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*Review article*

# Pediatric emergency and critical care in low-income countries

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## Summary

The United Nations' Millennium Development Goal 4 is to reduce the global under-five mortality rate by two-thirds by 2015. Achieving this goal requires substantial strengthening of health systems in low-income countries. Emergency and critical care services are often one of the weakest parts of the health system and improving such care has the potential to significantly reduce mortality. Introducing effective triage and emergency treatments, establishing hospital systems that prioritize the critically ill and ensuring a reliable oxygen delivery system need not be resource intensive. Improving intensive care units, training health staff in the fundamentals of critical care concentrating on ABC – airway, breathing, and circulation – and developing guidelines for the management of common medical emergencies could all improve the quality of inpatient pediatric care. Integration with obstetrics, adult medicine and surgery in a combined emergency and critical care service would concentrate resources and expertise.

***Keywords:*** critical care; pediatrics; developing countries; millennium development goals

## Introduction

In 2000, the United Nations adopted the eight Millennium Development Goals (MDGs) as a focus for international development (1). Goal number four is to reduce the global under-five mortality rate by two-thirds between the baseline in 1990 and 2015 (1). Achieving the goal would save over six million lives each year. There has been some progress but in 62 countries, under-five mortality is not declining fast enough and in 27 countries the rate is stagnant or getting worse (1). The majority of deaths are occurring in low-income countries. Over 150 out of every 1000 children born in sub-Saharan Africa today will die before the age of five whereas in developed countries the rate is only six per 1000 (2). Without a radical improvement in child health in low-income countries, MDG4 will not be achieved.

At the latest United Nations meeting on the MDGs in September 2008 this disappointing progress was highlighted (3). To reduce child mortality, new efforts are required to improve nutrition and hygiene, increase breastfeeding, immunization coverage and vitamin A supplementation as well as to improve maternal education and knowledge about reproductive health. While these preventative measures are certainly important, many children will still become ill and require treatment. Strengthening

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health systems and giving good quality care is therefore a vital strategy to achieve MDG4. Pneumonia and diarrhea each kill two million children worldwide each year. Malaria kills one million and there are as many as three million deaths in the neonatal period annually (4). HIV, traffic accidents, trauma, and burns also cause significant mortality (5). Treating the patients suffering from all these diseases requires functioning health facilities. In particular, care for the sickest patients should be prioritized as they have the greatest risk of mortality. This review is based on a literature search (6) and the author's experiences of working in pediatrics and in the ICU of a rural hospital in Tanzania. It illustrates the obstacles to good care for critically ill children in low-income countries (defined in accordance with the World Bank country classification system) (7) and the measures that could be implemented to improve care.

## The current state of pediatric emergency and critical care

Emergency and critical care can be defined as all care given in hospital to patients with sudden, serious reversible disease. In low-income countries this care has been identified as one of the weakest parts of health systems (8,9). The problems begin as a patient comes to the hospital. There is often no emergency department and patients are first seen on a ward or in outpatients (10,11). There is usually little prioritizing of patients, no formal triage system, and clinicians see the patients in the order they arrive (12). Once a critically ill patient is identified, there can be delays in accessing emergency drugs and providing essential treatment (9). Critically ill children need rapid identification, prioritization and urgent treatment, and where hospital systems don't provide this the result can be disastrous. Fifty percent of deaths of children in hospital occur within 24 h of admission (13).

The critically ill are often admitted to general wards as many hospitals do not have an ICU (11). Recent studies have highlighted poor standards on pediatric wards in first referral level hospitals (9,14–16). Essential clinical signs in sick children such as respiratory rate and ability to drink are frequently not sought or recorded (15). Inappropriate monitoring and treatments were seen in 76% of inpatients in one study in Kenya (9). Established treatments and supportive therapies are not used and global strategies or national guidelines are not followed (14). The consequences of poor quality care will be most serious for the critically ill inpatients.

These problems can partially be explained by the massive lack of resources for health care in low-income countries. Many countries spend less than US$20 per person per year on health (as a comparison the UK spends US$2500) (17). There is a severe lack of doctors, nurses, and other health staff (18). Too few health professionals have been trained, and many are subsequently lost to other jobs or to the 'brain drain' to richer countries (19). There can be major deficiencies in laboratory and support services, hospital management, and equipment supplies (16).

Critical care services have additional challenges. As a specialty it has been neglected. Although the World Health Organization states that every hospital where surgery and anesthesia are performed should have an ICU, a recent survey from Zambia showed that only 7% of hospitals do so (20,21). In Tanzania, there are only 13 specialists in anesthesia and intensive care for a country of 39 million people (V. Mwafongo, personal communication). Physicians and nurses are rarely trained in critical care and lack the knowledge and methods for caring for the critically ill (19,22). There is a misconception that critical care has to be complicated and technologically sophisticated. Furthermore, working in under-resourced hospitals can lead to a sense of fatalism whereby very sick children are presumed to be beyond saving and left to take their chances. While some of these children are too ill to be saved, others have reversible disease and may respond to quick resuscitative therapies.

## Improving pediatric emergency and critical care

There is scope for improving emergency and critical care with a better use of existing resources rather than major financial or technological investment (23,24). The quality of care that hospitals provide has importance for overall population mortality and morbidity (14,24). Introducing Triage and Emergency Treatment, improving inpatient care and introducing hospital systems for prioritizing the very sick, would all have a significant effect.

## Triage and emergency treatment

Effective triage and emergency care is possible (25). A triage and admissions system can be organized to enable quick identification of critically ill patients, to ensure clinicians see these patients first and that more time is taken over their care than for stable patients (26–28). The Cape Triage Score, a nation-wide triage system in South Africa for children and adults has reduced waiting times and mortality rates (29,30). Emergency treatments can be immediately administered by nurses before a specific diagnosis is made and while waiting for a doctor (26).

The World Health Organization (WHO) has an established strategy for managing children in primary health centers. Known as the Integrated Management of Childhood Illness (IMCI), its introduction has led to an impressive improvement in care (31). Up to 20% of children treated through IMCI are referred to hospital (26). Emergency Triage and Treatment (ETAT) guidelines have now been developed to improve the initial hospital care for these children (26,32). Results from early trials have been promising (33,34). In Malawi, ETAT halved the pediatric inpatient mortality rate (10). Using the ETAT algorithm in Brazil (a middle income country) one in 40 children was found to need emergency treatment and one in six required priority treatment (33). ETAT should be implemented on a global scale.

## Intensive care units (ICU)

Hospital systems that are designed to prioritize critically ill patients would maximize the use of available resources for the greatest patient benefit (25). The presence of an ICU allows a concentration of critical care expertise, drugs, and equipment (35). Advanced intensive care using technologically sophisticated equipment such as ventilators, patient monitors, and syringe pumps would be inappropriate in most hospitals in low-income countries. Instead, an ICU should be set up rationally offering simple and effective therapies that depend on the local disease panorama, the hospital's financial and human resources and the community's needs. Such basic functions as a better standard of nursing care than on the wards, 24 h monitoring and the provision of oxygen can provide a vital service (20,36).

## Critical care knowledge

Health staff need to be better trained in caring for critically ill patients (9,14). Topics such as seeking and recording essential clinical features in sick children and following a simple A (airway), B (breathing) and C (circulation) approach should be emphasized (15,32). Undergraduate training for doctors, medical assistants, and nurses should have a greater focus on critical care. In-service training courses should be held regularly. Training has been shown to increase short-term knowledge and improve attitudinal skills and short courses in emergency and critical care of either 20 h or 2 weeks have had impressive effects (10,33,34,37). The introduction of appropriate routines and protocols can result in better management of patients and more efficient use of resources (10,35,38). Resources such as the new WHO pocket book 'Hospital Care for Sick Children' should be available and utilized (39). Regular clinical audits would also help raise standards generally (15).

## Oxygen

Many of the deaths from pneumonia, as well as deaths from other causes, are associated with hypoxia, and oxygen therapy can be life saving (40). Unfortunately inadequate oxygen administration is a major problem in low-income countries (9). Oxygen can be supplied using an oxygen concentrator or a cylinder. Oxygen concentrators are practical and cheap to run if the electricity supply is reasonably stable (40,41). Oxygen cylinders are robust, but transportation for refilling can be expensive and unreliable, making cylinders most useful as a back-up (20,42). Pulse oximetry, although still rare in developing countries, can allow identification and relative prioritization of hypoxic patients (20). Introducing a good oxygen supply and pulse oximetry in Papua New Guinea has been shown to reduce case fatality rates for pneumonia by 35% (43).

## Integrating pediatric emergency and critical care with other disciplines

Emergency and critical care is essential in specialties other than pediatrics. In order to tackle high maternal and neonatal mortality rates there is a need for good quality emergency obstetric and neonatal care

(44,45). A review from 2005 claims that there is a 'firm evidence base for promoting emergency obstetric care as a key strategy in reducing maternal mortality' (46). Reducing maternal mortality by three quarters is another of the MDGs (1). Emerging evidence suggests that neonatal resuscitation can and should be cheap and simple without compromising the quality of the intervention (44). Patients requiring postoperative stabilization have been shown to benefit greatly from good quality basic intensive care in sub-Saharan Africa (36). The WHO has recently published Essential Trauma Care guidelines which include recommendations for critical care services for trauma patients (5,47). All these disciplines involve the principles of triage, quick interventional treatments, and critical care. Introducing a combined service for the critically ill would concentrate resources and expertise and have the potential to improve quality of care and reduce costs.

## Costs

Emergency and critical care need not be expensive so long as the focus is kept on ABC and basic, cheap interventions. The package of emergency triage and treatment for children recently implemented in Blantyre in Malawi cost US$1.75 per patient, and it is believed that the triage and resulting rational treatments may have even reduced overall costs (10). Admitting a child with dehydration to give adequate oral rehydration fluids costs US$75 (48). Implementing an oxygen delivery system in Papua New Guinea cost US$51 per child treated (43). Laying an unconscious child in the lateral position to prevent aspiration is cost-free. Furthermore, even if improving emergency and critical care increases the costs, hospitals could become more cost effective through improvements in quality and there is certainly scope for enhancing efficiency in many health facilities (16).

## Conclusion

Pediatric emergency and critical care in a low-income country could look like the following: Children are first seen in an emergency ward where triage quickly recognizes the critically ill child. Emergency treatments are given quickly and the patient is transferred to an ICU. The ICU cares for adults as well as children in order to concentrate expertise and the nurses and doctors are trained in critical care. The nursing staffs monitor the patients regularly and record the essential clinical signs. There is at least once daily assessment by a doctor and out-of-hours medical cover. Guidelines on the unit describe how to manage common medical emergencies. An emphasis on ABC means unconscious patients are nursed in the recovery position, suction is available, oxygen concentrators are used for hypoxic patients, and dehydration and shock are recognized and treated quickly. Hypoglycemia is suspected early and treated. Emergency drugs and equipment available on the ward and staff and relatives do not need to leave the unit to fetch or pay for supplies. Such an emergency and critical care service would be realistic and could be established in most hospitals in low-income countries.

The UN has acknowledged that if the Millennium Development Goal to reduce child mortality is to be realized, US$10 billion is needed to strengthen health systems in low income countries (3). Improving emergency and critical care for children is feasible and would have the potential for a significant reduction in mortality. It should be central to this goal.

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