# Telemetric antenatal fetal monitoring

**Paul C Duminy, Leon October**

**To the Editor:** The origin of antenatal fetal heart rate monitoring (AFM) appears lost in the mists of time. Odendaal,[1] in his signal thesis on cardiotocography, mentions that Legumeau de Kegadarek had first observed the occurrence of fetal heart rate decelerations in 1822, after which Von Winckel, in 1893, observed that bradycardia may be associated with poor fetal outcome. Electronic AFM has remained an integral part of obstetric practice since the early 1970s, when continuous monitoring became established and the true significance of decelerations was appreciated.

Developing communities often have inordinately high perinatal mortality and morbidity rates. This is associated with poor socio-economic conditions, malnutrition and a lack of sufficient antenatal care due to a variety of factors, including a chronic shortage of health funding, equipment and service providers. In sub-Saharan Africa there are 81 deaths per 1 000 live births compared with 14/1 000 in Europe.[2]

The South African health care system provides access to all levels of health care to the community at large. At primary care level patients are cared for by trained nursing staff, and should enjoy speedy referral to specialised centres as required. This

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ideal is often not realised owing to poor transport facilities and long distances that must be covered, non-availablity of sophisticated equipment and a shortage of medical personnel. This applies especially to rural areas, resulting in obstetric patients being at high risk and the attending midwives often having to manage their patients without physician support.

The Kraaifontein Midwives' Obstetric Unit (MOU) is a primary care centre in Cape Town serving some 30% of patients in the Karl Bremer Hospital (KBH) catchment area, delivering 1 500 - 1 800 babies per year. The unit is visited by medical officers (MOs) on a weekly basis but is otherwise reliant on telephonic consultation or ambulance transfer of patients when there is cause for concern. Because the MOU has not been designed and equipped to perform AFM, all patients requiring such monitoring are transferred to KBH, leading to unnecessary transfer by ambulance – an expensive resource in short supply. Such transfers often occur late in the day, resulting in unnecessary overnight hospitalisation and separation of these mothers from their homes and families.

## Objective

A descriptive, non-randomised cohort trial was undertaken to investigate whether AFM using electronic data transfer technology between two geographically separated facilities could reduce the load on human and other resources by avoiding unnecessary referrals and transfers. The system was used by staff who were largely computer illiterate. Their ability to utilise this technology and its acceptability to patients and staff were assessed.

## Materials and methods

The Fetal Assist Dopplex Centrale system from Huntleigh-Diagnostics (the system) was employed in the primary-to-secondary referral setting with the Kraaifontein MOU as the primary service provider and KBH as its secondary, referral hospital from January 2002.

The AFM used was the Fetal Assist, a small, A5-sized AFM machine complete with cardio- and tocographic monitoring capability and an on-screen cardiotocographic (CTG) display. Depending on the indication for the AFM, the tracings were stored for future reference but all were sent directly by modem via local telephone cable to the central receiving station (the Dopplex Centrale), located in the maternity section at KBH. The tracings were analysed by the medical staff and reported on by telephone to the MOU, together with any relevant instructions with regard to further management.

All patients who required routine CTG assessment were managed in this way. Patients requiring urgent delivery or transfer to KBH were excluded.

Outcomes analysed were adverse incidents, acceptability to patients and staff, and savings in terms of ambulance transfer and hospitalisation (measured in South African rands).

## Results

One hundred and forty-five patients were monitored without any untoward negative maternal or fetal incidents. The 42 patients who were monitored because of post-datism and who normally would not have been considered for transfer were excluded from further analysis. This report is based on the remaining 81 patients.

Despite initial fears that implementation of the system might lead to undue delays in diagnosis, treatment or transfer of patients with an increased incidence of adverse perinatal or maternal incidents, this was not demonstrated. In the case of the one baby who died, the fetal heartbeat was already absent at the time of presentation to the MOU.

Staff operating the system were largely computer illiterate. After a very brief introduction to the new technology, however, no operator difficulties were encountered. The system soon became so well established and accepted that it was used to monitor patients other than those originally envisaged, such as those with prolonged pregnancies where the finding of a normal AFM was reassuring to both midwives and patients. No patient objections were recorded with regard to being monitored, or to the system itself.

Because they are indigent most of our patients require ambulance transport, thus placing an additional burden on the already strained services. By using the system it was possible to avoid transfer of 22 out of 103 patients, freeing the ambulance teams to be deployed on more urgent matters.

Patients referred from the MOU are often transferred late in the working day as they are dependent on non-urgent ambulance transport. This usually results in overnight hospitalisation as no return transport is available, and such unwarranted bed occupancy denies other potential patients

**Table I . Cost of system (in South African rands) – 4-year projection with addition of 2 new Fetal Assist units per year**

| | | | | |
|---|---|---|---|---|
| Capital expenditure | | | | |
| Fetal Assist (2) | 84 000 | 84 000 | 84 000 | 84 000 |
| Dopplex Centrale | 40 000 | 0 | 0 | 0 |
| Cumulative | 124 000 | 168 000 | 252 000 | 336 000 |
| Saving realised | | | | |
| Ambulance transport | 16 200 | 32 400 | 48 600 | 64 800 |
| Hospital costs | 110 322 | 220 644 | 330 966 | 441 288 |
| Total | 126 522 | 253 044 | 379 566 | 506 088 |
| Yearly saving | 2 522 | 169 044 | 295 566 | 422 088 |
| Cumulative saving | 2 522 | 171 566 | 467 132 | 889 220 |

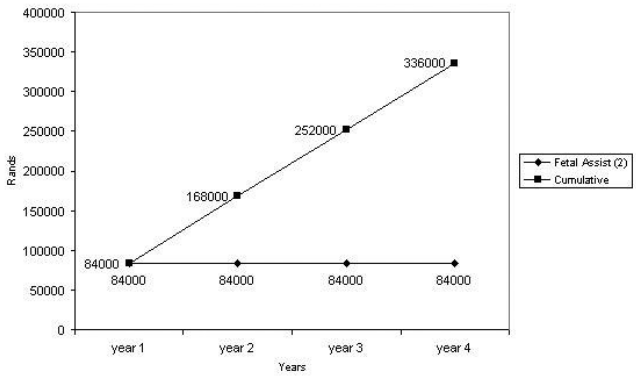


*Fig. 1. Cost of system (South African rands) — 4-year projection.*

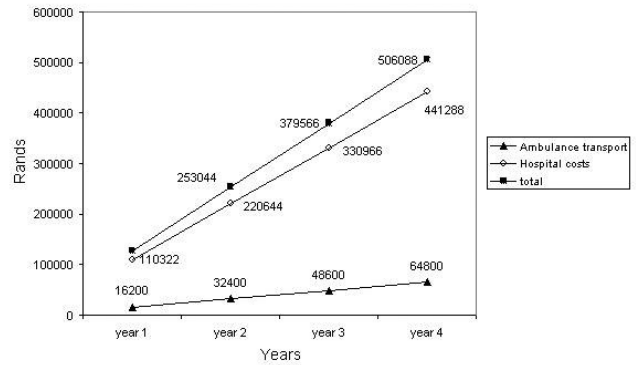


*Fig. 2. Direct saving — 4-year projection.*

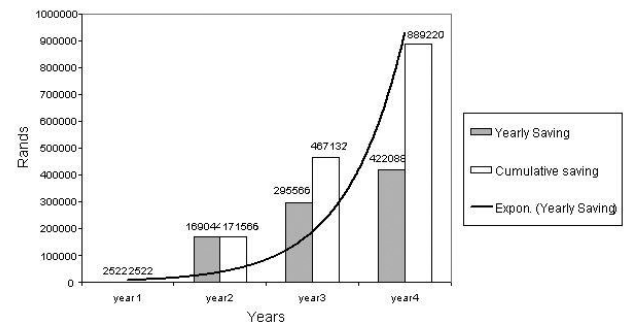


*Fig. 3. Total savings — 4-year projection showing exponential trend.*

admission and causes avoidable expense. The 1 - 1.5 days spent in hospital also causes stress to mothers who are separated from their families and homes.

Based on the above it is calculated that the direct savings related to the prevention of transfer of these 81 patients was as follows (Table I): (*i*) ambulance transfer – 81 patients at R100 cost to the state per patient = R8 100; (*ii*) hospitalisation for 1.5 days – 81 patients at R454 cost per day per patient = R 55 161; and (*iii*) total direct savings = R63 261.

Using the above assumptions a simple linear projection for the remainder of 2002 indicated a direct saving of some R126 522. Factoring in the capital investment of R124 000 for the complete system would realise a projected first-year saving of R2 522. No additional costs were calculated for telephone expenses, as these would have been incurred in any event.

Greater direct saving was projected during the second and subsequent years as further capital expenditure was not required, even if the patient numbers monitored remained constant. As the Dopplex Centrale is capable of being used as the central station for multiple Fetal Assists, saving would increase in an exponential fashion as new units are brought on line (Figs 1 - 3), assuming that similar numbers of patients would be monitored per Fetal Assist and notwithstanding the further capital expense incurred as projected (Figs 1 and 3).

## Discussion and recommendations

As far as we are aware this is the first such project undertaken in South Africa. We were able to demonstrate that the factors of distance and non-availability of medical consultation, often implicated in high perinatal mortality/morbidity figures, could be addressed by using currently available technology. Telemetric technology is feasible, affordable and highly acceptable to patients and health care providers. It is suggested that similar systems be considered for installation in all obstetric services with similarly structured referral systems. Such a system could also be applied in the private sector.

The introduction of such a system is cost-effective, with savings generated recouping original lays (Fig. 2) within months, with sustainable saving over time (Fig. 3).

Patients and staff at primary health centres enjoyed the greatly enhanced medical support and all in this study experienced it positively. Similar technology may be applied over the wider field of medicine. Within the near future even telephone lines may no longer be required[3] as cables are being replaced by faster and more reliable satellite communication.

Electronic data transfer, used successfully in many other spheres of modern-day life, must take its rightful place in medicine, especially in developing countries where improved care and support can be rendered to those most in need.

The enthusiasm and hard work of the nursing staff at the Kraaifontein MOU and the medical staff at KBH are gratefully acknowledged. The generosity and support of Huntleigh-Diagnostics of Cardiff, Wales, is much appreciated. We thank David Stanger who initiated the project, Neil Lambden who was responsible for the computer training and support, and Dr L Naude, Senior Medical Superintendent of Karl Bremer Hospital, for permission to publish.

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