Systematic Review

Critical care in low-income countries

Tim Baker

Department of Physiology and Pharmacology, Karolinska Institute, Section for Anaesthesia and Intensive Care, Karolinska University Hospital, Stockholm, Sweden

Summary

Critical care in low-income countries remains rudimentary. When defined as all aspects of care for patients with sudden, serious, reversible disease, critical care is not disease or age specific and includes triage and emergency medicine, hospital systems, quality of care and Intensive Care Units. This review collates the literature on critical care in low-income countries and explores how the care can be both feasible and effective. Emergency care including triage is often one of the weakest parts of the health system; but if well organized it can be life-saving and cost-effective. Emergency triage and treatment has been developed for paediatric admissions with promising results. Hospital systems do not currently prioritize the critically ill and few hospitals have Intensive Care Units. The quality of care given to inpatients on hospital wards is often poor and could be improved in many ways. There is a lack of training and awareness of the principles of critical care. Basic critical care concentrating on ABC – airway, breathing and circulation – need not be resource intensive. Oxygen is a cheap and effective treatment for pneumonia and other severe disease, but is not always available. Improved critical care could have a significant effect on the burden of disease and effects of ill health. Research into the most cost-effective treatments and methods of caring for critically ill patients is urgently needed.

keywords critical care, developing countries, triage, emergency medicine

Introduction

Critical care remains in its infancy in many low-income countries (Amoateng-Adjepong 2006). In rich, industrialized countries caring for critically ill patients involves a co-ordinated system of triage, emergency management and Intensive Care Units (ICUs). This is complicated and unaffordable for many low-income countries. There is, however, a need for dealing with sudden, serious reversible disease in all countries in the world (Linton 1994; Kobusingye et al. 2005).

Indeed, the burden of critical illness is especially high in low-income countries (Dunser et al. 2006). Severe infections such as pneumonia, diarrhoea and malaria are endemic and traffic accidents, obstetric complications and surgical emergencies are all common. Ninety per cent of the 10 million children below 5 who die each year worldwide are in 42 of the poorest countries (Black et al. 2003). More than half of all maternal deaths occur on the African continent (Pearson & Shoo 2005). And 90% of trauma deaths occur in low or middle-income countries (Mock et al. 2005). Underlying malnutrition, poor health status or HIV cause patients to be weak and presentation to hospital is often late due to long travel distances and an inability or reluctance to pay hospital fees. Fifty per cent of child deaths in hospitals occur within 24 h of arriving at the hospital (Molyneux 2001). A survey from South Africa found that as many as 25% of medical admissions were sufficiently ill to merit admission to the High Care Unit (van Zyl-Smit et al. 2007). Treatments such as surgical operations and anti-retroviral therapy for HIV can cause life-threatening complications that increase the demand for critical care: 80% of peri-operative Caesarean section deaths occur on general wards in the postoperative period (Towey & Ojara 2007).

As the majority of critically ill patients in developing countries are children and young adults, there is a good potential for recovery (Jochberger et al. 2008). However, reported fatality rates are high (Dunser et al. 2006). For example, mortality for head injury in Benin is 70% and mortality for eclampsia in Senegal and Nigeria is 40% (Amoateng-Adjepong 2006). The care that critically ill patients receive in hospital is often informal and unco-ordinated or even absent (Gove et al. 1999; Dunser et al. 2006). Little work has been done looking specifically at critical care in low-income countries (Lipman & Lichtman...
The aim of this review is to collate the literature on critical care in low-income countries and to suggest future developments in this field. In this review, the term ‘critical care’ is used to cover all care given to critically ill patients and ‘low-income country’ is defined in accordance with the World Bank’s classification system.

**Method**

The literature review used the databases PubMed, WHO Library (WHOLIS), African Index Medicus, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Cochrane. Search terms used were: Developing Countries; Africa; Critical Care; Intensive Care; Intensive Care Units; Emergencies; Emergency Service, Hospital; Emergency Medical Services; Emergency Treatment; Emergency Medicine; Triage. Additional literature was found from the reference lists of retrieved publications. Further discussion is complemented by my experience of working on the ICU of a rural hospital in Tanzania.

What emerges from the literature can, for the purposes of this review, be divided into three areas: (i) triage and emergency care; (ii) ICUs; and (iii) quality of hospital care.

**Triage and emergency care**

Many hospitals in low-income countries lack a formal triage system (Nolan et al. 2001; Dunser et al. 2006; Wallis et al. 2006). Clinicians usually see the patients on a ‘first-come-first-served’ basis, there is often no emergency department and patients are seen in either the wards or the outpatients clinic when they arrive (Thomson 2005). This results in potentially deadly delays for critically ill patients (Wallis et al. 2006). Once a critically ill patient is identified, there can be further delays in initiating emergency treatment. Triage and emergency treatment have been identified as among the weakest parts of the health system (Gove et al. 1999; Razzak & Kellermann 2002).

Effective triage and emergency care has been described (Robertson-Steel 2006). A triage and admissions system can be organized to enable quick identification of critically ill patients, to ensure that clinicians see these patients first and that more time is taken over their care than for stable patients (Gove et al. 1999; Kobusingye et al. 2005; Maclennan et al. 2006). The Cape Triage Score, a nationwide triage system in South Africa, has reduced waiting times and mortality rates (Wallis et al. 2006; Wallis & Balfour 2007). Emergency treatments can be immediately administered by nurses before a specific diagnosis is made and while waiting for a doctor (Gove et al. 1999). Early warning scores (EWS) based on simple physiological parameters such as pulse rate and respiratory rate identify patients at higher risk of death in the United Kingdom (Subbe et al. 2001). Preliminary results from a study in Tanzania show that EWS could also be effective in a low-income country setting (J. Rylance, T. Baker, E. Mushig and D. Mashaga, manuscript in progress). Triage can also be used on hospital wards, as the condition of inpatients frequently changes during their stay in hospital, necessitating review and emergency treatment. Ward based triage and ‘Medical Emergency Teams’ (MET) have been established in some Western countries (Hillman et al. 2005). They involve ward nurses contacting an emergency team when physiological parameters deviate from the decided normal range. MET have not yet been evaluated for use in low-income countries.

A lot of work has focused on emergency care for children. As up to 20% of children treated in primary healthcare centres are referred to hospital, emergency triage and treatment (ETAT) guidelines have been developed to improve initial hospital care (Gove et al. 1999; WHO 2005). Results from early trials have been promising (Tamburlini et al. 1999; Robertson & Molyneux 2001): in Malawi ETAT halved the paediatric inpatient mortality rate (Molyneux et al. 2006). Using the ETAT algorithm in Brazil (a middle-income country) identified one in 40 children as needing emergency treatment and one in six as requiring priority treatment (Tamburlini et al. 1999). Treatment of these children could have been delayed without triage. ETAT has not as yet been implemented on a global scale.

To tackle high maternal and neonatal mortality rates, there is a need for good quality emergency obstetric and neonatal care (Pearson & Shoo 2005; Newton & English 2006). 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’ (Paxton et al. 2005). Emerging evidence suggests that neonatal resuscitation can and should be cheap and simple without compromising the quality of the intervention (Newton & English 2006). Both emergency obstetric and neonatal care revolve are based on the principles of triage, quick interventional treatments and critical care, and could form part of, and strengthen, a combined service for the critically ill.

**Intensive Care Units**

A hospital system that prioritizes the critically ill patients could maximize the use of available resources for the greatest patient benefit (Robertson-Steel 2006). Many hospitals in low-income countries do not have an ICU and seriously sick patients are treated on the general wards (Dunser et al. 2006). The presence of an ICU allows a...
concentration of critical care expertise, drugs and equipment (Watters et al. 2004). WHO states that every hospital where surgery and anaesthesia are performed should have an ICU (WHO 2003b), but a recent survey from Zambia showed that only 7% of hospitals do (Jochberger et al. 2008).

There is a wide range of the level of care that an ICU can provide, gradable through various systems. The United States National Institutes of Health (NIH) grade ICUs from Level I to IV (Lipman & Lichtman 1997): level I provide sophisticated care with 24 h specialist cover, level II units have a specific purpose such as coronary care, level III are community hospital ICUs with limited invasive monitoring and level IV are known as High Dependency Units. In Zambia, the grading from Level 1 to 3 is in the opposite direction (Watters et al. 2004). Level 1 ICUs provide basic monitoring and simple equipment with a cost of a few dollars per bed per day. Level 2 has mechanical ventilation and cardiac monitoring with a calculated cost in Zambia of US$76 per patient per day. Level 3 is advanced ICU with all possible sophisticated treatments and a cost of US$500–1000 per patient per day. In low-income countries, the advanced NIH Level I and II units are found only in academic or private centres (Lipman & Lichtman 1997).

The majority of ICUs in low-income countries are more basic NIH Level IV or Zambian Level 1, given the general lack of resources. Indeed, an ICU can provide a vital service with such basic functions as a better standard of nursing care than on the wards, 24-h monitoring and the provision of oxygen (WHO 2003b). An ICU that is set up rationally would prioritize basic and cheap therapies and fit into a coordinated service that benefits all critically ill patients. This would include both adults and children with any diagnosis. It would receive patients from all wards and departments as well as new admissions and post-surgery. It is not known how large ICUs should be in hospitals in low-income countries. In the USA, 13.4% of total hospital beds are for Critical Care (Halpern et al. 2004); in Cape Town in South Africa the figure is 6.6% (van Zyl-Smit et al. 2007). Even taking a low figure of 2% would mean that a district hospital with 300 beds should have a six-bed ICU (Watters et al. 2004).

The exact make-up of an ICU will depend on the local diseases, the hospital’s financial and human resources and the community’s needs. Ideally, a physician trained in anaesthesia and intensive care would be responsible for the ICU. This is not always possible and currently the medical input often comes from non-physician anaesthetic officers, medical assistants or other physicians. Nurses are frequently left to manage the patients themselves as the medical staff have more duties elsewhere (Dunser et al. 2006). It is not known which staffing system is optimal, but it is likely that a well-functioning ICU would emphasize training in critical care and medical presence on the unit. An example of a rationally developed ICU is St Marys Hospital Lacor in Uganda (Towe & Ojara 2007). On that eight-bed unit, there is a ratio of one nurse to four patients, one full time physician anaesthetist and one clinical officer. The focus is on simple therapies such as close monitoring, accurate intravenous fluid management, rational use of oxygen, adequate pain management, blood transfusions and renal output monitoring in the early postoperative period. As the majority of patients in that unit are surgical, ventilatory support has been introduced for postoperative respiratory failure.

One treatment particular to critical care that deserves special mention is oxygen. Acute respiratory infections are the main cause of death of children in developing countries (Perrelet et al. 2004). Many of these deaths, as well as deaths from other causes, are associated with hypoxia, and oxygen therapy can be life saving (Enarson et al. 2008). Unfortunately, oxygen is not always available. A survey from Tanzania showed that 75% of district hospitals had an oxygen supply for <25% of the year (WHO 2003b). Inadequate oxygen administration was found to be a major factor in the quality of paediatric care in seven developing countries (Nolan et al. 2001). 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 (Perrelet et al. 2004; Enarson et al. 2008). A WHO survey found that the capital costs of treating a patient with oxygen were between 0.42 and 1.97 US cents per hour (WHO 2003a). Oxygen cylinders are robust, but transportation for refilling can be expensive and unreliable, making cylinders most useful as a back-up (Dobson 2001; WHO 2003b). Pulse oximetry, although still rare in developing countries, can allow identification and relative prioritization of hypoxic patients (WHO 2003b). Introducing pulse oximetry together with a good oxygen supply reduced case fatality rates for pneumonia by 35% in Papua New Guinea (Duke et al. 2001, 2008).

Quality of hospital care

The quality of care that hospitals provide is important for overall population mortality and morbidity (Duke et al. 2003; English et al. 2004). There is a discrepancy between global strategies and national guidelines for the care of sick patients on one hand and actual practices in health facilities on the other (Reyburn et al. 2008). Recent studies have highlighted poor standards on paediatric wards in first referral level hospitals (Nolan et al. 2001; English et al. 2004). Traditionally, funding for curative services
has been concentrated in academic centres and tertiary hospitals, while public health funding has been spent on community interventions. District and rural hospitals have fallen between these two areas even though a majority of seriously ill patients are treated at such first-level referral hospitals (Duke et al. 2006).

One explanation for the poor quality of care is the huge lack of resources. Less money is spent on the total health budgets in many low-income countries than that spent on just intensive care medicine in industrialized countries (Dunser et al. 2006). Countries such as Uganda, Ghana and Pakistan each spend less than US$20 per person per year on health (WHO 2006). This has a huge impact on all aspects of the care of critically ill patients. There can be inadequate laboratory, X-ray and ultrasound facilities and a lack of essential drugs and basic equipment (Towey & Ojara 2007). Furthermore, in many low-income countries the patients pay for their care ‘out-of-pocket’; in India, for example, patients pay 78% of the healthcare costs directly (Dunser et al. 2006). In Burkina Faso, an emergency caesarean section costs the equivalent of 1.5 months’ salary of a civil servant (Richard et al. 2007).

Many hospitals are lacking in doctors, medical assistants, nurses and other health professionals (Narasimhan et al. 2004). Too few health staff have been trained, and many are subsequently lost to other jobs or to the ‘brain drain’ to richer countries (Lipman & Lichtman 1997). The lack of staff is felt most acutely by the critically ill as increased waiting times, rushed and superficial management and poor staffing on the wards can be life-threatening.

A lack of awareness of the principles of critical care is another obstacle to good quality care. Staff are rarely trained in caring for the critically ill (Molyneux et al. 2006). The World Federation of Societies of Intensive and Critical Care Medicine (WFSICCM) envisions a world in which ‘all critically ill and injured persons receive care from integrated teams of dedicated experts directed by trained and present intensivist physicians’ (Besso et al. 2006). In low-income countries, pre-service and university education in intensive care is limited or non-existent (Lipman & Lichtman 1997). In the hospitals, there is often little time or expertise for in-service training and staff development (T. Duke, unpublished observation).

There is scope for improvement with a better use of existing resources rather than major financial or technological investment (Duke et al. 2003, 2006). A focus on improving in-patient management and quality of care in district and rural hospitals is needed (Nolan et al. 2001; English et al. 2004); appropriate routines and protocols can result in better management of patients and more efficient use of resources (Watters et al. 2004; van Zyl-Smit et al. 2007). Training increases short-term knowledge and improves attitudinal skills, and short courses in emergency and critical care of either 20 hours or 2 weeks have had impressive effects (Tamburlini et al. 1999; Robertson & Molyneux 2001; Simkiss 2003; Molyneux et al. 2006). Specialist nurses or anaesthetic medical assistants trained in critical care are vital when physicians are scarce (Towey & Ojara 2007). Following a simple A (airway), B (breathing) and C (circulation) approach can be a successful way to organize critical care protocols (WHO 2005). The ideal way to improve the quality of hospital care is across all hospital disciplines and not to be restricted within vertical or limited programmes (Molyneux 2001; Duke et al. 2003). Critical care is one broad hospital-wide service that could achieve this.

Discussion

The WHO states that the three fundamental functions of a health system are to improve the health of the population, provide financial protection against the costs of ill-health and respond to people’s expectations (WHO 2000). Critical Care can contribute positively to all three functions: ‘It is clear that many of the conditions that contribute to the burden of disease in low- and middle-income countries can be mitigated through prompt treatment’ (Razzak & Kellermann 2002). Populations often have a self-perceived need of acute care for life-threatening conditions and emergency and critical care would respond to these expectations (Razzak & Kellermann 2002). Poor quality critical care that is unable to prevent avoidable deaths can discourage communities from taking sick patients to hospital, thereby further increasing mortality rates (Kobusingye et al. 2005).

A basic critical care service in a low-income country could look like this: a triage system quickly recognizes the critically ill patients. Simple emergency treatments are administered in the admissions area, and critically ill patients are transferred immediately to an ICU. On the ICU, a higher nurse:patient ratio than on the general wards allows regular monitoring of the patients and good record keeping with appropriate observation and treatment charts. Patients are reviewed regularly by the nurses, there is a daily assessment by a doctor and out-of-hours medical access. The nurses and doctors are trained in the principles of critical care medicine. There are simple and appropriate guidelines for managing common medical emergencies. Unconscious patients are nursed in the recovery position. Suction is available to keep airways clear, as are adjuncts such as oro-pharyngeal airways. Hypoglycaemia is suspected early and treated liberally. Dehydration and shock
are prevented and treated with oral rehydration solution and intravenous fluids. Oxygen is available and used for dyspnoeic patients. Emergency drugs such as diazepam and equipment such as intravenous giving sets and needles are available close to the bedsides. Staff and relatives do not need to leave the ward to fetch or pay for emergency supplies. Then, once stabilized, the patient is transferred to a general ward where ward-based triage can refer any deteriorating patient back to the ICU.

Such a basic critical care service would provide the most essential care for very sick patients and would be feasible in most low-income settings. So what prevents Critical Care services from looking like that? The huge lack of resources is an overriding issue that affects all areas of the health system. Deficiencies in drugs, equipment or health staff are all substantial obstacles. In such a setting, it is often the critically ill whose needs are not met. However, basic critical care need not be resource demanding. The package of emergency triage and treatment for children recently implemented in Blantyre in Malawi costs US$1.75 per patient, and it is believed that the triage and resulting rational treatments may have even reduced overall costs (Molyneux et al. 2006). Hospital systems currently do not prioritize the critically ill and are unable to act quickly and respond to emergency needs. Health staff have not been trained in critical care and lack the knowledge and methods for caring for the critically ill. Critical care medicine has been neglected. It cuts across many disciplines, is not age or disease specific and there are very few Intensive Care specialists. There is also a misconception that critical care has to be complicated and technologically sophisticated. Lastly, it is not known which treatments and routines are most cost-effective and how best to establish a critical care service in a low-resource setting.

To combat these problems, a new emphasis is needed on care for the critically ill. Training in Critical Care should be introduced and improved at pre-service and in-service levels. Hospital systems should be modified to include effective triage, emergency care and ICUs that can provide basic critical care. Importance should be placed on the development and acquisition of simple and inexpensive tools rather than complicated equipment. It is vital that these changes are made in a rational way to ensure the greatest benefit and prevent Critical Care from becoming expensive and diverting resources away from other needy parts of the health system. Research into effective methods for caring for the critically ill is urgently needed, and the cost-effectiveness of each intervention should be analysed in terms of the reduction in mortality and morbidity. Data collection should be rigorous to allow ongoing monitoring and evaluation of the services provided and their sustainability as part of the hospital and wider health system.

The WHO has developed global guidelines for ‘essential services’ aimed at major health problems which are low in cost and high in yield, and which can realistically be made available to almost everyone in a given population. Guidelines for Essential Critical Care would be an important addition to this series.

References


Critical care in low-income countries


