Good-quality research: a vital step in improving outcomes in paediatric intensive care units in low- and middle-income countries

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Child mortality in Africa is high and there are an estimated 3.5 million deaths annually in under-5s [1]. A proportion of these deaths will have occurred in hospital where inpatient mortality rates are relatively high (15–30%) [2–4], but the overall number of paediatric admissions either of those who survived or died has not been estimated as data have not been consistently collected by health services across countries. Many children presenting to hospital in sub-Saharan Africa arrive with severe forms of common childhood illnesses (especially malaria, diarrhoea, pneumonia, sepsis and meningitis) [2]. Over half the deaths in these children occur within the first 24 hours of admission, which illustrates how crucial it is to commence appropriate treatment quickly. Although this high immediate mortality may be partly because of delays in reaching hospital or failure to implement triage and early treatment [5], it is also because few children will ever be managed in an intensive care unit since these are lacking in most hospitals across Africa.

Management of the sick child is an important goal in reducing child mortality in low- and middle-income countries (LMIC) [6], and developing more effective emergency and intensive care services for children has been identified as crucial to making reductions [7]. Improving these emergency care services need not involve complex and expensive interventions: integration with other hospital services, prioritising the critically ill and introducing simple emergency treatments would be effective [8]. In addition, a vital step in achieving these objectives is good-quality research, including clinical trials of interventions in the emergency room. Many recommendations lack an adequate evidence base since the relevant research in LMIC settings is limited [9].

The article by Nyirasafari *et al*. [10] in this issue of Paediatrics and International Child Health, describing mortality in a paediatric intensive care unit in Kigali, Rwanda and highlighting the challenges faced by staff, adds important information to this research area and discusses how the data could be used to improve outcomes. Collecting data even on basic measures to arrive at a score and determine outcomes in paediatric intensive care units (PICU) may result in better adherence to national guidelines [11,12] and can help in comparing units, adjusting for their individual patient populations. Severity of illness and risk scores make these comparisons and risk-adjustments more straightforward but the authors, along with others, have found that risk scores developed and validated in high-income settings often need to be changed or modified to be applied in LMIC [10,15]. They created a modified paediatric risk of mortality (PRISM) score which had a range of 0– 30 and used only 5 of 17 components of PRISM, with a cut-off at 5 for severity; thus children would have had only one or two components with severely deranged physiology to satisfy the PRISM criteria.

The alternative is to develop a severity of illness score from scratch in LMIC settings and there has been an increase in these in recent years. They include the Lambaréné Organ Dysfunction Score (LODS) [13], Pediatric Early Death Index for Africa (PEDIA) [14], FEAST Pediatric Emergency Triage (PET) score [15], and Signs of Inflammation in Children that Kill (SICK) [16], some designed for diagnoses such as malaria [13] and others for more general admissions to a children's ward [14,15,16]. Some of these have already been externally validated and have shown good discrimination in similar emergency care settings [17] and could be extended with validation in PICU settings. Scores from high-income settings modified for LMIC also need to be externally validated as this is an important step in measuring the generalisability and suitability of the score [18]. An important point is that whilst such 'scores' will always show very good discrimination on the data from which they are created, validation is vital in assessing their practical use within the original setting and elsewhere. It is also important to highlight that, if the score helps identify

children with the prospect of an improving outcome rather than only those about to die, it should discriminate well in similar or different settings. Also, if a score is to be a part of triage, it needs to be tested as a part of standard clinical practice and so simplicity and ease of measuring the components will be vital. Validated risk scores that use easily recognisable clinical measures and can be calculated by nurses or doctors could also be used to help with increased monitoring and evaluation of the patient during admission.

Information from PICUs on the type of patient, disease burden and type of treatment currently available can also help advocate for new treatments or logistical interventions focussed on those diseases and patients [19]. These interventions need to be simple and effective and to work well where resources are limited, preferably across diseases too as children can have one or more comorbidities which are difficult to differentiate quickly. Also, by understanding the disease burden, countries and institutions can prioritise future interventions to identify those who would derive most benefit. These types of data can also feed into cost-effectiveness analyses to help research develop into policies, and policies to translate into practical guidelines used at the bedside.

The World Health Organization's Hospital Care for Children guidelines have been implemented in some countries with a training programme that helps staff with their professional development [20]. This is alongside other training initiatives and package interventions focussed on emergency care in LIMCs, such the Emergency Triage and Treatment programme (ETAT) [21]. These types of general guideline-driven interventions with several components have been shown to improve outcomes in emergency care [12,22], but the evidence (especially from clinical trials) for each component of the intervention is lacking. Training staff as teams can also help bring about positive changes in clinical environments and improve communication [23]. But, despite evidence for improved outcomes with protocols and algorithms for care, the study by Nyirasafari *et al*. highlights that their PICU was unable to adopt them, possibly because the unit was new or because of the patient burden combined with limited staff and resources [10]. It was also notable that there

was a large number of children on vaso-active drugs, possibly because of an algorithm incorporating aggressive fluid resuscitation despite the modest number with indications on admission for fluid-bolus therapy. Fluid bolus therapy has been the subject of a large, multi-centre, randomised controlled trial in African children which showed that, compared with children not given bolus therapy (controls), fluid boluses were harmful [24]. Using the data they have collected, the unit could re-evaluate their processes and try to implement the appropriate protocols and evidence-based interventions for their patient population and resources, thus potentially reducing their mortality rate.

PICUs in LMIC face many challenges but they are a key part of providing life-saving care to the many children who desperately need it. Improvements can be achieved in many different ways even when resources are limited [25]. Analysis and use of data collected in PICUs is vital to improving outcomes and is necessary to inform focussed and appropriate future research in these settings.

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