EDITORIAL

Critical care in Africa

Health care in Africa, and particularly sub-Saharan Africa, faces substantial challenges including the burden of disease and the limited resources available.

During the period 2000 - 2002 there were approximately 204 million undernourished people in sub-Saharan Africa,[1] with a high impact on health. As can be seen from Fig. 1,[2] death rates per year per 1 000 population for infections (including HIV) are substantially higher in sub-Saharan Africa than elsewhere in the world. The modelled death rates for road traffic injuries are 32.3/100 000 population[3] for both low- and middle-income countries in Africa – higher than anywhere else in the world.

The resources available for health care in the region are low, with most countries spending less than $100 per capita per annum (South Africa is an exception to this) and many spending less than $25. To put this in context, the World Health Organization (WHO) estimates that the minimum annual spending required to provide basic, life-saving services is US$35 - 50 per person.[4]

In addition there are huge deficits in the availability of trained health care personnel. Although sub-Saharan Africa has 11% of the world's population and bears over 24% of the global disease burden, it is home to only 3% of the global health workforce, and spends less than 1% of the world's financial resources on health.[5,6]

Critical care

In that setting it has been challenging to define the place of critical care. Recent reviews of critical care in the developing and least-developed countries[7-12] have all highlighted massive discrepancies between the load of critically ill patients and the resources available, huge differences between critical care in the rich and poor countries of the world, and an extreme shortage of published research regarding the place and development of critical care in the poorer parts of the world. As highlighted by Amoateng-Adjepong,[12] many of the published results of critical care from developing countries make depressing reading, with very high mortality rates.

Intensive care as recognised in developed countries is simply not possible in much of sub-Saharan Africa, as the necessary infrastructure, imaging and radiological services, laboratory services and other support systems are not available.[13]

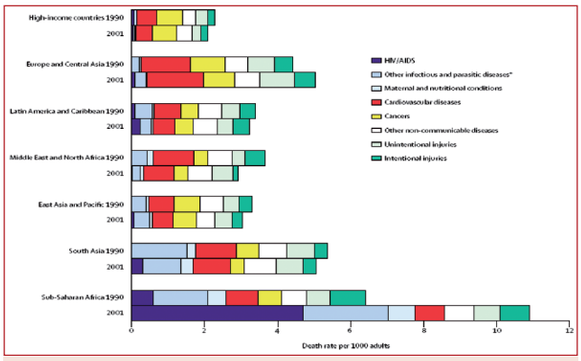

Fig. 1. Death rates per region for people aged 15 - 49 years (Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. Lancet *2006; 367: 1747-1757, reproduced with permission).*

Baker[10] has highlighted the fact that care of the critically ill extends from initial triage and emergency care, through hospital care to intensive care. In fact, this care may start earlier at the level of first responders and transport systems.[14]

At community level

In Ghana one programme undertook to train commercial drivers in the acute care of road traffic accident victims. At a cost per participant of approximately US$3 they were able to demonstrate a significant improvement in the quality of care provided to accident victims by the course participants.[15] The training of village health care workers in areas such as Cambodia and Northern Iraq has shown significant improvement in outcomes for trauma victims at very low cost.[16,17]

Transport

Scribante and Bhagwanjee[18] have shown that within South Africa there are substantial differences between provinces in the time taken to transfer critically ill patients to an intensive care unit (ICU) (average time for transfer ranged from 0.3 to 6 hours), showing that substantial improvements could be implemented in South Africa (again without massive expenditure). In Nigeria one of the major causes of maternal mortality at a teaching hospital complex was lack of transport.[19] Communication facilities are fundamental to the development of transport and emergency systems.[14] Before the introduction of mobile phones rapid communication throughout much of Africa was

extremely limited, and there are great opportunities to use cellular telephones to substantially upgrade the quality of emergency care throughout the region.[3]

Organisation of emergency services

Organisation of emergency services may have a dramatic impact on the outcomes of critical illness or injury. In paediatric practice, restructuring of emergency care at a teaching hospital in Malawi resulted in a nearly 50% reduction in mortality at minimal expense.[20] The essential trauma care project has provided guidelines for the resources and training required to provide essential trauma care for patients in a variety of income settings.[21-23] Despite the availability of triage systems[24-27] there are relatively few places where these have been implemented.

At the district hospital

Once patients have reached hospital systems, it is important to ensure that the appropriate infrastructure and care systems are in place. Many hospitals in Africa simply do not have adequate infrastructure including water, electricity and oxygen. Work in paediatric hospital care has shown some important directions for development. A review of the quality of care for seriously ill children in seven developing countries[28] showed that the quality of care was inadequate. Other studies focused on the levels and quality of paediatric care in district hospitals in a number of countries.[29-34] It was recognised that while considerable resources were being put into community-based medical services, and while academic tertiary centres tended to attract many resources, particular problems were encountered at the district hospitals that could be addressed with good effect on children's outcomes.[35]

The WHO has subsequently embarked on a well-designed training programme to improve the quality of care offered to the 10 - 20% of children who present to primary health care facilities and need referral and ongoing care (Table I). Every attempt has been made to base these recommendations on evidence-based analyses.[33,36]

One particular problem that was identified at a number of sites was the availability of oxygen. Hypoxaemia was identified as being both common and a predictor for mortality in sick children and neonates,[37-39] but clinical signs lacked sensitivity for diagnosis.[40,41] This was even more complex at high altitude, where tachypnoea was relatively common.[42] Wandi *et al*. demonstrated that if WHO criteria were used for the diagnosis of hypoxaemia, 29% of hypoxic children would have been missed while a further 30% of children who did not require oxygen would have been given it,[39] emphasising the need for pulse oximetry for accurate identification of hypoxaemia in children.

Particular attention was paid to the question of when oxygen should be administered to children, particularly at high altitude, where Subhi *et al*. concluded that 85% saturation was a reasonable cut-off for the administration of oxygen.[43] Further studies showed that if oxygen could be administered with some control using pulse oximetry there was a significant decrease in mortality.[38] A programme was then developed to provide oxygen systems to rural hospitals,[44] taking into account the real problems of installing and maintaining such systems (expense related to cylinders and liquid oxygen delivery in remote areas, and requirements for electricity and maintenance for concentrators)[45] and ensuring that appropriate technology is employed.[46] It was important not only to provide the means to administer oxygen, but also to monitor therapy. In 2008 Duke *et al*. demonstrated that there was a 35% reduction in the risk of death from pneumonia in a group of hospitals in Papua New Guinea where pulse oximetry and oxygen concentrators were introduced, in the context of a process that provided training, support and ongoing maintenance to the system.[47]

Intensive care

The WHO manual on surgical care at the district hospital makes the comment that 'Referral hospitals usually have an intensive care unit (ICU). However, facilities for intensive care should be available in every hospital where surgery and anaesthesia are performed.'[48] The manual goes on to define intensive care as follows: 'At the simplest level, the ICU is a ward that has a better standard of nursing and is better equipped than a general ward.' In fact there are extremely limited numbers of intensive care beds available throughout sub-Saharan Africa. In Zambia (with 11.7 million people), for instance, a survey of

Table I. World Health Organization training material for hospital care of children

The *Pocket Book of Hospital Care for Children*
Introduction course for the *Pocket Book of Hospital Care for Children*
Training Courses for Emergency Triage Assessment and Treatment (ETAT) and Management of Severe Malnutrition
Assessment tool for hospital care for children
Framework for quality improvement
Manual for quality improvement[29]

68 hospitals (including the teaching hospital and 4 referral hospitals) showed a total of 29 intensive care beds at 5 hospitals[8] (a 1988 study showed that of 200 patients given mechanical ventilation in an ICU in Zambia, 46 were discharged home[49]). This is a marked contrast to the picture in South Africa, where a survey of intensive care and high care[50] (which would be regarded as intensive care beds elsewhere in Africa) showed a total of 1 783 public and 2 385 private beds serving a population of 47 million people. The result is that in Africa many critically ill patients who would be admitted to ICUs in richer countries are treated in general wards with minimal staffing and facilities.[7]

Some of the paucity of intensive care beds may relate to the perception that 'Many ministries of health in these countries believe they are faced with a choice of funding prevention efforts v. providing funds for tertiary care services, which, by their very nature, cater to the very few.'[7] Several authors have recently argued that intensive care would be cost-effective in many developing countries[7,10] and could drop mortality by up to 50%,[7] thus having a very high impact on those who receive intensive care. This depends at least partly on the level of intensive care: basic monitoring and simple equipment may cost a few dollars per bed per day; mechanical ventilation and cardiac monitoring may cost US$76 per day (calculated in Zambia), while sophisticated intensive care may cost US$1 000 per day or more.[10] A review of the data in Table II and Fig. 2 suggests that for many countries in the region there are simply not enough health care resources to provide more complex care. The number of personnel with specific training in areas such as anaesthesia and critical care is extremely limited,[8,51] and there is considerable debate about the most effective ways in which to provide training for critical care staff in developing countries.[52-54] The possibility of intensive care in many areas is also limited by the availability of routine infrastructure such as laboratories,[55-57] blood banks with safe products[58,59] and medical imaging services. Even basic infrastructure may be limited, and in the Zambian study quoted above, a median of three

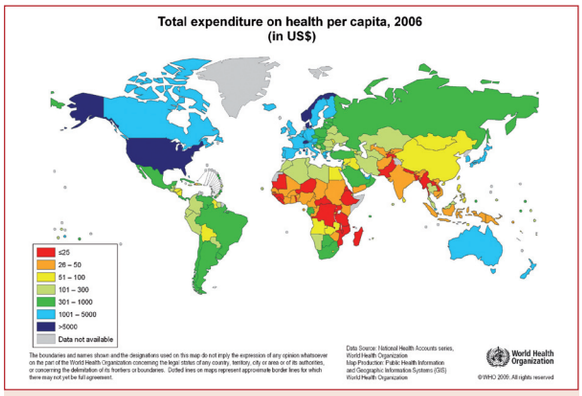

Fig. 2. International health spending per capita (http://www.who.int/nha/use/THE_pc_US$_2006.png, accessed 22 June 2009).

Table II. Health data[64]

Country	Population (millions)	Infant mortality rate (/1 000 births)	Life expectancy at birth (yrs) for males	Under-5 mortality (/1 000 live births)	Maternal mortality rate (/100 000 live births)	HIV (% of people aged 15 - 49 years infected)
USA	298	6	75	8.3	14	0.6
India	1 103	62	63	85	530	0.9
South Africa	47	67	47	75	230	21.5
Nigeria	131	103	45	197	800	5.4

Country	Income per capita (GDP per capita in US$)	Government health expenditure per person per annum (current US$)	Doctors per 1 000 population	Nurses per 1 000 population
USA	$39 710	$2 548	2.56	9.37
India	$3 100	$7	0.6	0.8
South Africa	$10 960	$114	0.77	4.08
Nigeria	$930	$6	0.28	1.7

power cuts a month were reported in the intensive care units.[8]

Clearly considerable research is required to evaluate both the role of intensive care in areas such as sub-Saharan Africa, and the ways in which it should be developed and funded.

The Nigerian experience

In this copy of *SAJCC* two articles on intensive care from Nigeria have been published,[60,61] one focusing on quality of care in the ICU[60] and the other on ICU admissions as a potential marker of quality of care in the operating room.[61] The authors are to be congratulated on collating and publishing these data, as there is a paucity of information regarding critical care in Africa. Nigeria is a populous country with limited resources available for health care within the government sector (Table II) and very limited numbers of health care professionals.

The number of beds available to the population of Port Harcourt and related regions is low at 8 beds for a population of some 9.5 million people,[60] but in a similar range to that reported in Zambia.[8] As in many other parts of Africa, intensive care is limited to patient monitoring and does not provide the option of mechanical ventilation. The overall mortality over the period of the study was 24.3%, while the mortality among patients who were regarded as requiring admission was 41.6%. These results are comparable to those of Isamade *et al.*, who reviewed admissions to the ICU at the Jos University Hospital in Nigeria between 1994 and 2002.[62] In that study 738 patients ranging in age from 1 day to 98 years (mean 28.3 years) were admitted with an overall mortality of 42.8%. The majority (48.2%) were admitted following surgery, with other groups being medical (15.2%), polytrauma (9.5%), burns (11%) and obstetrics and gynaecology (16.1%). Trauma (including burns) and postoperative surgical admissions accounted for >60% of deaths.

It is striking that 41.5% of patients admitted to the ICU in Port Harcourt 'did not actually require ICU admission' (mostly obstetric patients who were admitted because of lack of space in the maternity wards), while others with a guarded prognosis (e.g. burns greater that 65 - 90% of body surface area, severe head injury with Glasgow Coma Score <6) were also admitted to the ICU. Given the implications of maternal death and the maternal mortality rate in the region (Table II), it is possible that some patients did benefit from the ICU admission, and possibly the admissions reflect an appropriate concern for the welfare of these patients. Conversely, the number of patients discharged home from the unit (24.3%) suggests that many patients with relatively low severity of illness were being admitted. It would be particularly interesting to know how many patients who may have benefited from intensive care were not admitted to the unit over this period. Provision of these data would provide important information for future planning of admission criteria to the ICU.

In their discussion the authors have clearly highlighted the potential benefits to be gained from improved record systems, full-time medical (and nursing) staffing and the development of clear admission and discharge criteria. Internationally the literature has demonstrated that these interventions substantially improve the quality of care. It is also clear that a focus on the care of critically ill obstetric and trauma patients may be appropriate in this context.

Okafor *et al.*[61] have focused on the role of unexpected ICU admissions as a marker of adverse events in the operating room. While it is debatable whether unexpected intensive care admissions are a valid marker of quality of care in the operating room,[63] this approach has enabled the authors to identify problems in the management of patients with surgery closely related to the airway (and thyroid). Without a more complete review of outcomes of patients who were not admitted to the ICU after surgery, it may only identify certain types of problems (e.g. may not identify problems related to postoperative sepsis), and has certainly not identified 'near-miss' episodes in the operating room.

The authors also state that 'Eighteen of the 20 surgery-related UIA [unplanned intensive care unit admissions] could probably not have been predicted, compared with 5 of the 6 anaesthesia-related admissions', but do not provide evidence to support this statement. It would be interesting to perform a 'root-cause analysis' on the adverse events that have been identified in this study. Although the authors have concluded that experienced hands and improved skills are necessary in handling both anaesthetic and surgical procedures/operations in high-risk patients, they have not actually presented data to show that this is in fact the case. There is a concern that in the face of limited resources (where 'experienced hands' may not be generally available), this conclusion may divert attention from the development of working and training procedures that may have more impact on the quality of patient care.

Conclusions

In the face of huge burdens of disease, high numbers of critically ill patients in Africa and limited resources it is a significant challenge to determine the ideal nature and role of critical care in the region. It is possible that a view of critical care that extends beyond the ICU may be useful as we strive to optimise the care of critically ill or injured patients, or provide appropriate postoperative care following major surgery.

Ongoing research into and audit of the provision of critical care throughout the region is desperately needed and merits a focus of both funding and effort.

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