

Appropriate technology and education for improved intrapartum care in under-resourced countries



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Each year, over a million infants die worldwide during labour, while an even greater number die on the first day of life.¹ As deaths in the first 24 hours after delivery make up approximately a third of neonatal deaths and a fifth of deaths in under-5s, intrapartum events resulting in these losses need to be urgently addressed if the fourth Millennium Development Goal of reducing under-5 deaths by two-thirds is to be met by 2015.²

Both maternal and neonatal mortality rates are particularly high in sub-Saharan Africa.³ In South Africa the estimated neonatal mortality rate is 21/1 000 live births and the stillbirth rate 18/1 000 deliveries,⁴ figures far higher than those in industrialised countries. Twenty-one per cent of these neonatal deaths are due to 'intrapartum asphyxia',⁴ while 40% of stillbirths are 'fresh'.⁵ Of the latter, 46% are clearly attributed to 'intrapartum hypoxia' or antepartum haemorrhage.⁵ An intrapartum event is therefore closely related to many perinatal deaths and 'remains the most important cause of perinatal deaths in district hospitals' in South Africa, where 'large gaps exist in the vital areas of monitoring, supervision and decision making'.⁵

A review of missed opportunities and avoidable factors associated with perinatal deaths in the Perinatal Problem Identification Programme highlights too few well-trained and clinically competent staff as well as a lack of essential equipment as major defects⁵ in the health care system. A good understanding of the fetal response to the stress of labour and the ability to monitor fetal well-being and manage women in labour are needed.

When the fetus is faced with an inadequate supply of oxygen, the appropriate response is a bradycardia to reduce myocardial oxygen demands. During labour, this characteristically occurs towards the end of a contraction when the placental oxygen reserve is most depleted. Failure to manage the situation correctly and relieve fetal hypoxia may lead to perinatal death or morbidity due to meconium aspiration or multi-organ hypoxic damage, especially permanent cerebral injury. Monitoring the fetal heart rate is therefore an essential part of the management

of labour in order to detect these delayed decelerations and take appropriate action.

While the routine use of a partogram has improved the management of women in labour, care of the fetus remains problematic especially in district hospitals where suitable equipment is often not available. Albers⁶ and Banta and Thacker⁷ found intermittent auscultation to be a safe and effective method of fetal monitoring in low-risk pregnancies, while Mahomed *et al.*⁸ found that decelerations of the fetal heart rate in labour were detected more reliably with a Doppler ultrasound monitor than with a Pinard fetal stethoscope. Doppler ultrasonography is therefore ideally placed for routine use in the management of low-risk labours. It is also preferred by mothers to either the fetal stethoscope or cardiotocograph.⁹

Currently available Doppler ultrasound monitors are, however, inappropriately designed and not suitable for poor countries as they are expensive, require disposable batteries or reliable mains electricity, break easily and often cannot be repaired due to lack of maintenance services. What is needed is a built-for-purpose, robust and easy-to-use monitor that is relatively cheap and independent of conventional power sources.

To address this challenge, a team of South African and UK neonatologists (Professor David Woods of the University of Cape Town, Professor John Wyatt of University College London, and Dr Joy Lawn of the South African Medical Research Council) launched a not-for-profit company (Power-free Education and Technology) and partnered with the design team from FreePlay Energy in South Africa (project leader John Hutchinson, industrial designer Philip Goodwin and electronics designer Stefan Zwahlen) to develop and evaluate a Doppler ultrasound fetal heart rate monitor that met the requirements of under-resourced settings. The Freeplay fetal heart rate monitor has rechargeable batteries that can be charged from electric mains, a solar panel or a cigarette lighter fitting in a motor vehicle. If none of these are available, it can be hand-cranked to provide rapid recharging and



Demonstrating the hand crank to recharge the batteries of the Doppler ultrasound fetal heart rate monitor. One minute of winding provides 10 minutes of monitoring.



The wind-up pulse oximeter being used to measure the oxygen saturation of a preterm infant with respiratory distress receiving continuous positive airway pressure support.



The wind-up fetal heart rate monitor together with a wind-up pulse oximeter. Both would improve the emergency care of women in labour.

guarantee operation under most conditions. Every minute of winding provides 10 minutes of use. The heart rate is displayed digitally and the 'sounds' amplified to facilitate

finding a good signal. Limited field trials show the monitor to be accurate and reliable, and it has been well received by nursing staff in primary care delivery clinics. It will be manufactured by Ultrasound Technologies Ltd in Wales, UK.

A book on intrapartum care, written by professors Gerhard Theron and Bob Pattinson, has recently been added to the series of self-directed learning courses developed by the Perinatal Education Programme.¹⁰ The book enables the learner to master all the important lessons of intrapartum care, especially those of fetal monitoring. Measuring the fetal heart rate alone is of very limited value unless the significance of heart rate changes and the correct management is understood.

The innovative and very successful Perinatal Education Programme promotes self-study and group learning to improve knowledge,¹¹ clinical skills,¹² attitudes¹³ and patient care.¹⁴ Over 25 000 nurses, doctors and students have used the maternal care courses in South Africa. Together with the new national protocols and training scheme for basic intrapartum care, all doctors and nurses caring for women in labour in primary care clinics and hospitals now have the opportunity to improve patient care, especially in rural districts.

The promise of an appropriately designed fetal heart rate monitor and a learning course that enables health professionals to take responsibility for their own continuous education should reduce perinatal deaths and the number of survivors who suffer varying degrees of hypoxic cerebral damage.

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