Why babies die — a perinatal care survey of South Africa, 2000 - 2002

R C Pattinson, for the PPIP sentinel sites

Objective. To identify the major causes of perinatal mortality in South Africa.

Setting. Seventy-three state hospitals throughout South Africa representing metropolitan areas, cities and towns and rural areas.

Method. Users of the Perinatal Problem Identification Programme (PPIP) amalgamated their data to provide descriptive information on the causes of perinatal death and the avoidable factors, missed opportunities and substandard care in South Africa.

Results. A total of 8 085 perinatal deaths among babies weighing 1 000 g or more were reported from 232 718 births at the PPIP user sites. The perinatal mortality rates for the metropolitan, city and town, and rural groupings were 36.2, 38.6 and 26.7 / 1 000 births, respectively. The neonatal death rate was highest in the city and town group (14.5 / 1 000 live births) followed by the rural and metropolitan groups (11.3 and 10.0 / 1 000 live births respectively). The low birth weight rate was highest in the metropolitan group (19.6%), followed by the city and town group (16.5%) and the rural group (13.0%).

The most common primary cause of perinatal death in the rural group was intrapartum asphyxia and birth trauma (rate 6.92 / 1 000 births) followed by spontaneous preterm delivery (5.37 / 1 000 births). The most common primary cause of death in the city and town group was spontaneous preterm delivery (6.79 / 1 000 births) followed by intrapartum asphyxia and birth trauma (6.21 / 1 000 births) and antepartum haemorrhage (5.7 / 1 000 births). The metropolitan group's most common primary causes were antepartum haemorrhage (7.14 / 1 000 births), complications of hypertension in pregnancy (5.09 / 1000 births) and spontaneous preterm labour (4.01 / 1 000 births). Unexplained intrauterine deaths were the most common recorded primary obstetric cause of death in all areas. Complications of prematurity and hypoxia were the most common final causes of neonatal death in all groups.

Conclusion. Intrapartum asphyxia, birth trauma, antepartum haemorrhage, complications of hypertension in pregnancy and spontaneous preterm labour account for more than 80% of the primary obstetric causes of death.

S Afr Med J 2003; **93:** 445-450.

Historically, where there has been a dramatic reduction in maternal mortality, this has been associated with two technical phases.[1] The first phase is a description of the magnitude of the problem (both in local and in comparative terms) and the realisation that it is feasible to do something about it. The second phase is the acquisition of new (scientific) knowledge, the teaching of this new knowledge to health workers, and finally making the knowledge and facilities available to the vast majority of the population. This, coupled with a political will and pressure from the population to do something about it, has resulted in a dramatic drop in the maternal mortality ratio. The same principles exist for reducing perinatal mortality.

In South Africa, the ingredients for the second phase are in place. The scientific knowledge is available, the teaching systems are in place, and a health system exists that can provide health care to the vast majority of the population.

Medical Research Council Maternal and Infant Health Care Strategies Research Unit, Department of Obstetrics and Gynaecology, University of Pretoria and Kalafong Hospital, Pretoria

R C Pattinson, MD, FCOG (SA), MRCOG

However, the perinatal mortality rate is not known, nor the most common causes of perinatal death. Hence the magnitude and manageability of the problem have yet to be defined. This study was undertaken to fill that gap.

Methods

Users of the Perinatal Problem Identification Programme (PPIP) amalgamated their data to provide descriptive information on the causes of perinatal death and the avoidable factors, missed opportunities and substandard care in South Africa. PPIP was developed in the 1990s by the Medical Research Council (MRC) Research Unit for Maternal and Infant Health Care Strategies and has been extensively field-tested since 1996. PPIPis a simple, user-friendly computer-based programme. Once simple perinatal data have been entered, it calculates various perinatal care indices, describes the medical conditions that led to the perinatal death and lists the avoidable factors, missed opportunities and substandard care associated with the deaths. The data from various sites can be collated, thus enabling perinatal care indices, patterns of disease and avoidable factors to be analysed for various groups

of sites, e.g. provinces; levels of care; or metropolitan areas, cities and towns, and rural areas. Once this information is available, the priority problems are clearly identified and solutions can be sought. PPIP follows the ICASolution Audit System, described in 1995.[2] This system, although not time-consuming or labour-intensive, relies on the presence of regular perinatal mortality meetings to discuss the various deaths and the possible shortcomings in care. The classification system used in the PPIP to describe causes of perinatal death was first used in Aberdeen by Baird and Thomson in the 1940s, and is clearly defined in *Perinatal Problems: The Second Report of the 1958 British Perinatal Mortality Survey*.[3] The chief purpose of the classification system was to assist in the prevention of perinatal deaths, and therefore the aim of the Aberdeen classification system is to identify 'the factor which probably initiated the train of events leading to death'. This system clearly points to where prevention can be targeted. The classification system was modified by Whitfield *et al*.[4] in 1986 to bring it into line with modern obstetrics and this forms one of the systems used in the Confidential Enquiry into Stillbirths and Deaths of Infants. The Aberdeen classification was adapted again by Pattinson *et al*.[5] in 1989 for use in developing countries and again in 1995[2] to include the concept of avoidable factors, missed opportunities and substandard care.

The PPIPusers were grouped into three categories, those from metropolitan areas (as defined by the new mega-cities), cities and towns, and rural areas. This was done as it grouped the hospitals into naturally comparable units and covered most of the institutional deliveries occurring in those areas. The groups fall naturally into those areas with easy access to tertiary services (metropolitan group), those with easy access to secondary-level care, regional and district hospitals (city and town group), and those with access mainly to primary-level care district and subdistrict hospitals (rural group).

Seventy-three PPIPsentinel sites provided data, as given below:

Metropolitan. Addington, Chris Hani Baragwanath, Grey's, Kalafong, King Edward VIII, Mahatma Gandhi Memorial, Peninsula Maternity and Neonatal Services (Groote Schuur, Peninsula Maternity and Somerset hospitals and their midwife obstetric units) and Pretoria Academic hospitals.

Cities and towns. Calvinia, De Aar, Eben Donges, Empangeni, Frontier, Goldfields Regional, Jan Kempdorp, Kimberley, Klerksdorp, Kuruman, Ladysmith, Leratong, Louis Trichardt, Mafikeng, Madadeni, Mankweng, Middelburg, Potchefstroom, Rob Ferreira, Settlers, Springbok, Thabazimbi, Uitenhage, Virginia, Warmbaths, Witbank and Zeerust hospitals.

Rural. All Saints, Blouberg, Botlokwa, Ceres, C N Phatudi, Donald Fraser, Elim, Ellisras, F H Odendaal, Gelukspan, George Masebe, Groothoek, Helena Frans, Jane Furse, Kgapane, Letaba, Lydenburg, Mary Terese, Malamulele, Mapulaneng, Mecklenburg, Mokopane, Nkhensani, Port Alfred, Robertson, Seshego, Shongwe, St Elizabeth's, St Patrick's, St Rita's, Tintswalo, Themba, Tshilidzini van Velden, Voortrekker, W F Knoble and Witpoort hospitals.

Each site submitted its data electronically to the PPIP co-ordinating centre where it was collated. Data were collected for the dates 1 October 1999 - 30 September 2002. Not all hospitals were PPIP sites for the whole period; however, the data submitted were used. Descriptive data are presented as proportions of the total (percentages) and rates per 1 000 births. The proportional data identify the priority concerns for that group. The rates per 1 000 births allow for comparison between the various groups. This enables one to judge the real magnitude of the problem at the various sites. The data are descriptive and only standard statistical methods were used.

Results

Table I gives the data from all the PPIP sentinel sites. The city and town group has the highest perinatal mortality rate (PNMR) at 38.3 / 1 000 births and also the highest neonatal death rate (NNDR) at 14.5 / 1 000 births. The NNDR was consistently higher in the city and towns and rural areas for all birth weight categories, especially noticeable between 1 000 and 2 000 g (Fig. 1). There is a high low birth weight rate (LBWR) in all groups, but especially in the metropolitan and city and town groups, with the rates being 19.6% and 16.5% respectively. The stillbirth / neonatal death ratio was highest in the metropolitan area (2.75:1).

Table II describes the pattern of primary obstetric causes of death in the various areas, expressed as percentages and rates per 1 000 births. Unexplained intrauterine deaths constituted a significant proportion of deaths in each group (metropolitan 28.2%, city and town 23.6%, and rural 27.5%). The majority of these fetuses were macerated and there was insufficient information available to allocate specific causes. Intrapartum asphyxia and birth trauma were the major causes of death in the rural group (25.9%) and second most common cause in

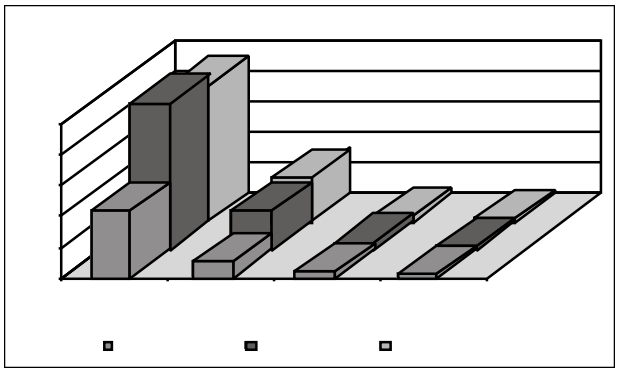

Fig. 1. Neonatal mortality rates in birth weight categories for metropolitan, city and town, and rural areas, 2000 - 2002.

Table I. Basic data and perinatal care indices for the PPIP sentinel sites, 2000 - 2002

	Metropolitan areas (*N*)	Cities and towns (*N*)	Rural areas (*N*)
Total deliveries ≥ 1 000 g	52 668	117 796	62 254
Live deliveries ≥ 1 000 g	51 269	114 951	61 284
Stillbirth ≥ 1 000 g	1 399	2 845	970
NND ≥ 1 000 g	508	1 670	693
Total deaths ≥ 1 000 g	1 907	4 515	1 663
PNMR (≥ 1 000 g)	36.20	38.33	26.71
NNDR (≥ 1 000 g)	9.91	14.52	11.31
NNDR 1 000 - 1 499 g	117	238	224
NNDR 1 500 - 1 999 g	35	69	77
NNDR 2 000 - 2 499 g	10	14	14
NNDR 2 500+ g	3	5	5
LBWR	19.6	16.5	13.0
PCI (≥ 1 000 g)	1.85	2.32	2.06
Caesarean section rate (%)	25.1	17.5	11.7
SB / NND ratio	2.75:1	1.7:1	1.40:1

NND = neonatal death; PNMR = perinatal mortality rate; NNDR = neonatal death rate; LBWR = low birth weight rate; PCI = perinatal care index; SB / NND ratio = stillbirth / neonatal death ratio.

Table II. Pattern of disease in metropolitan areas, cities and towns and rural areas, 2000 - 2002

	Metropolitan areas		Cities and towns		Rural areas	
	%	Rate / 1 000	%	Rate / 1 000	%	Rate / 1 000
Primary causes (≥ 1 000 g)	*N* = 1 907*	52 668†	*N* = 4 515	117 795	*N* = 1 663	62 254
Unexplained IUD	28.2	10.2	23.6	9.06	27.5	7.36
Spontaneous preterm labour	11.1	4.01	17.7	6.79	20.1	5.37
Hypertensive disorders	14.1	5.09	13.4	5.14	6.1	1.62
Antepartum haemorrhage	19.7	7.14	14.9	5.70	6.7	1.78
IUGR	3.0	1.10	1.8	0.69	0.6	0.16
Intrapartum asphyxia	8.7	3.15	14.4	5.50	22.9	6.12
Trauma	0.8	0.30	1.9	0.71	3.0	0.80
Infections	2.1	0.76	5.0	1.90	3.7	1.00
Fetal abnormalities	8.0	2.90	4.7	1.80	4.3	1.14
Maternal disease	3.2	1.16	1.7	0.65	1.5	0.40
Other	1.1	0.40	1.0	0.39	1.1	0.30
Final causes (≥ 1 000 g)	*N* = 508	51 269	*N* = 1 670	114 951	*N* = 693	61 284
Immaturity-related	28.3	2.81	41.1	6.00	32.6	3.69
Hypoxia	28.0	2.77	29.8	4.32	38.7	4.37
Trauma	0.4	0.04	0.5	0.07	1.2	0.13
Infection	18.9	1.87	14.5	2.11	9.1	1.03
Congenital abnormalities	16.5	1.64	8.3	1.21	7.9	0.90
Other	2.8	0.27	2.8	0.12	3.8	0.42
Unknown	5.1	0.51	3.0	0.43	6.8	0.77

*Total number of deaths.
†Total number of births.
IUD = intrauterine death; IUGR = intrauterine growth restriction.

cities and towns. Deaths due to these causes were significantly higher in the rural and city and town groups compared with the metropolitan group ($p < 10^{-6}$). The PNMRs due to antepartum haemorrhage were 7.14 and 5.7 / 1 000 births in the metropolitan and city and town groups respectively, occurring significantly more frequently than in the rural group ($p < 10^{-6}$).

Spontaneous preterm labour was the most common primary obstetric cause of death in the city and town group and occurred significantly more frequently than in the metropolitan and rural groups ($p < 10^{-6}$). Hypertension in pregnancy was the third most common primary obstetric cause of death in the metropolitan group and fifth most common cause in the city

and town group. If cases in the subcategory abruptio placentae with hypertension were included in the hypertension in pregnancy group, then death due to hypertension would be the second most common primary obstetric cause of death in the metropolitan group. Deaths due to hypertension occurred significantly less frequently in the rural group compared with the metropolitan and city and town groups ($p < 10^{-6}$). Death due to infection was the sixth most common cause of death in the city and town group and occurred significantly more frequently than in the metropolitan and rural groups ($p < 10^{-6}$). Testing for syphilis in perinatal deaths varied considerably at the various sites, with syphilis status being unknown in 35.4%, 35.3% and 54.3% of cases in the metropolitan, city and town and rural areas respectively. There is clearly underreporting on syphilis as a cause of death.

Immaturity was the most common cause of neonatal death in the city and town group and had the highest rate of any condition. Death due to this cause occurred significantly more frequently here than in the metropolitan and rural groups ($p < 10^{-6}$). Death due to hypoxia was the most common cause of neonatal death in the rural areas, occurring significantly more frequently than in the metropolitan group ($p < 10^{-6}$) but not the city and town group. Death due to infection was rarely reported in the rural group and syphilis testing was lowest in this group. The metropolitan areas had the highest rate of death due to congenital abnormalities.

Fig. 2 illustrates the rate per 1 000 births for the primary obstetric causes of death among babies with birth weights ≥ 2 500 g. Intrapartum asphyxia and birth trauma were the most common causes of perinatal death overall, responsible in metropolitan areas, cities and towns and rural areas for 20.4%, 35.8% and 45.3% of deaths respectively. If unexplained intrauterine deaths are excluded, then intrapartum asphyxia is by far the biggest problem in this birth weight category.

Spontaneous preterm labour is second to unexplained intrauterine death as the most common cause of perinatal death overall (Table II). There is a marked difference between the NNDR in the metropolitan areas and the NNDR in cities and towns and in the rural areas. This difference is most apparent between the birth weights 1 000 g and 2 000 g (Fig. 3). Unexplained intrauterine death was responsible for 49.7% of perinatal deaths in rural areas, 29.4% in cities and towns and 22.2% in metropolitan areas.

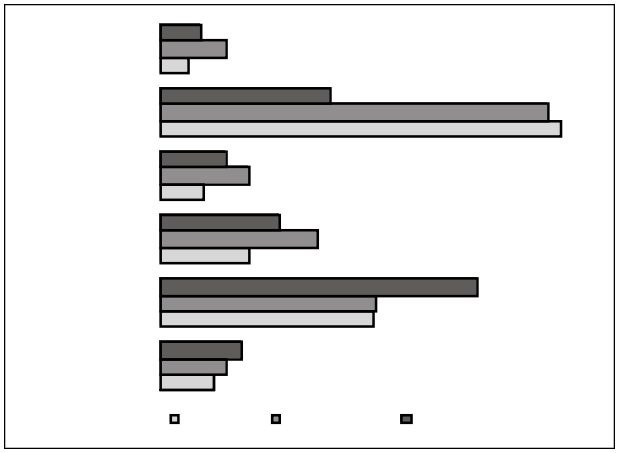

Fig. 2. Comparison of the rates of primary obstetric causes of perinatal death (> 2 499 g), 2000 - 2002 (rate/1 000 births).

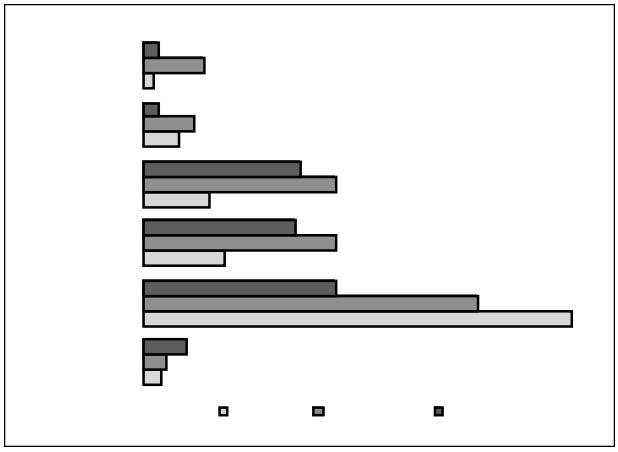

Fig. 3. Comparison of the rates of primary obstetric causes of perinatal death (> 999 < 2 000 g), 2000 - 2002 (rate/1 000 births).

Discussion

These data are unique in that most of the input is from non-academic hospitals, giving a relatively true reflection of the perinatal care situation in South Africa. However, it must be remembered that those hospitals supplying PPIPdata are likely to be of higher standard than those not supplying data. Hence the information is biased and probably reflects a more favourable situation than is generally the case. To achieve a true picture of perinatal mortality rates, the minimal dataset concerning births at all sites in South Africa is required.

Another weakness of the data is that they are not population-based. When the data are compared with population-based PPIP data available from five sites, the patterns are the same, but the mortality rates are slightly lower.[6]

Finally, the data systematically exclude births occurring in private institutions. Inclusion of these data would probably decrease the PNMR and NNDR. These limitations must be kept in mind when interpreting the data.

A high LBWR was found at all sites. This indicates a developing country where the majority of the population is poor. The LBWR is two to three times higher than in a developed country. A surprising finding requiring further

investigation is that the LBWR is reported to be approximately one-third lower in rural areas than in the metropolitan areas. There are various possible explanations. For example, mothers with small fetuses are referred to the cities and towns; women who go into labour prematurely in rural areas deliver their babies at home and are never recorded; and lifestyle in the rural areas is very different from that in urban and peri-urban areas. Any or all of these might explain the difference. It is a priority to establish whether the finding is correct and if so, why.

The stillbirth / neonatal death ratio (SB / NND) is unexpectedly high in the metropolitan areas. This is probably a reflection of good neonatal care. In the rural areas and cities and towns the ratio is much lower and the NNDR much higher. Stillbirths reflect antenatal care and neonatal deaths reflect care during labour and in the nursery. In a developed country, the SB / NND ratio is close to one. Where no care exists, and the stillbirth rate and NNDR are both high, the ratio will also be close to one. As communities start using institutions for birth, the care during and after labour improves. Complications during labour and the neonatal period are managed more effectively, hence the NNDR declines and so the SB / NND ratio rises. Finally, as the provision of antenatal care improves and pregnant women attend clinics, so the SB / NND ratio will decline. In developing countries there are usually many more stillbirths to neonatal deaths and the ratio is high. Irrespective of this, it is clear that the high number of stillbirths in the metropolitan areas suggests that much effort will need to go into improving the provision of antenatal care in the metropolitan areas. This is not to say that the same problems do not exist in the rural areas and cities and towns, but improving care during labour and in the nursery might be a higher priority in those areas.

Intrapartum asphyxia accounts for almost half of the perinatal deaths among babies born weighing ≥ 2 500 g in rural areas, and just more than 1 in 3 deaths in cities and towns. It would be expected that without the traumatic labour these babies would have been perfectly normal. The high rates of death due to intrapartum asphyxia and trauma at all sites, but especially in cities and towns and rural areas, are cause for great concern.

Spontaneous preterm labour is another very common primary obstetric cause of perinatal death. The neonatal death rates for babies born weighing between 1 000 g and 2 000 g is almost twice as high in the rural areas and cities and towns as in the metropolitan areas (Fig. 1). Spontaneous preterm labour is by far the most common cause of perinatal death in babies weighing between 1 000 g and 2 000 g at birth (Fig. 3).

Perinatal deaths due to antepartum haemorrhage and hypertension occur significantly less frequently in rural areas than in the other areas. This is a real difference and not just a proportional difference. Again the reason for this is unknown and one could speculate on the influence of lifestyle, especially smoking and stress, in women from the cities and towns. This aspect will need to be investigated further.

There is a surprising variation in availability of syphilis serology status for women who have had a perinatal death. One would expect syphilis testing to be especially thorough for those women who have lost a baby. Hence it should constitute the best case scenario of syphilis screening in the population served by the institution. However, in some areas the syphilis serology status of women who have had a perinatal death is not known in more than 80% of cases, demonstrating a serious lack of provision of basic antenatal care in these areas. Simple, inexpensive on-site methods of screening for syphilis are available[7] and there is no excuse for administrators not to ensure that screening is performed throughout. Deaths due to syphilis contributed significantly to perinatal mortality, and the number is clearly underreported. As syphilis can be effectively detected and treated, there can be no excuse for babies still to die from it, and certainly no baby who is alive when the mother enters the health service should die from syphilis.

There are a disturbing number of unexplained intrauterine deaths recorded in this survey. A number are recorded as such because of lack of information, such as the unknown syphilis status of the patients. However, for a large group there is adequate clinical information, but still no cause can be found. Also, the prevalence of these truly unexplained macerated intrauterine deaths appears to be rising (Kalafong Hospital PPIP data: all weight categories in 1994 — 11 / 1 000 births, 2 000 — 17 / 1 000 births, and for the Atteridgeville community in 1994 — 9 / 1 000 births and 2000 14 / 1 000 births). Previously, amniotic fluid infection syndrome (AFIS) was found to be a common cause. The clinical diagnosis is difficult and is usually only made after the birth of the baby. AFIS is usually a subclinical chorioamnionitis, which occurs in malnourished or immune-suppressed patients. Determining the actual cause of the unexplained macerated intrauterine deaths is important and might change the relative importance of the various categories of primary obstetric causes of death. Concurrent with the rise in incidence of unexplained macerated intrauterine deaths has been the rise of the HIV / AIDS epidemic. It has been well described that a pregnant woman who is HIV-infected has an almost four times greater chance of having a stillbirth and two times greater risk of preterm labour.[8] Perhaps there is a cause and effect relationship. If a major cause of unexplained intrauterine deaths is AFIS, a randomised trial on the role of prophylactic erythromycin in HIV-infected pregnant women would be very useful. This is a priority for investigation.

Conclusion

In South Africa we now have a good estimate of the magnitude of the problem of perinatal death. Intrapartum asphyxia, birth

trauma, antepartum haemorrhage, complications of hypertension in pregnancy, and spontaneous preterm labour account for more than 80% of the primary obstetric causes of death.

This article has been written on behalf of the all PPIP users in South Africa. Without their hard, dedicated work, none of this would have been possible. Collation of the data and co-ordination of the sites was expertly done by Roz Prinsloo. The study was partly funded by Save the Children USAthrough a grant from the Bill and Melinda Gates Foundation. The contents are solely the responsibility of the authors and do not necessarily reflect the views of Save the Children USAor the Bill and Melinda Gates Foundation. We are thankful for other funding from the Medical Research Council, the World Health Organisation and the National Department of Health.

References

1. De Brouwere V, Tonglet R, Van Lerberghe W. Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialised West? *Trop Med Int Health* 1998; **3:** 771-782.
2. Pattinson RC, Makin JD, Shaw A, Delport SD. The value of incorporating avoidable factors into perinatal audits. *S Afr Med J* 1995; **85:** 145-147.
3. Baird D, Thompson AM. The survey of perinatal deaths re-classified by special clinico-pathological assessment. In: Butler NR, Alberman ED, eds. *Perinatal Problems: the Second Report of the 1958 British Perinatal Mortality Survey* . Edinburgh: Churchill Livingstone, 1969: 200-210.
4. Whitfield CR, Smith NC, Cockburn F, Gibson AAM. Perinatally related wastage — a proposed classification of primary obstetric factors. *Br J Obstet Gynaecol* 1986; **93:** 694-703.
5. Pattinson RC, De Jonge G, Theron GB. Primary causes of total perinatally related wastage at Tygerberg Hospital. *S Afr Med J* 1989; **75:** 50-53.
6. Pattinson RC. Population based data. In: Pattinson RC, ed. *Saving Babies: APerinatal Care Survey of South Africa 2000*. Pretoria: Government Printer, 2000: 31-35.
7. Pattinson RC. On-site screening for syphilis — the time has come. *S Afr Med J* 1998; **88:** 780.
8. Brocklehurst P, French R. The association between maternal HIV infection and perinatal outcome: a systematic review of the literature and meta-analysis. *Br J Obstet Gynaecol* 1998; **105:** 836-848.

Challenges in saving babies — avoidable factors, missed opportunities and substandard care in perinatal deaths in South Africa

R C Pattinson, for the PPIP sentinel sites

Objective. To identify the most common avoidable factors, missed opportunities and substandard care in perinatal care in South Africa.

Setting. Seventy-three state hospitals throughout South Africa representing metropolitan areas, cities and towns, and rural areas.

Method. Users of the Perinatal Problem Identification Programme (PPIP) amalgamated their data to provide descriptive information on the causes of perinatal death and the avoidable factors, missed opportunities and substandard care in South Africa.

Results. A total of 8 085 perinatal deaths among babies weighing 1 000 g or more were reported from 232 718 births at the PPIP sentinel sites. Avoidable factors, missed opportunities and substandard care were reported to be patient-related (between 31.5% and 47.5% of deaths), due to administrative problems (between 10.1% and 31.1% of deaths), and due to health worker-related problems (between 28.4% and 36.0% of deaths) in the metropolitan and rural areas respectively. Figures for cities and towns lay between these ranges. Deaths due to intrapartum asphyxia and birth trauma were thought to be clearly preventable within the health system in 63.1%, 34.4% and 35.7% of cases in the metropolitan areas, cities and towns, and rural areas respectively. Deaths due to hypertension and antepartum haemorrhage were thought to be clearly preventable within the health system in 18.7%, 15.4% and 20.0% of cases in the metropolitan areas, cities and towns, and rural areas respectively. Far fewer preventable deaths were recorded in the spontaneous preterm labour category.

Conclusion. Concentration on the remediable priority problems identified (namely labour management, resuscitation of the asphyxiated neonate, and care of the premature neonate) makes the reduction of perinatal mortality in South Africa feasible and inexpensive.

S Afr Med J 2003; **93:** 450-455.

Medical Research Council Maternal and Infant Health Care Strategies Research Unit, Department of Obstetrics and Gynaecology, Universty of Pretoria, and Kalafong Hospital, Pretoria

R C Pattinson, MD, FCOG (SA), MRCOG

Historically, where there has been a dramatic reduction in maternal mortality this has been associated with two technical phases.[1] The first phase is a description of the magnitude of the problem (both in local and in comparative terms) and the