled non-obstetric procedures increased from 41 to 173 during the same period. Blood banks intended for use in obstetrical emergencies were used much more frequently for non-obstetric indications, such as surgical emergencies and trauma. The authors referred to these unanticipated benefits as ripple effects (32).

Challenges to implementation of emergency medical care

Beyond limited disease-specific or facility-specific interventions there are no successful models for systematically improving the overall provision of emergency medical care in developing countries. Fortunately, many countries already have programmes focused on emergency obstetric care and/or the integrated management of childhood illnesses. Such programmes may provide the necessary framework for creating a more inclusive, all-diseases approach to emergency medical care. It is important to note that, in many developing countries, the private for-profit and not-for-profit sectors are playing increasing roles in health systems (33). A broad programme such as emergency medical care requires wide consultation before it can be successfully implemented.

Despite the paucity of empirical data on emergency medical care in developing countries it is possible to specify the core components of such a system. They include: community education on accessing the emergency care system and administering first aid; simple communication systems for notifying the emergency care system of patients in need; transport, preferably motorized, for moving patients to the nearest health care facility; triage criteria to ensure efficient and timely utilization of existing resources at every level of the health care system; training of health centre personnel on the principles of emergency care; basic kits of instruments, supplies and medications enabling trained providers to give appropriate care at each level of the system.

The minimum standards for emergency medical care should be made clear, but it is not easy to define the emergency services to which everyone should have access. This matter should be discussed by communities, health care providers, health system researchers, policy-makers, ethicists and other interested parties. The framework for discussion should include, but not be limited to, the burden of disease, the availability of effective emergency interventions and the cost.

Rather than attempting to create an emergency medical care system *de novo*, planners should consider the use of established primary care centres. In addition to their traditional missions of providing preventive and primary care, these facilities could serve as casualty collection points for the initial evaluation and management of paediatric, maternal, trauma and medical patients with urgent problems. With proper training in the principles of triage and emergency stabilization, and a simple kit of essential equipment and supplies, the staff should be able to handle most problems on site. When a patient's condition requires resources not possessed by a primary care centre, he or she could be transferred to the nearest hospital. The involvement of primary health care centres in the provision of emergency medical care should ensure that the greatest possible good is done for the largest possible number of people and should reduce the risk of district and regional hospitals becoming overwhelmed by non-emergency cases.

In addition to supplementing the knowledge and skills of professional providers at community health centres, low-income countries should consider implementing programmes for teaching the fundamentals of first aid to large numbers of volunteers. Initiating a few simple measures at the scene of an accident can do much good. The India Institute of Technology has produced a low-literacy manual for teaching basic first aid to both villagers and urban dwellers. It includes advice on using simple supplies and even local materials in order to accomplish vital tasks such as the control of bleeding and the immobilization of fractures (34). Once volunteers have been identified and trained the most motivated and talented can be recruited to transport victims to the nearest community health centres. A durable vehicle of sufficient size, with a few essential features and supplies, is sufficient for the vast majority of cases.

At the other end of the spectrum, attention should be given to the training received by physicians and other health care professionals. There is a marked disparity between what is taught in medical schools and what is expected of physicians in developing countries (1). Most medical students in developing countries acquire their training and skills on the inpatient wards of large tertiary care hospitals in urban areas, where emphasis is placed on making the right diagnosis rather than on the principles of triage and emergency management. This model may make sense in developed countries, where graduating physicians almost invariably obtain further training before engaging in independent clinical practice. However, it does not prepare physicians in developing countries for work in community health centres. In these facilities the most pressing requirement is to sort sick patients and make appropriate triage and treatment decisions. In order to do this well, doctors and nurses need to be trained to recognize the severity of illnesses and to categorize conditions in relation to the likelihood of a threat to life or limb, treatment priority, and the strategies most likely to maximize outcome, rather than on the basis of precise diagnoses. The training of health care providers in this manner requires a critical mass of physicians, nurses and other paramedical staff who understand the principles of emergency care and are prepared to exert pressure for their inclusion in the curricula of their respective disciplines.

The measures we describe are not particularly expensive and can benefit large numbers of patients. However, cost is still likely to represent a formidable barrier to implementing emergency medical care systems in developing countries. Depending on the extent of a country's health care infrastructure, the implementation of an effective emergency medical care system may require little more than incremental reforms, or it may demand a major overhaul of the health care system.

Several small-scale experiments have examined the utility of cost recovery systems, private/community partnerships, and emergency loan funds for financing improvements to systems. All have met with some success (35). There are also successful models of private voluntary efforts for the provision of emergency medical transport. In Pakistan the Edhi Ambulance Service, a voluntary organization supported mainly through private and community donations, provides transport services to a large part of the country at minimal or no cost (36). Considerable savings could be achieved by recruiting citizens as volunteers helping to provide their own emergency care. The obstetric transportation system in Nigeria, outlined above, reported start-up costs of US\$ 268 and had recurring costs of US\$ 5.89 per transport.

Despite the encouraging experiments that have been conducted, doubts remain that investments in emergency medical care may divert resources from other preventive or curative programmes. This may be particularly problematic in countries with very limited resources. It may be difficult to gain public support for improvements in emergency medical care if they are built on funds taken from other worthwhile programmes.

The implementation of even a rudimentary emergency medical care system may have unintended consequences. The limited availability of even primary care services is a major concern, particularly in rural areas and highly impoverished communities. The few facilities that exist in these locations are already overburdened. If emergency medical care leads to an increase in the utilization of services the pressure on such facilities may become unbearable. Alternatively, if ambulance crews do not properly conduct triage by illness severity, people may use the emergency medical care system to bypass their community health centres and seek treatment at higher levels of care. The only way to determine if this is a legitimate concern is to conduct pilot programmes and assess their impact on both health care utilization and clinical outcomes.

Conclusion

Health care in developing countries has not traditionally focused on emergency medical care. Although health promotion and disease and injury prevention should be core values of any health system, many acute health problems will continue to occur. The incorporation of a basic level of emergency medical care into health care systems could have a significant impact on the well-being of populations. It would respond to the self-perceived needs of populations and decrease the long-term human and economic costs of illness and injury.

Priority should be placed on developing minimum guidelines for emergency medical care in low-income countries. The efficacy of such care could be assessed by implementing pilot programmes in several low-income and middle-income countries. This would help to determine the degree to which emergency medical care systems save lives and at what cost. ■

Conflicts of interest: none declared.

Résumé

Faut-il des soins médicaux d'urgence dans les pays en développement ?

La prévention est une valeur centrale de tout système de santé. Cependant, bon nombre de problèmes de santé continueront à exister malgré les services de prévention. Dans les pays en développement, une charge de morbidité importante est due à des pathologies et à des traumatismes pour lesquels le facteur temps est crucial, comme les infections graves, l'hypoxie provoquée par les infections respiratoires, la déshydratation due à la diarrhée, les blessures intentionnelles et non intentionnelles, les hémorragies du post-partum et l'infarctus aigu du myocarde. Dans ces pays, la fourniture d'un traitement en temps utile pour les urgences mettant en jeu le pronostic vital ne s'inscrit pas dans les priorités de bon nombre de systèmes de santé. On examine dans le présent article les données qui montrent la nécessité d'élaborer et/ou de renforcer

les systèmes de soins médicaux d'urgence de ces pays. On y plaide en faveur du rôle qu'ils peuvent jouer pour améliorer la santé des populations et répondre aux attentes concernant l'accès aux soins d'urgence. Nous étudions ces soins médicaux d'urgence dans la communauté, pendant le transport et dans les établissements de première ligne et de recours au niveau régional. Les obstacles auxquels se heurte la mise en place de soins médicaux d'urgence efficaces sont les suivants : absence de modèles structurels, objectifs de formation inappropriés, préoccupations relatives au coût et durabilité face à la forte demande de services. Un niveau élémentaire mais efficace de soins médicaux d'urgence répond bien aux besoins ressentis et réels de la communauté et permet d'améliorer la santé des populations.

Resumen

Atención médica de urgencia en los países en desarrollo: ¿vale la pena?

La prevención es un valor básico de cualquier sistema asistencial, pero naturalmente la actuación de los servicios preventivos no impide que sigan produciéndose numerosos problemas de salud. Una proporción importante de la carga de morbilidad de los países en desarrollo se debe a enfermedades y traumatismos en los que el factor tiempo es decisivo, como por ejemplo las infecciones graves, la hipoxia asociada a infecciones respiratorias, la deshidratación causada por la diarrea, los traumatismos intencionales o involuntarios, la hemorragia posparto y el infarto agudo de miocardio. La prestación de tratamiento oportuno en situaciones de urgencia de consecuencias potencialmente mortales no constituye una prioridad para muchos sistemas de salud de los países en desarrollo. En este artículo se examinan los datos que revelan la necesidad de desarrollar y/o fortalecer los

sistemas de atención médica de urgencia en esos países. Se resalta el papel que la mejora de los servicios médicos de urgencia podría desempeñar en la mejora de la salud de las poblaciones y la respuesta a las expectativas de acceso a la asistencia de urgencia. Se analiza la atención médica de urgencia en la comunidad, durante el transporte, y en los servicios de primer contacto y de derivación regional. Entre los obstáculos al desarrollo de una atención médica de urgencia eficaz figuran la falta de modelos estructurales, unos focos de capacitación inadecuados, problemas de costos, y las presiones que para la sostenibilidad supone la alta demanda de servicios. Un nivel de atención de urgencia básico pero eficaz permite responder a las necesidades comunitarias percibidas y reales y mejorar la salud de las poblaciones.

References

- Macfarlane S, Racelis M, Muli-Musiime F. Public health in developing countries. *Lancet* 2000;356:841-6.
- Walt G. WHO under stress: implications for health policy. *Health Policy* 1993;24:125-44.
- World Bank. *Minimum package of health services: criteria, method and data*. Washington (DC): World Bank; 1995.
- Gove S. Integrated management of childhood illness by outpatient health workers: technical basis and overview. *Bulletin of the World Health Organization* 1997;75 Suppl 1:7-24.
- Mcord C. Health care in Mozambique: the colonial legacy to 1985. In: Wright M, Stein Z, Scandlyn J, editors. *Women's health and apartheid: the health of women and children and the future of progressive primary health care in southern Africa*. New York (NY): Columbia University; 1988:177-84.
- World Bank. *Project information on Health Investment Fund Project of Moldova*. Washington (DC): World Bank; 2000.
- World Bank. *Project information on Health Sector Reforms Project, Romania*. Washington (DC): World Bank; 2000.
- World Health Organization. *The World Health Report 2000 – Health systems: improving performance*. Geneva: World Health Organization; 2000.
- MacRorie RA. Births, deaths and medical emergencies in the district: a rapid participatory appraisal in Nepal. *Tropical Doctor* 1998;28:162-5.
- Wolffers I. Illness behaviour in Sri Lanka: results of a survey in two Sinhalese communities. *Social Science and Medicine* 1998;27:545-52.
- Asowa-Omorodion FI. Women's perception of the complications of pregnancy and childbirth in two Esan communities, Edo State, Nigeria. *Social Science and Medicine* 1997;44:1817-24.
- Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Social Science and Medicine* 1994;38:1091-110.
- Rosenfield A, Maine D. Maternal mortality — a neglected tragedy: where is the M in MCH? *Lancet* 1985;2:83-5.
- Fawcus S, Mbizvo M, Lindmark G, Nystrom L. A community-based investigation of avoidable factors for maternal mortality in Zimbabwe. *Studies in Family Planning* 1996;27:319-27.
- Guiscafré H, Martínez H, Palafox M, Villa S, Espinosa P, Bojalil R, et al. The impact of a clinical training unit on integrated child health care in Mexico. *Bulletin of the World Health Organization* 2001;79:434-41.
- Varghese M. Technologies, therapies, emotions and empiricism in pre-hospital care. In: Mohan D, Tiwari G, editors. *Injury prevention and control*. London and New York: Taylor and Francis; 2000. p. 249-64.
- Sodemann M, Jakobsen MS, Molbak K, Alvarenga IC, Aaby P. High mortality despite good care-seeking behaviour: a community study of childhood deaths in Guinea-Bissau. *Bulletin of the World Health Organization* 1997;75:205-12.
- Geefhysen CJ, Isa AR, Hashim M, Barnes A. Malaysian antenatal risk coding and the outcome of pregnancy. *Journal of Obstetrics and Gynecological Research* 1998;24:13-20.
- Samai O, Senegheh P. Facilitating emergency obstetrical care through transportation and communication, Bo, Sierra Leone. *International Journal of Gynecology and Obstetrics* 1997;59 Suppl 2:S157-64.
- Arreola-Risa C, Mock CN, Lojero-Wheatly L, Cruz O, Garcia C, Canavati-Ayub F, et al. Low-cost improvement in prehospital trauma care in Latin American City. *Journal of Trauma: Injury, Infection and Critical Care* 2000;48:119-24.
- Shehu D, Ikeh AT, Kuna MJ. Mobilizing transport for obstetric emergencies in northwestern Nigeria. *International Journal of Gynecology and Obstetrics* 1997;59 Suppl 2:S173-80.
- Schmid T, Kanenda O, Ahluwalia I, Kouletio M. Transportation for maternal emergencies in Tanzania: empowering communities through participatory problem solving. *American Journal of Public Health* 2001;91:1589-90.
- Ahmed M, Shah M, Luby S. Survey of surgical emergencies in a rural population in the Northern Areas of Pakistan. *Tropical Medicine and International Health* 1999;4:846-57.
- Mock CN, Jurkovich GJ, nii-Amon-Kotei D. Trauma mortality patterns in three nations at different economic levels: implications for global trauma system development. *Journal of Trauma — Injury Infection and Critical Care* 1998;44:804-12.
- Winikoff B, Carignan C, Bernardik E, Semeraro P. *Medical services to save mothers' lives: feasible approaches to reducing maternal mortality*. New York: Population Council, Program Division; 1991 (Working Paper No. 4).
- Berer M. HIV/AIDS, pregnancy and maternal mortality and morbidity: implications for care. In: Berer M, Ravindran TK, editors. *Safe motherhood initiatives: critical issues*. Oxford: Blackwell Science; 1999:198-210.
- Geefhuysen CJ. Safe motherhood in Indonesia: a task for the next century. In: Berer M, Ravindran TK, editors. *Safe motherhood initiatives: critical issues*. Oxford: Blackwell Science; 1999:62-72.
- Gove S, Tamburlini G, Molyneux E, Whitesell P, Campbell H. Development and technical basis of simplified guidelines for emergency triage assessment and treatment in developing countries. WHO Integrated Management of Childhood Illness (IMCI) Referral Care Project. *Archives of Diseases in Childhood* 1999;81:473-7.
- Reyes H, Tome P, Guiscafré H, Martínez H, Romero G, Portillo E, et al. [The verbal autopsy on children with a respiratory infection and acute diarrhoea. An analysis of the disease-care-death process.] *Boletín Médico del Hospital Infantil de México* 1993;50:7-16. In Spanish.
- Nolan T, Angos P, Cunha AJ, Muhe L, Qazi S, Simoes EA, et al. Quality of hospital care for seriously ill children in less-developed countries. *Lancet* 2001;357:106-10.
- Tamburlini G, Di Mario S, Maggi RS, Vilarim JN, Gove S. Evaluation of guidelines for emergency triage assessment and treatment in developing countries. *Archives of Diseases in Childhood* 1999;81:478-82.
- Leigh B, Kandeh HBS, Manu MS, Kuteh M, Palmer IS, Doah KS, et al. Improving emergency obstetric care at a district hospital, Makeni, Sierra Leone. *International Journal of Gynecology and Obstetrics* 1997;59 Suppl 2:S55-65.
- Mills A, Brugha R, Hanson K, McPake B. What can be done about the private sector in low-income countries? *Bulletin of the World Health Organization* 2002;80:325-30.
- Vergheze M, Mohan P. *When someone is hurt. A first-aid guide for lay persons and community workers*. New Delhi: Other Media Communications; 1998.
- Maine D. Lessons for program design from the PMM Projects. *International Journal of Gynecology and Obstetrics* 1997;59 Suppl 2:S259-65.
- Razzak JA, Cone DC, Rehmani R. Emergency medical services and cultural determinants of an emergency in Karachi, Pakistan. *Prehospital Emergency Care* 2001;5:312-6.