Saving Babies 2003:
Fourth Perinatal Care Survey of South Africa

Compiled by
MRC Research Unit for Maternal and Infant Health Care Strategies, PPIP Users, the National Department of Health, and the Saving Babies Technical Task Team

The report can be viewed on www.ppip.co.za

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  " All it takes for evil to flourish is for good people to do nothing" Burke
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Note: The **Perinatal Education Programme** has produced a training manual using maternal and perinatal audits called **Manual 5: Saving Mothers and Babies**. It is a very valuable tool for sites wanting to start with audits or to introduce new members of staff to maternal and perinatal audits. The manual can be obtained from:

Perinatal Education Programme, PO Box 34502, Groote Schuur, Observatory 7937, South Africa. Fax (021) 671 8030. Phone Distribution Manager (021) 671 8030, Editor-in-Chief (Prof. DL Woods) (012) 404 6022

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3. Intrapartum asphyxia and birth trauma – AP Macdonald, R van der Walt
4. Spontaneous preterm labour – WJ Steinberg, R Fuentes
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(Chapter heads underlined)

Foreword

Pregnancy is a unique physiological state in that it involves at least two individuals – the woman and the newborn. This dyad should bring to the attention of all health care givers the complexity in clinical management, particularly in recognition of factors that are predictors of significant adverse outcomes. In resource-limited countries, it is the extreme adverse outcomes that are still highly prevalent and are thus the main targets for intervention. High rates of maternal mortality and morbidity, and the considerable burden of perinatal mortality are health indicators that show the largest discrepancy in health care between poor and rich countries.

Most maternal and perinatal deaths and morbidities are preventable. The workings of the Committees on the Saving Mothers and Saving Babies Reports have gone a long way to identifying the major causes of maternal and perinatal deaths in South Africa. We can now confidently discuss these health indicators. In addition, this edition of Saving Babies, not only identifies the main causes of perinatal deaths and gives more details about events surrounding these cases, it also illustrates that the use of computerized software packages resulting in huge databases is possible in resource-limited countries.

Ideally, each perinatal mortality should be assessed in a manner similar to that of Confidential Enquiries into Maternal Deaths. This is still not possible but the latest Saving Babies Report gives us a scenario which can be regarded as the best picture because we must be conscious of the concept of the "inverse case rule" which implies that the highest number of deaths may be occurring at sites with least health resources. Nonetheless, the recommendations and health strategies made in this report must be implemented to reduce perinatal deaths and look forward to addressing issues of morbidity and quality of care for women and their children, who form the bedrock of any society.

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Executive Summary

Key findings

The PPIP users have performed a mammoth task and coupled with the superb PPIP v2 software, a clear picture of perinatal care in South Africa has emerged. There have been some incorrect classifications and there were differences in interpretation of avoidable factors, missed opportunities and substandard care. However, the strength of the data lies in its size of the sample (462348 births and 12773 perinatal deaths) and the distribution of health institutions participating (102 institutions throughout all areas in South Africa). The picture drawn by the data is the best scenario for South Africa, as usually only the most concerned hospitals perform audit and are prepared to share their problems with other institutions.

The most immediate and important problem identified is that of managing the pregnant woman in labour. Intrapartum asphyxia and birth trauma were responsible for about one in five of all deaths recorded in the database. This varied between one in four in rural areas to one in seven in metropolitan areas. More than three quarters presented with a live baby at the institution and more than three quarters of the infants weighed more than 2.5 kg. More than three quarters of the neonatal deaths due to hypoxia could be attributed to this primary cause. These babies should not have died. Analysis of avoidable factors and further in-depth analysis of another 100 cases indicated that the majority occur in low-risk women with apparently uncomplicated labour. The major avoidable factors were the failure to detect or respond to evidence of fetal distress. In other words, basic standard management of labour is not being provided to all women in labour. Labour is unpredictable and all women in labour must have at least hourly monitoring and this requires staffing of labour wards at the equivalent level of a high care ward. Resuscitation of the hypoxic infant must be an essential skill of all health workers involved in delivering babies.

The next clearly identified problem is the high proportion of unexplained intrauterine deaths, almost one in four. More than 80% of the babies were macerated, they constituted the majority of deaths in the 1.5-2.5 kg weight category, and comprised 23% of the deaths in babies over 2.5 kg. This must be seen in the context of idiopathic intrauterine growth restriction, post-maturity and congenital abnormalities being rarely diagnosed outside of institutions associated with medical schools, and the high proportion (39% of cases) where the syphilis serology was unknown. The higher proportion of neonatal deaths resulting from congenital abnormalities than intrauterine deaths is further evidence of the under diagnosis of congenital abnormalities. If good antenatal care is provided, all four of these conditions can be easily detected, and with intrauterine growth restriction, post maturity and infections the deaths can be prevented. Although poor or no attendance at antenatal care was recorded as an avoidable factor in one in five cases of unexplained intrauterine deaths, the majority of women did attend antenatal care. Furthermore, surveys have indicated that 95% of women countrywide attend antenatal care when pregnant. Hence, the high proportion of unexplained intrauterine deaths is probably a good indication that the quality of antenatal care is poor.

The finding that more than half of the deaths due to complications of hypertension in pregnancy were macerated stillbirths and the most common avoidable factor was lack of referral to the appropriate level of care provides further evidence of poor quality of antenatal care. Hypertension was a common cause of perinatal deaths (10%), with two thirds occurring in the 1-2 kg weight categories, disturbing is the fact that one third occurred over 2 kg, clearly where intervention could have prevented the death.

Spontaneous preterm birth is a major cause of perinatal death with approximately one in six deaths being due to this primary cause. Almost 80% of the deaths due to immaturity could be attributed to this primary cause. Prevention of premature births is not possible at present, leaving care of the immature infant as the only possible mechanism to reduce this neonatal mortality rate. The finding that the metropolitan areas have less than half the neonatal morality rates experienced for infants born between 1 and 2 kg in the cities and towns indicates it can be done.

Abruptio placenta is a major cause of death (12%) and is the only major primary cause where there is no clear solution or strategy to reduce the deaths. Perhaps the most important finding is the much higher prevalence in urban areas than rural areas. Lifestyle issues such as smoking might be an important factor where preventative measures might be directed.

Recommendations

1. Perinatal mortality audits must occur in each institution conducting births
2. Ensure adherence to standard protocols in:
    a. Monitoring the mother, progress in labour and the fetus during labour and ensure appropriate action is taken when abnormalities occur;
    b. Neonatal resuscitation;
    c. Basic care of all neonates post resuscitation;
    d. Antenatal care especially with respect to hypertension, detecting and managing intrauterine growth restriction and post term pregnancies and syphilis;
    e. Voluntary counselling and HIV testing, prevention of mother to child transfer and antiretroviral treatment for those that meet the criteria;
    f. Evaluation of a stillbirth.
3. Kangaroo mother care should be the primary way to manage stable low birth weight infants.
4. All level 2 and 3 hospitals involved in the care of neonates should be able to provide respiratory support using at least nasal CPAP.
5. A system of outreach programmes should be established to cover the whole country that includes support for, education and audit of the sites visited.
6. Early confirmation of pregnancy and immediate initiation of antenatal care on confirmation of pregnancy should be the norm.
7. Health promotion to the public should include messages on early confirmation of pregnancy and initiation of antenatal care, attention to

fetal movements, appropriate action to danger signs, and plans for getting to the institution where the birth is planned.

8. Establishing staffing and equipment norms per level of care must be performed for every health institution concerned with the care of pregnant women.
9. Criteria for referral and referral routes must be established and utilized appropriately in all provinces.
10. Provincial Maternal Child and Women's Health units to primarily ensure the minimal perinatal data set is completed and analysed for each institution in their province.

Implementation strategy

1. Quality assurance programmes to be introduced in each institution providing care for pregnant women for:
    a. Antenatal care;
    b. Intrapartum care;
    c. Neonatal resuscitation;
    d. Basic post resuscitation neonatal care.
2. In-service training on:
    a. Antenatal card;
    b. Partogram;
    c. Fetal Heart Rate monitoring including electronic monitoring;
    d. Neonatal resuscitation;
    e. Basic neonatal care;
    f. Kangaroo mother care;
    g. Nasal CPAP use;
    h. Conducting audits.
3. Incorporate in the job description, change the job description or create dedicated posts for implementing the outreach strategy such that the outreach programmes can support, educate and audit the institutions in the above fields.
4. Provide the infrastructure to establish pregnancy confirmation and initiation of antenatal care at a single visit at the same site. Distribution of antenatal cards to general practitioners should be part of this. This could be by promoting "antenatal friendly clinics" and allowing for easy access and incorporating general practitioners in the antenatal care system.
5. Use the different media to promote specific clear messages about pregnancy.
6. Insist all institutions conducting births complete the minimal perinatal data set monthly and submit it to their provincial MCWH unit.

Conclusion

Analysing the data clearly suggests that the factor underlying most of the deaths is the poor quality of care, whether, antenatal, intrapartum or in the neonatal period. There are many reasons for this; probably most important are lack of personnel, facilities, knowledge and poor morale.

The recommendations and strategies dealing with these issues must be implemented.

Chapter 1
The how, when, where, what and why babies die in South Africa

Since 2000, a wide range of hospitals have been submitting data obtained from perinatal audits based on the Perinatal Problem Identification Programme (PPIP). The database at the end of 2003 consisted of just under 500 000 births with close to 13000 perinatal deaths 1000g or more. The software for the programme has been upgraded and the data transferred to the new version (PPIP v2.4b). The larger database enables a greater depth of analysis and this coupled with the PPIP v2 allows new insights into perinatal care in South Africa. Analysis of the data enables the how, when, where, what and why babies die in South Africa to be answered. This chapter gives an overview of the findings.

The methods and definitions used are given in Appendix 1. Data was submitted electronically from metropolitan areas (29 institutions), city and towns (39 institutions) and rural areas (34 institutions). The data was amalgamated for the time period 1st October 1999 to 30th September 2003. Table 1.1 gives the perinatal care indices and Figure 1 illustrates the mortality rates for the different areas.

Table 1.1. Comparison of perinatal care indices between the different areas of South Africa

≥1000g	South Africa	Metropolitan	City & Town	Rural
Total births	**462348**	204193	150026	108129
Total live births	**454639**	200738	147559	106342
Total SB	**8269**	3455	3027	1787
Total NND	**4502**	1494	1856	1152
Total Deaths	**12773**	4949	4885	2939
PNMR	**27.63**	24.24	32.56	27.18
SBR	**17.88**	16.92	20.18	16.53
NNDR	**9.90**	7.44	12.58	10.83
LBWR %	**15.4**	17.6	17.6	13.3
PCI	**1.79**	1.4	2.0	2.0
SB:NND ratio	**1.64**	2.1	1.6	1.5

Figure 1.1. Comparison of mortality rates in the different areas in South Africa

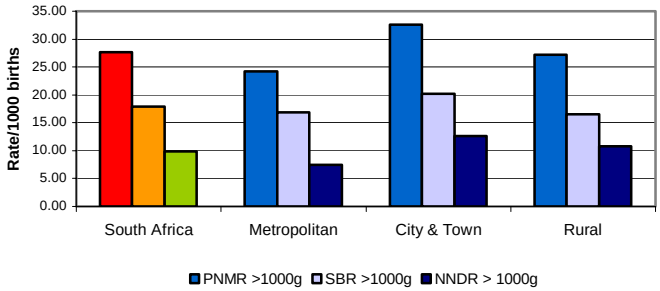


Figure 1.2. Comparison of stillbirth rate for the different areas and weight categories

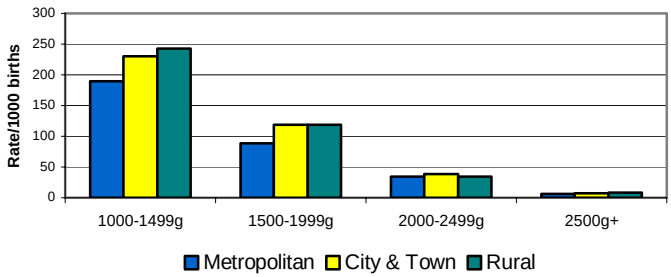
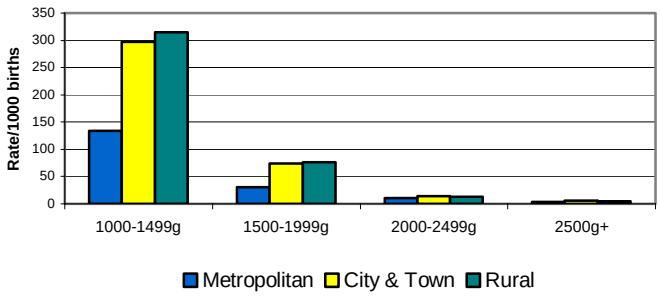


Figure 1.3. Comparison of neonatal death rate for the different areas and weight categories



Figures 1.2 and 1.3 illustrate the differences in mortality rates for stillbirths and neonatal deaths in different weight categories. Although the stillbirth

mortality rates are slightly better in the metropolitan areas, the most glaring difference is in the neonatal death rate where the metropolitan areas have half the rates that the city and town and rural areas have, for babies between 1 and 2 kilograms. To make an impression on PNMR the neonatal care in city and towns and rural areas must be improved.

Table 1.2 gives the route of delivery (where recorded) at the various levels. In the metropolitan area, the route of delivery was not recorded in 23,0%, 6.8% in city and town and 1.8% in rural areas. The relative proportions of forceps and vacuum deliveries were not recorded. The metropolitan areas performed the highest proportion of caesarean sections, and the least number of assisted deliveries. The city and towns performed the highest rate of assisted births, but this was still very low at 1.9%. The lowest caesarean section rate was in the rural areas 14.7%. The national average of each route of delivery may be inaccurate given the relative large proportions of births in the various areas was unknown.

Table 1.2. Routes of delivery for the different areas

	Metropolitan		City and Town		Rural	
Route of delivery	**N**	**%**	**N**	**%**	**N**	**%**
NVD	118795	74.2	110638	78.1	88038	82.3
Vaginal Breech	2006	1.3	2179	1.5	1411	1.3
Assisted delivery	1713	1.1	2707	1.9	1751	1.6
Caesarean section	37640	23.5	26170	18.5	15757	14.7
Total recorded	160154	100.0	141694	100.0	106957	100.0

Primary Obstetric Causes of Death

Figure 1.4 illustrates the categories of primary causes of perinatal deaths in South Africa. The category antepartum haemorrhage has been split into abruptio placenta (including abruptio placentae associated with hypertension) and other causes of antepartum haemorrhage, namely placenta praevia and antepartum haemorrhage of unknown origin.

Figure 1.4. Primary obstetric causes of death in South Africa

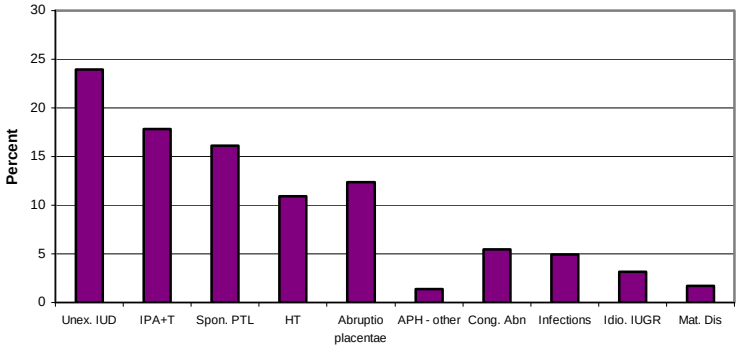


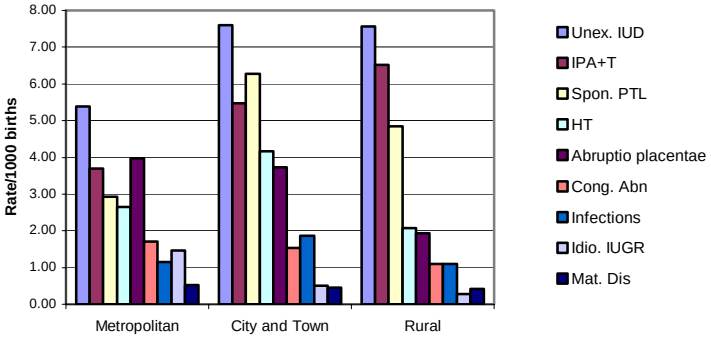
Table 1.2 compares the primary obstetric causes of deaths for the different areas.

Table 1.2. Comparison of the primary obstetric causes of death between the different areas

	Metropolitan			City and Town			Rural		
≥1000g	Number	%	Rate/1000	Number	%	Rate/1000	Number	%	Rate/1000
Unex. IUD	1098	22.2	5.38	1140	23.3	7.6	818	27.8	7.57
IPA+T	754	15.3	3.7	821	16.8	5.47	704	24.0	6.51
Spon. PTL	596	12.0	2.92	940	19.3	6.27	524	17.8	4.85
HT	542	11.0	2.65	626	12.8	4.17	224	7.6	2.07
Abruptio placentae	811	16.4	3.97	560	11.5	3.73	210	7.1	1.94
Cong. Abn	349	7.1	1.71	230	4.7	1.53	119	4.0	1.1
Infections	234	4.7	1.15	281	5.8	1.87	119	4.0	1.1
Idio. IUGR	298	6.0	1.46	75	1.5	0.5	30	1.0	0.28
Mat. Dis	106	2.1	0.52	67	1.4	0.45	44	1.5	0.41
Other	104	2.1	0.51	72	1.4	0.47	97	3.3	0.9
APH - other	55	1.1	0.27	73	1.5	0.49	50	1.7	0.46
Total	4949	100	24.24	4885	100	32.55	2939	100	27.18

Figure 1.5 illustrates the categories of primary causes of death per area.

Figure 1.5. Comparison of primary causes of death in different areas



Almost 1 in 4 perinatal deaths were unexplained stillbirths (Unex. IUD) and this was the most common category of death in all areas of the country. Unexplained stillbirths comprise a conglomerate of primary causes, most likely undiagnosed intrauterine growth restriction, post term pregnancies, infections and congenital abnormalities. These categories are probably under represented and are important as interventions are available to prevent these deaths (see Chapter 2).

Perinatal deaths due to intrapartum asphyxia and birth trauma (IPA+T) were mostly preventable and were the most common primary obstetric cause as a whole. They occurred most commonly in rural areas followed by cities and towns, namely in under resourced primary and secondary levels of care. Deaths due to spontaneous preterm birth (Spon. PTL) are most common in city and towns. Abruptio placenta and complications of hypertension in pregnancy (HT) occurs predominantly in urban areas (metropolitan areas and city and towns). Congenital abnormalities (Cong. Abn) were under represented in city and towns and rural areas probably indicating under diagnosis. Infections were most common in cities and towns, but given the high proportion of perinatal deaths that were not tested for syphilis and this indicates that syphilis was clearly under-represented. Idiopathic intrauterine growth restriction and post term pregnancies (Idio. IUGR) were rarely diagnosed outside of metropolitan areas. Pre-existing maternal disease (Mat. Dis.) excluding hypertension are rare causes of perinatal death.

Figures 1.6 and 1.7 illustrate when the deaths occurred in relation to birth and admission to a health institution for the various categories of death. This form of data analysis is only available in PPIPWIN v2. About 82% of unexplained stillbirths were macerated. More than half (56%) of deaths

due to IPA+T were early neonatal deaths and in a further 21% the fetus was alive on admission but stillborn. More than two thirds (69%) of deaths due to spontaneous preterm labour were early neonatal deaths. Most deaths due to abruptio placentae were dead prior to admission and were fresh stillbirths (32%). Half of all deaths (54%) due to hypertension were macerated at birth. More than half the congenital abnormalities (59%) were neonatal deaths.

Figure 1.6. Distribution of the time of death in relation to birth for the various primary obstetric causes

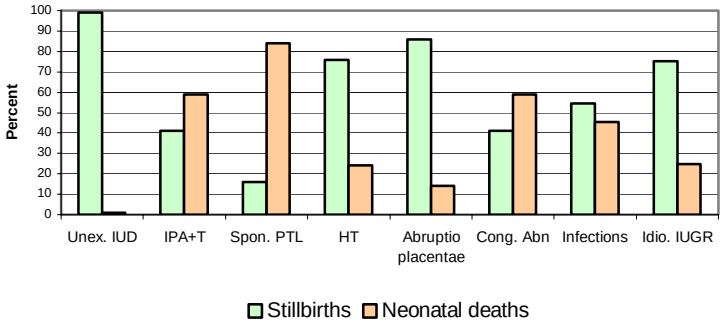


Figure 1.7. Distribution of time of death in relation to admission to a health institution

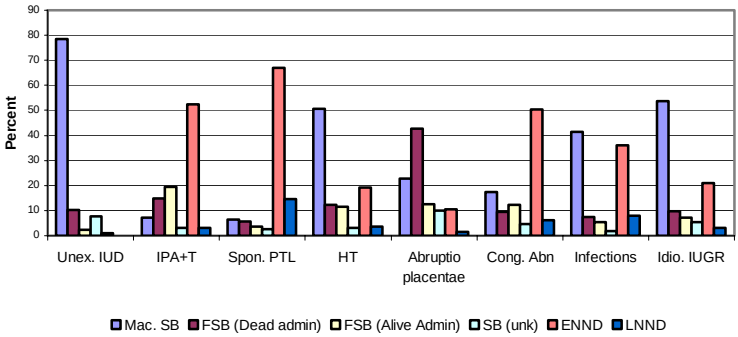


Figure 1.8 illustrates the distribution of primary causes of death amongst stillbirths and neonatal deaths. A surprising proportion of deaths due to hypertension and intrapartum asphyxia and birth trauma were stillbirths. There were more neonatal deaths due to congenital abnormalities than stillbirths.

Figure 1.8. Distribution of primary causes of death amongst stillbirths and neonatal deaths

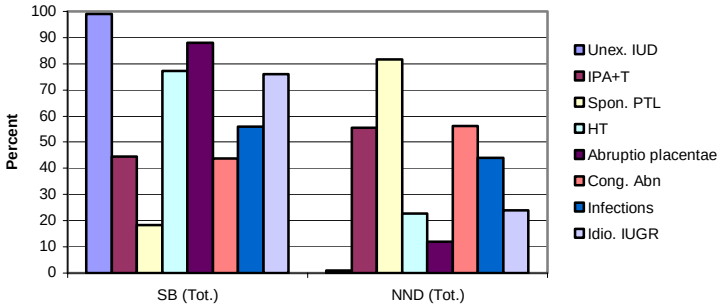


Figure 1.9 illustrates the distribution of the primary causes of death within each birthweight category. The majority (53%) of macerated stillbirths were unexplained stillbirths, but a disturbing proportion (16%) were due to hypertension. Fresh stillbirths that were dead by the time of admission were mostly due to abruptio placenta (38%). Fresh stillbirths that were alive on admission were mostly due to intrapartum asphyxia and birth trauma (39%), with significant proportion due to abruptio placentae (17%) and hypertension (14%). The primary obstetric causes of early neonatal deaths were due mainly to intrapartum asphyxia and birth trauma (30%) and spontaneous preterm labour (35%). Late neonatal deaths resulted mainly from complications of spontaneous preterm birth.

Figure 1.9. Distribution of primary causes of death within each time of death category

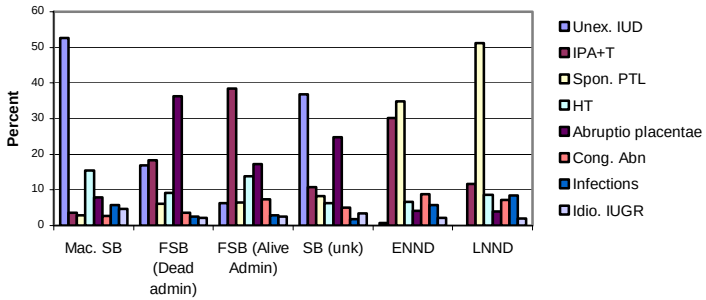


Figure 1.10 illustrates the contribution the various primary causes of perinatal death make to deaths of fetuses that were alive on admission to a health institution and subsequently died, either as a stillborn or in the neonatal period. This grouping gives the potential that the health institution

has for intervention within the institution. There was an opportunity for hospital intervention in intrapartum asphyxia and birth trauma (30%), spontaneous preterm birth (31%) and complications of hypertension and abruptio placentae (15%).

Figure 1.10. Fetus alive on admission but stillborn or died neonatally

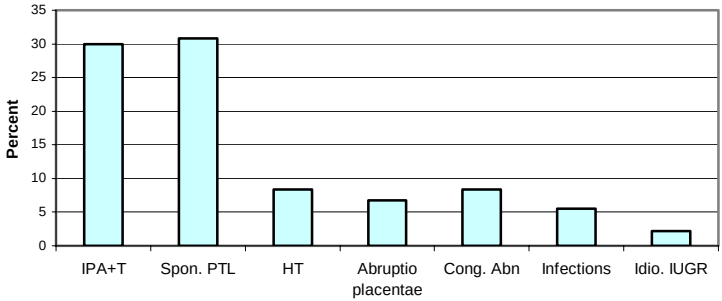


Figure 1.11 illustrates the distribution of deaths within each birth weight category. Intrapartum asphyxia and birth trauma were responsible for 39% and unexplained stillbirths for 23% of deaths over 2.5kg. Surprisingly, spontaneous preterm birth was responsible for only 36% of deaths between 1-1.5kg. Abruptio placentae and complications of hypertension in pregnancy were responsible for 28% and unexplained stillbirths for 19% of deaths were the other major contributors in this category. Unexplained stillbirths dominated the categories of death between 1.5 and 2.5 kg.

Figure 1.11. Distribution of deaths within each birthweight category

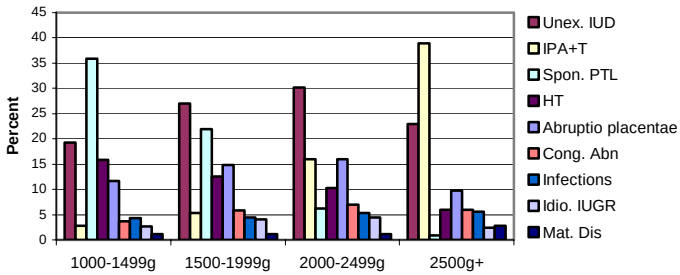
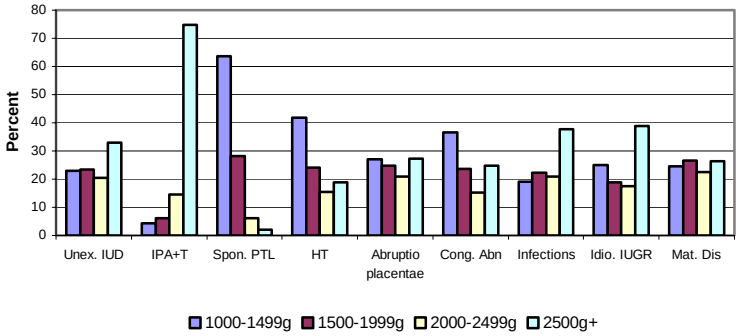


Figure 1.12 illustrates the distribution of the primary causes of death within the birthweight categories.

Figure 1.12. Distribution of the primary causes of death within the birthweight categories



Unexplained stillbirths were distributed fairly evenly across all the weight categories with a slight rise in the 2500g category. Deaths due to intrapartum asphyxia and birth trauma were in the vast majority of cases (75%) more than 2500g. As expected the majority of deaths due to spontaneous preterm birth were in the lower birth weight categories and the proportion declines dramatically as the birth weight increases. Deaths due to complications of hypertension in pregnancy were most frequent in the lower birth weight categories, but 34% occurred in babies weighing 2 kg or more. Deaths due to abruptio placentae were evenly distributed over the different birthweight categories. A surprising proportion of deaths due to infection occurred in the 2500g or more category (38%). The majority of deaths in the idiopathic intrauterine growth restriction category occurred over 2500g (39%) indicating the importance of post-term pregnancy in this group and as a preventable cause of death.

Figure 1.13. Distribution of various weight categories in deaths due to abruptio placentae and hypertension

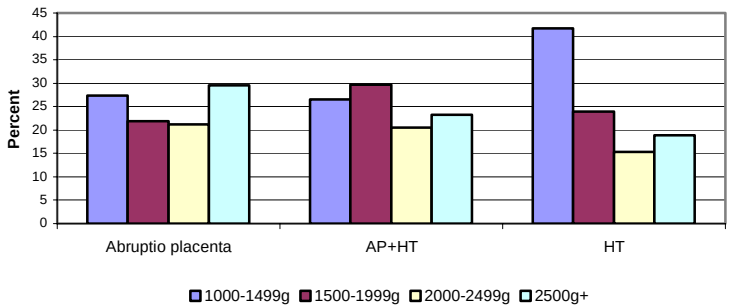


Figure 1.13 compares the distribution of deaths due to abruptio placenta, abruptio placenta with hypertension (AP+HT) and hypertension alone. Abruptio placenta alone has a different death distribution when compared with hypertension in birth weight categories. Interestingly, abruptio placentae when complicated with hypertension followed more closely the distribution of abruptio placentae than hypertension.

Final causes of neonatal death

Figures 1.14 and 1.15 illustrate the major causes of neonatal death and when the death occurred. Neonatal deaths due to immaturity and hypoxia were by far the most common final causes of death. More than a third of neonatal deaths due to infection occurred after 7 days, indicating the problem of nosocomial infection in neonatal units.

Figure 1.14. Final causes of neonatal death

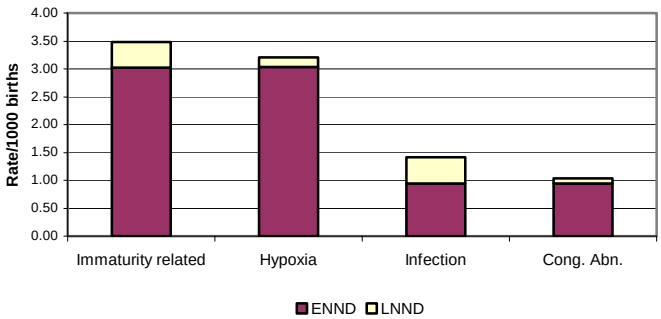


Figure 1.15. Distribution of time of neonatal deaths per final cause category

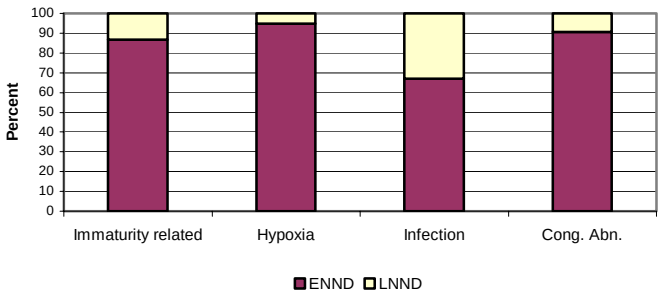


Table 1.3 lists the primary obstetric causes of neonatal deaths due to hypoxia, immaturity and infections. Intrapartum asphyxia and birth trauma

were responsible for 74.7% of deaths due to hypoxia with complications of hypertension being the second most common cause at 7.0%. Spontaneous preterm birth was responsible for 78.2% of neonatal deaths due to immaturity with complications of hypertension again being second at 8.3%. Spontaneous preterm birth (33.0%) and infections (34.5%) were responsible for the majority of neonatal deaths due to infection. Nosocomial infections were the major neonatal cause of deaths due to infection in the spontaneous preterm birth group, whereas congenital infection was most common in the maternal infection group.

Table 1.3. Contribution of obstetric conditions to hypoxia, immaturity and infections as final neonatal cause of death

Primary obstetric cause	Percentage		
	Hypoxia (n=1485)	Immaturity (n=1575)	Infection (n=642)
Intrapartum Asphyxia	71.8	2.2	5.3
Birth Trauma	2.9	0.4	0.5
Spontaneous preterm birth	5.2	78.2	33.0
Abruptio placentae	5.1	3	7.7
Hypertension	7.0	8.3	6.5
Congenital Abnormalities	0.3	0.3	1.9
Infections	2.2	3.6	34.5
Idiopathic. IUGR	2.6	0.4	3.1
Other Antepartum Haemorrhage	0.7	1.5	0.1
Pre-existing maternal disease	0.5	0.6	1.9
Other	1.7	1.5	5.5

Avoidable factors, missed opportunities and substandard care

Allocating avoidable factors, missed opportunities and substandard care to cases is subjective, dependent on the area the clinician is working and on the knowledge of the clinician allocating the factors. Hence the data presented below is qualitative in nature and will give an idea of the magnitude of the problem, but is not exact. However, due to the large database of cases and large number of clinical health workers participating, the factors identified are clearly important. Where the clinical health workers have assigned the factor as **probably** being directly related to the death of the baby, that indicates those health workers were confident of a direct link between that factor and the death of the baby. Those factors must be taken seriously and are indicated separately. The very fact that the hospitals participate in the audit is an indication that these hospitals are a cut above the average and if anything the magnitude of the problems

identified are under represented. (The specific factors will be discussed in the various chapters).

Figure 1.16 and 1.17 illustrates the distribution of the factors throughout the various categories and their distribution in the various areas. About half the deaths had some form of avoidable factor related to the health system (health worker related or administrative) and in about 15%, if the factors had not occurred the baby would probably have survived. The distribution of health worker and administrative avoidable factors were evenly distributed in the various areas. Patient related factors were lowest in the metropolitan areas.

Figure 1.16. Avoidable factors, missed opportunities and substandard care

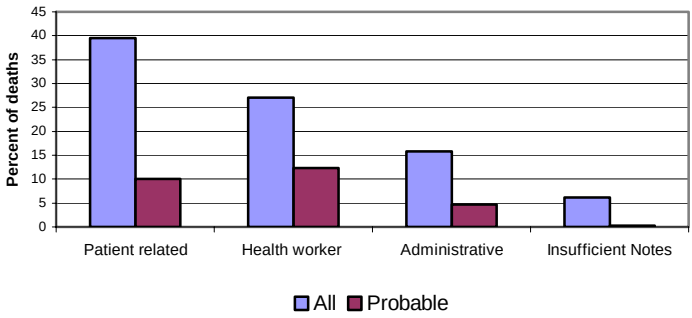


Figure 1.17. Comparison of probable avoidable factors

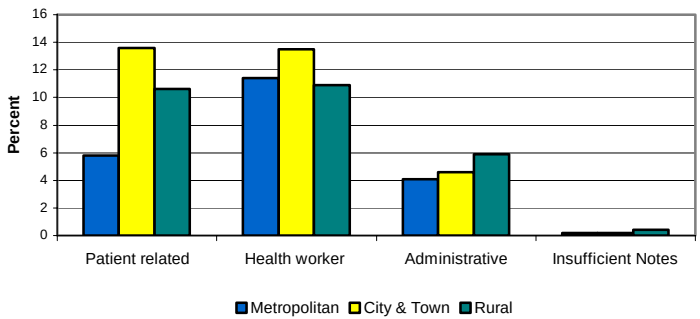


Figure 1.18 illustrates the probable avoidable deaths for each primary obstetric cause of death. A significant proportion of probable health worker avoidable deaths occurred in babies dying due to intrapartum asphyxia,

birth trauma and hypertension and very few in spontaneous preterm birth, abruptio placentae and unexplained stillbirth categories. About 1 in 4 of neonatal deaths due to hypoxia were thought to be probably preventable had the health worker acted differently. Very few of the neonatal deaths due to immaturity were thought to have been preventable.

Figure 1.18. Probable avoidable deaths per disease category

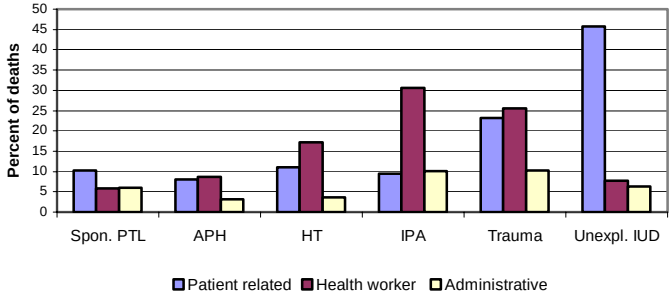


Figure 1.19. Avoidable factors in neonatal deaths

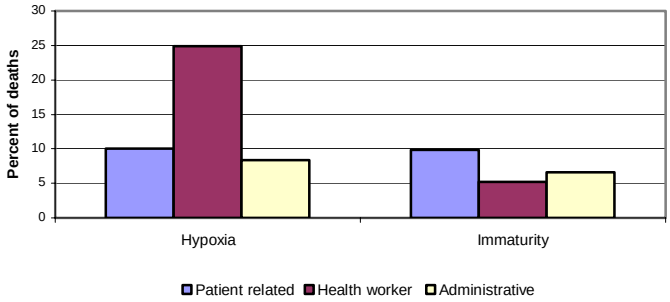


Table 1.4 lists the top 10 individual avoidable factors for each area. They are ranked according to those factors recorded as being probably directly related to the death of the infant. The total number of occasions that a factor was recorded is given in the next column (All).

Poor or no antenatal attendance was the most common recorded avoidable factor. Lack of transport was an important factor in all areas, with transport problems between institutions being recorded more often in metropolitan areas and home to institution problems more common in the city and towns and rural areas. Delay in seeking medical attention in labour and delay in referral to secondary or tertiary areas was common in all areas and often

would also reflect transport problems. The lack of adequate neonatal facilities was the more commonly recorded, the further from the metropolitan areas the patient happened to be. Surprisingly, lack of doctors or nurses was most commonly reported in the metropolitan areas and was not prominent in either the city or towns or rural areas. This may be because of greater numbers of patients at larger institutions in metropolitan areas than in the others, or it may be under reporting.

Poor or no intrapartum fetal monitoring and poor management of the second stage were common health worker related problems in the intrapartum time period, whereas inappropriate responses to hypertension, poor symphysis-fundal growth, and apparent post term pregnancies were the health worker factors most common in antenatal clinics. However, inappropriate response to poor fetal movement on the part of the mother was the common factor that can be addressed during antenatal care in all areas.

Table 1.4. Top 10 avoidable factors associated with perinatal deaths for each area

Metropolitan (n = 4949 perinatal deaths)		Probable	All
1.	Poor or no antenatal attendance	152	1019
2.	Fetal distress not detected (fetus not monitored or signs missed)	145	228
3.	Delay in seeking medical attention during labour	61	315
4.	Insufficient doctors or nurses on duty to manage patient	61	153
5.	Delay in referring to secondary or tertiary level	55	135
6.	Lack of transport between health institutions	45	171
	Lack of transport between home and institution	12	165
7.	No response to poor symphysis-fundal growth	52	71
8.	Inappropriate response to poor fetal movement	53	399
9.	No response to apparent post-term pregnancy	41	53
10.	No response to hypertension in pregnancy	41	83

Lack of neonatal facilities was recorded 108 as being associated with the perinatal death of which 38 were thought to be directly responsible

City and Town (n = 4885 perinatal deaths)		Probable	All
1.	Poor or no antenatal attendance	324	1054
2.	Delay in seeking medical attention during labour	166	369
3.	Fetal distress not detected (fetus not monitored or signs missed)	116	188
4.	Inappropriate response to poor fetal movement	101	209
5.	Delay in referring to secondary or tertiary level	71	202
6.	Lack of transport between health institutions	19	52
	Lack of transport between home and institution	65	157
7.	Delay in calling for more experienced assistance	56	99
8.	No response to hypertension in pregnancy	56	100
9.	Inadequate neonatal facilities	33	72
10.	Prolonged second stage without intervention	25	54

No response to poor symphysis-fundal growth (22 probable of 40 total cases), inappropriate response to rupture of membranes (62 cases) and antepartum haemorrhage (58 cases) were also common

Rural (n = 2939 perinatal deaths)		Probable	All
1.	Poor or no antenatal attendance	152	516
2.	Delay in seeking medical attention during labour	65	275
3.	Fetal distress not detected (fetus not monitored or signs missed)	63	155
4.	Inappropriate response to poor fetal movement	56	271
5.	Inadequate neonatal facilities	50	147
6.	No response to hypertension in pregnancy	31	75
7.	Prolonged second stage without intervention	24	48
8.	Lack of transport between health institutions	14	39
	Lack of transport between home and institution	23	91
9.	Inappropriate response to rupture of membranes	19	52
10.	Delay in referring to secondary or tertiary level	17	47

Poor use of the partogram was probably directly associated with 17 perinatal deaths and was recorded in 56 cases

Discussion

The PPIP users have performed a mammoth task, and coupled with the superb PPIPWIN v2 software, a clear and comprehensive picture of perinatal care in South Africa has emerged. There have been a few incorrect classifications and there were differences in interpretation of avoidable factors, missed opportunities and substandard care. However, the strength of the data lies in its size of the sample (462348 births and 12773 perinatal deaths) and the distribution of health institutions participating (102 institutions throughout all areas in South Africa). The picture drawn by the data is the best scenario for South Africa, as usually only the most concerned hospitals perform audit and are prepared to share their problems with other institutions.

The most immediate and important problem identified is managing the pregnant woman in labour. Intrapartum asphyxia and birth trauma were responsible for about one in five of all deaths recorded in the database. This varied between one in four in rural areas to one in seven in metropolitan areas. More than three quarters presented with a live baby at the institution and more than three quarters of the infants weighed more than 2.5kg. More than three quarters of the neonatal deaths due to hypoxia could be attributed to this primary cause. These babies should not have died, and PPIP users reported that between 1 in 2 and 1 in 3 of these deaths could probably have been prevented depending on the area the death occurred. Analysis of avoidable factors and further in-depth analysis of another 100 cases[1] indicated that the majority occur in low-risk women with apparently uncomplicated labour. The major avoidable factors were the failure to detect or respond to evidence of fetal distress. In other words, basic standard management of labour is not being provided to all women in labour. Labour is unpredictable and all women in labour must have at least hourly monitoring and this requires staffing of labour wards at the equivalent level of a high care ward. Resuscitation of the hypoxic infant

must be an essential skill of all health workers involved in delivering babies.

The next clearly identified problem is the high proportion of unexplained stillbirths, almost one in four. More than 80% of the babies were macerated, they constituted the majority of deaths in the 1.5-2.5 kg weight category, and comprised 23% of the deaths in babies over 2.5 kg. This must be seen in the context of idiopathic intrauterine growth restriction, post-maturity and congenital abnormalities being rarely diagnosed outside of institutions associated with medical schools, and the high proportion (39% of cases) where the syphilis serology was unknown. The higher proportion of neonatal deaths resulting from congenital abnormalities than intrauterine deaths is further evidence of the under diagnosis of congenital abnormalities. If good antenatal care is provided, all four of these conditions can be easily detected, and with intrauterine growth restriction, post-maturity and infections the deaths can be prevented. Although poor or no attendance at antenatal care was recorded as an avoidable factor in one in five cases of unexplained stillbirths, the majority of women did attend antenatal care. Furthermore, surveys have indicated that 95% of women countrywide attend antenatal care when pregnant[2]. Hence, the high proportion of unexplained stillbirths is probably a good indication that the quality of antenatal care is poor.

The finding that more than half of the deaths due to complications of hypertension in pregnancy were macerated stillbirths and the most common avoidable factor was lack of referral to the appropriate level of care provides further evidence of poor quality of antenatal care. Hypertension was a common cause of perinatal deaths (10%), with two thirds occurring in the 1-2 kg weight categories. However, one third occurred over 2 kg, clearly where intervention could have prevented the death.

Spontaneous preterm birth is a major cause of perinatal death with approximately one in six deaths being due to this primary cause. Almost 80% of the deaths due to immaturity could be attributed to this primary cause. Antenatal and intrapartum prevention of spontaneous premature births is mostly not possible at present[3], leaving care of the immature infant as the only possible mechanism to reduce this mortality rate. The finding that the metropolitan areas have less than half the neonatal mortality rates experienced for infants born between 1 and 2kg in the cities and towns indicates that there is a great potential for improving care of the immature neonate outside of the metropolitan areas.

Abruptio placenta is a major cause of death (12%) and is the only major primary cause where there is no clear solution or strategy to reduce the

deaths. Perhaps the most important finding is the much higher prevalence in urban areas than rural areas. Lifestyle issues such as smoking might be an important factor where preventative measures might be directed.

Conclusion

Analysing the data clearly suggests that the factor underlying most of the deaths is the poor quality of care, whether antenatal, intrapartum or in the neonatal period. There are many reasons for this; probably most important are lack of personnel, facilities, knowledge and poor morale.

The recommendations and strategies must deal with these problems and must be implemented.

The problems in perinatal care have been very clearly delineated by the PPIP users. Lack of improvement in the quality of care during pregnancy and in the neonatal period is clearly an infringement of a pregnant woman's basic right to expect a healthy child.

Recommendations and implementation strategies

Recommendations

1. Perinatal mortality audits must occur in each institution conducting births
2. Ensure adherence to standard protocols in:
    a. Monitoring the mother, progress in labour and the fetus during labour and ensure appropriate action is taken when abnormalities occur;
    b. Neonatal resuscitation;
    c. Basic care of all neonates post resuscitation;
    d. Antenatal care especially with respect to hypertension, detecting and managing intrauterine growth restriction and post term pregnancies and syphilis;
    e. Voluntary counselling and HIV testing, prevention of mother to child transfer and antiretroviral treatment for those that meet the criteria;
    f. Evaluation of a stillbirth.
3. Kangaroo mother care should be the primary way to manage stable low birth weight infants.
4. All level 2 and 3 hospitals involved in the care of neonates should be able to provide respiratory support using at least nasal CPAP.
5. A system of outreach programmes should be established to cover the whole country that includes support for, education and audit of the sites visited.
6. Early confirmation of pregnancy and immediate initiation of antenatal care on confirmation of pregnancy should be the norm.
7. Health promotion to the public should include messages on early confirmation of pregnancy and initiation of antenatal care, attention to fetal movements, appropriate action to danger signs, and plan for getting to the institution where the birth is planned.
8. Establishing staffing and equipment norms per level of care must be performed for every health institution concerned with the care of pregnant women.
9. Criteria for referral and referral routes must be established and utilized appropriately in all provinces.
10. Provincial Maternal Child and Women’s Health units to primarily ensure the minimal perinatal data set is completed and analysed for each institution in their province.

Implementation strategy

1. Quality assurance programmes to be introduced in each institution providing care for pregnant women for:
    a. Antenatal care;
    b. Intrapartum care;
    c. Neonatal resuscitation;
    d. Basic post resuscitation neonatal care.
2. In-service training on:
    a. Antenatal card;
    b. Partogram;
    c. Fetal Heart Rate monitoring including electronic monitoring;
    d. Neonatal resuscitation;
    e. Basic neonatal care;
    f. Kangaroo mother care;
    g. Nasal CPAP use;
    h. Conducting audits.
3. Incorporate in the job description, change the job description or create dedicated posts for implementing the outreach strategy such that the outreach programmes can support, educate and audit the institutions in the above fields.
4. Provide the infrastructure to establish pregnancy confirmation and initiation of antenatal care at a single visit at the same site. Distribution of antenatal cards to general practitioners should be part of this. This could be by promoting "antenatal friendly clinics" and allowing for easy access and incorporating GPs in the antenatal care system.
5. Use the different media to promote specific clear messages about pregnancy.
6. Insist all institutions conducting births complete the minimal perinatal data set monthly and submit it to their provincial MCWH unit.

References

1. Buchmann EJ, Pattinson RC. Babies who die from intrapartum hypoxia: a confidential enquiry in South African public hospitals. Tropical Doctor 2004 (in press).
2. Penn-Kekana L, Blauw D. Situational analysis of maternal health services in South Africa. Centre for Health Policy. 2001.
3. Pattinson RC. Are deaths due to prematurity avoidable in developing countries? Trop. Doctor 2004; 34: 7-10.

Chapter 2
Unexplained Stillbirths

Abstract

Aim: To describe the factors surrounding the unexplained stillbirths

Method: Data from PPIP users was amalgamated and the sub-set of data with unexplained stillbirths was analysed.

Results: There were 3056 unexplained stillbirths (79% macerated) recorded in the Saving Babies survey (October 1999-September 2003). This represents 24.3% of all perinatal deaths. Unexplained stillbirth was the most common category of death in all areas of the country. Few administrative or health worker-related avoidable factors were documented as being associated with these deaths. Two patient-related factors were each associated with many of the deaths: inappropriate response to poor fetal movements (28% of deaths), and no or infrequent attendance at antenatal care (20%of the deaths).

There is evidence that many of these unexplained deaths could have been caused by one of the following pathologies: intra-uterine growth restriction (IUGR), post-maturity, syphilis, congenital abnormalities and amniotic fluid infection syndrome. Deaths due to the first three of these are clearly avoidable if good antenatal care is provided.

Conclusion: The high numbers of unexplained stillbirths and their potential to be avoided demand that all cases of stillbirth, including macerated stillbirths, be carefully reviewed by an audit process, looking for a cause of death and any avoidable factors. Each institution should have a protocol for the investigation of the cause of intra-uterine deaths.

Recommendations

1. Unexplained stillbirths form the largest category of perinatal death in South Africa. Investigating the causes of these deaths is a research priority.
2. All stillbirths, including macerated stillbirths, should be reviewed by an audit process, looking thoroughly for a cause of death and any avoidable factors.
3. In-service education is recommended for all staff providing antenatal care, with particular emphasis on the detection and management of IUGR, post-maturity and syphilis. This should be followed up by quality assurance of antenatal care.
4. On-site syphilis testing should be available at all sites providing antenatal care.
5. All pregnant women should be educated to monitor their fetal movements from 28 weeks gestation and to report promptly if they are decreased.

Introduction

In the previous Saving Babies reports, unexplained stillbirths were not included in the primary obstetric causes when describing the relative importance of other primary obstetric causes of death. In the last report, a study at Mahatma Ghandi Hospital demonstrated that approximately 40% of deaths previously assigned to the unexplained stillbirth category would have been re-allocated to a specific cause when another interested party re-evaluated the case. The majority of these were related to idiopathic intrauterine growth restriction and post-mature pregnancies. These cases, if diagnosed during the antenatal period, could possibly have been prevented, making them a very important cause of death. Unexplained stillbirths accounted for a large proportion of deaths in the previous reports. If the causes were identified, the relative importance of the various causes of death documented in the Saving Babies survey might change significantly. It is vital that unexplained stillbirths as a category are examined more closely.

This chapter analyses the unexplained stillbirths in relation to timing of the death and the distribution in the various weight categories. The various avoidable factors are also examined to try and identify clues as to the primary causes of these deaths. A discussion about some of the more likely causes of unexplained IUDs, several of which are very much avoidable, is included as is a protocol for investigating an unexplained stillbirth. Recommendations are made about how these causes could be better identified. Appropriate solutions to preventing these deaths can be suggested once the causes are identified.

Timing of unexplained intrauterine deaths

Table 2.1. Timing of unexplained intrauterine death in relation to time of admission

	South Africa		Metropolitan		City and Town		Rural	
	N	%	N	%	N	%	N	%
Macerated	**2399**	**78.5**	812	74.0	899	78.9	688	84.1
FSB (Dead on admission)	**316**	**10.3**	123	11.2	126	11.1	67	8.2
FSB (Alive on admission)	**72**	**2.4**	19	1.7	28	2.5	25	3.1
Not classified	**237**	**7.8**	128	11.7	81	7.1	28	3.4
Misclassified as NND	**32**	**1.0**	16	1.5	6	0.5	10	1.2
Total	**3056**	**100.0**	1098	100.0	1140	100.0	818	100.0

Note: In 32 cases of deaths categorised as unexplained IUDs, the timing of the death was recorded as a neonatal death. In these cases there must have been errors in data input: either

they were not IUDs at all, or they were IUDs where a mistake was made in entering the information about the timing of the death. They have been excluded from further analysis

Table 2.1 describes the timing of unexplained intrauterine deaths and Figure 2.1 illustrates the timing of deaths in relation to admission to hospital. The vast majority (78.5%) were macerated stillbirths. One percent of cases were misclassified as being both intrauterine deaths and neonatal deaths. These have been excluded from further analysis.

Figure 2.1. Timing of unexplained intrauterine death in relation to admission

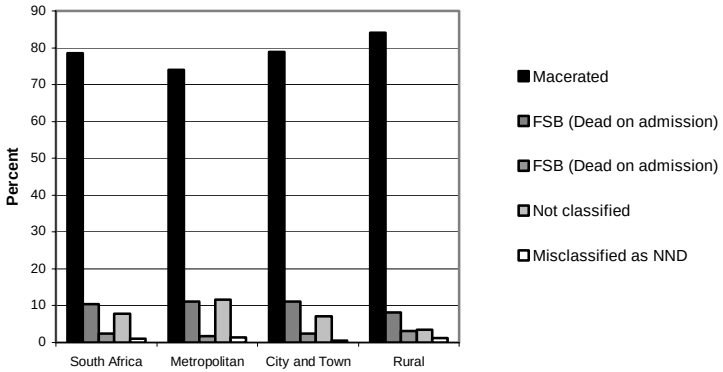
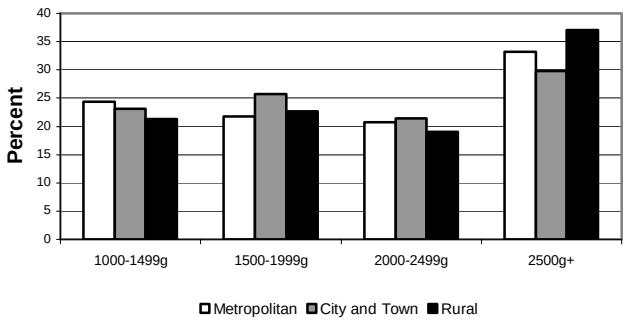


Figure 2.2 illustrates the distribution of unexplained intrauterine deaths in relation to birth weight category. The deaths are spread more or less evenly across all categories, but there is a disturbingly high proportion above 2.5kg.

Figure 2.2. Distribution of unexplained intrauterine deaths in relation to birth weight category



Avoidable factors, missed opportunities and substandard care

Table 2.2 gives the percentages of avoidable factors per area and whether the deaths were possibly avoidable or probably avoidable. The high proportion of patient related factors in all areas might be related to victim blaming. There were a high proportion of cases where the data was insufficient to properly evaluate the deaths in all areas.

Table 2.2. All and probable avoidable factors, missed opportunities and substandard care for unexplained intrauterine deaths

	Metropolitan		City and Town		Rural	
	All	Probable	All	Probable	All	Probable
	%	%	%	%	%	%
Health worker related	7.5	2.3	7.7	2.9	8.2	2.2
Administrative related	5.6	0.9	5.5	2.5	8.8	2.1
Patient related	48.4	4.3	45.2	12.3	46.3	12.5
Insufficient information	7.6	0	8.1	0	13.8	0

%: Percentage of all unexplained intrauterine deaths

Table 2.3. Avoidable factors for unexplained intrauterine deaths (IUDs), (probable and possible avoidable factors included)

Avoidable factors	No. of deaths where factor occurred	%
Patient related		
Inappropriate response to poor fetal movements	771	28.5
Never initiated antenatal care	365	13.5
Booked late in pregnancy	182	6.7
Health Worker Related		
No response to bad obstetric history	32	1.2
No response to poor uterine fundal growth	23	0.9
Other	22	0.9
Administrative problems		
Lack of transport: home to institution	63	2.3
No syphilis screening performed at hospital/clinic	48	1.8
Result of syphilis screening not returned to hospital/clinic	21	0.8
Insufficient information	352	-

%: Percent of all unexplained IUDs (excluding cases of insufficient information)

Table 2.3 lists the major factors recorded as avoidable factors, missed opportunities or substandard care in all categories. It is striking the high proportion of cases where an inappropriate response to poor fetal movements is recorded, almost one in three cases. Poor or no attendance at antenatal care occurred in approximately one in five cases. More than one in ten cases could not be evaluated because of inadequate information. It is

important to note that in 92 (3%) of cases the syphilis status was recorded as positive, but the case was classified as unexplained. A further 1229 (40.2%) of the unexplained stillbirths did not have syphilis serology taken, making the diagnosis of syphilis impossible.

Discussion

During the four years of the Saving Babies survey, 3056 perinatal deaths (≥1000g) were categorised as unexplained intra-uterine deaths (IUDs) and thus resulted in unexplained stillbirths. This represents 23.9% of all perinatal deaths in the survey. Overall, there were more unexplained IUDs than deaths due to any single recognised obstetric cause, such as preterm labour or antepartum haemorrhage. This was also true in each of the three different settings that were looked at namely metropolitan, cities and towns, and rural. Furthermore unexplained stillbirths were more common than other categories of death in all birthweight categories other than the very low birth weight babies under 1500g and infants more than 2500g. In both cases, unexplained stillbirth was the second most common category after preterm labour and intrapartum asphyxia respectively.

It is surely unacceptable that approximately one quarter of all perinatal deaths, recorded in this survey, remain unexplained. There is obviously some pathology that leads to each of these unexplained deaths. In 11.4% of these deaths, there was a lack of adequate case-notes that accounts for the death being unexplained. In the other 88%, the death remained unexplained despite adequate case-notes being available. The majority (79%) of these unexplained stillbirths resulted in the delivery of a macerated stillbirth (MSB). These unexplained MSBs accounted for over half (53%) of all MSBs recorded in the survey.

It is clear that unexplained stillbirths are a major issue in perinatal care in South Africa. One can assume that there are several different obstetric causes related to these deaths. Identifying these causes is a research priority. If the causes are identified, the relative importance of the various causes of death documented in the Saving Babies survey might change significantly.

During the process of perinatal mortality audit, there is sometimes a tendency to ignore apparently unexplained stillbirths, and rather to concentrate on trying to prevent those deaths with a known cause. In particular, macerated stillbirths are ignored, perhaps because of the misconception that such deaths tend to be unavoidable. This attitude must be changed, as this survey has demonstrated, almost a quarter of all perinatal deaths in South Africa are unexplained stillbirths. This is a huge

mortality, and measures must be taken to reduce it. The first step is to try to identify the important causes that lead to these deaths. Many of these deaths were no doubt "unexplained" because adequate care was not taken in looking for a cause. For each intra-uterine death, there needs to be a systematic process of investigating possible causes, according to a protocol. This is further discussed below, and it is an important topic for in-service education and outreach programmes. Despite such a process, many stillbirths will remain unexplained, and determining what are the important causes contributing to such deaths remains a research priority.

Possible causes of unexplained stillbirths

Looking carefully at the data in the Saving Babies survey, together with data from a number of other surveys and studies, there is strong evidence pointing to some of the important causes of unexplained stillbirths in South Africa. These are listed below.

Intra-uterine growth restriction and post-maturity

Chronic placental insufficiency results in intra-uterine growth restriction (IUGR) and if severe can eventually lead to intra-uterine death unless steps are taken to deliver the baby timeously and remove it from the unfavourable intra-uterine environment. The Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI)[1] from England and Wales has highlighted failure to detect or act upon poor fetal growth as being frequent avoidable factors related to so-called "unexplained " stillbirths. This has led to the realisation that IUGR is a substantial contributor to stillbirths[1]. Similarly, in the Euronatal study, a perinatal mortality audit conducted across ten European countries, the most common avoidable factors related to stillbirths were found to be the failure to detect or act upon poor fetal growth[2]. The PPIP classification of obstetric causes of death, as used in the Saving Babies survey, includes a specific category for IUGR, which is divided into two sub-categories, one for idiopathic IUGR and the other for post-maturity. Only 403 deaths were classified as IUGR in the Saving Babies survey, making up only 3.2% of all perinatal deaths.

It seems likely that a significant proportion of the unexplained stillbirths recorded were in fact deaths due to IUGR which were not recognised as such by those recording the deaths. Local evidence to support this theory comes from the prospective population-based perinatal mortality audit conducted in the North of Durban in 2001-2002, based at Mahatma Gandhi Memorial Hospital[3]. In this particular audit, each death was initially summarised by a junior doctor or a midwife, who had to specify the obstetric cause of death. A consultant obstetrician, referring to the patient's case-notes, and sometimes to the patient herself, then reviewed all

summaries. When necessary, the initial conclusions about the cause of death were modified following the consultant's review.

Data from the first seven months of the audit, which started in July 2001, revealed a total of 6296 births, including 234 perinatal deaths[3]. Of these deaths, 51 (21.8%) were initially classified as unexplained macerated stillbirths (MSB), while 8 (3.4%) were classified as IUGR. However, after consultant review, these figures changed to 31 (13.2%) for unexplained MSB, and 28 (12.0%) for IUGR. In other words, after careful assessment by an experienced obstetrician, 20 out of the 51 "unexplained" MSBs (39%) were in fact found to be deaths due to IUGR.

Another important finding of this Durban audit was that in 21 of the 28 cases (75%) of deaths due to IUGR, there were mistakes made by medical personnel (doctors and midwives) during antenatal care, which directly led to these deaths. In other words, these 21 deaths would definitely have been avoided if appropriate antenatal care had been provided. Furthermore, IUGR (including post-maturity) was by far the most common cause of definitely avoidable perinatal death[3].

This data from Durban, therefore, not only offers a plausible explanation for a substantial proportion of our so-called "unexplained" stillbirths, but also demonstrates that many of these stillbirths could be avoided through more skilled or careful antenatal care, without the need for additional material resources. Closer scrutiny of unexplained stillbirths, looking for evidence of IUGR, is therefore recommended. Important information that should always be assessed when considering the diagnosis of IUGR includes the best estimate of gestational age, the birth weight, and the recordings made at each antenatal visit.

As many deaths due to IUGR and post-maturity are clearly avoidable, educating all antenatal care providers about how to detect and manage these conditions must be made a priority. Important factors in improving IUGR detection would include ensuring that there is a standardised method that all antenatal care providers use to measure the symphysis-to-fundal height, and that there is a graph appropriate for the local population for plotting these measurements. Taking time to make a best estimate of the gestational age, (which should always include a careful history of the last menstrual period), is vital in detecting both idiopathic IUGR and postmaturity[3]. Quality assurance programmes should be put in place to ensure that appropriate antenatal care is being provided with respect to screening for and managing IUGR and post-maturity.

Syphilis

There were 258 deaths (2%) in the Saving Babies survey that were recorded as being due to syphilis. This, in itself, is an unacceptably high figure, but there is no doubt that the true figure is higher. An analysis of the syphilis serology results for deaths categorised as unexplained stillbirths reveals that 92 (3%) of these so-called "unexplained" deaths, in fact, had positive syphilis serology. If a woman with inadequately treated syphilis has an otherwise unexplained stillbirth, it would be reasonable to assume that the death is due to syphilis. Thus many of these 92 deaths should probably have been classified as syphilis deaths rather than unexplained deaths. Furthermore, in an additional 40% of unexplained stillbirths, no syphilis serology results were recorded. It can be assumed that a certain proportion of these deaths were syphilis-related deaths. This clearly demonstrates substandard antenatal care as well as substandard investigation of the cause of the stillbirth. Various problems related to obtaining syphilis serology results collectively formed the most important avoidable administrative factor associated with unexplained stillbirths.

The message is clear; avoidable deaths due to syphilis are still occurring, although many of them may not be recognised as such. To prevent such deaths, in-service education for all staff providing antenatal care is required, reinforcing strict adherence to protocols for screening for and treating syphilis. As failure to obtain syphilis results is still leading to perinatal deaths, it is essential that on-site syphilis screening be introduced at all antenatal clinics. Simple, inexpensive on-site methods for screening for syphilis are available[4].

Finally, it is essential that all women with unexplained stillbirths have their syphilis serology checked before being discharged. Those with negative syphilis serology earlier in the pregnancy should have it repeated to exclude new infection acquired since the previous testing.

HIV infection and amniotic fluid infection syndrome

Given the current HIV/AIDS epidemic in South Africa, it is difficult to ignore the possibility of a link between HIV infection and unexplained stillbirths. A review of the worldwide literature has demonstrated a clear association between HIV infection and stillbirth, the latter being almost four times more likely in an HIV-infected pregnant woman than in one who is not[5]. The Saving Babies data has not thus far been able to provide information about the HIV status of women suffering perinatal losses. However, with a rapidly increasing number of institutions in South Africa now routinely offering antenatal HIV testing, the information should soon be available. The HIV status of the mother can be recorded for each perinatal death when inputting data into the new version of PPIP. The HIV

prevalence amongst women who have a stillbirth could then be compared to the HIV prevalence amongst women giving birth to a live baby. It will be no surprise if we find that HIV infection is positively associated with unexplained stillbirths. However, there is a need to research not only the extent of the association between HIV and stillbirth in South Africa, but also to investigate the reasons for any such association. One condition that is probably related to a significant proportion of unexplained stillbirths, particularly in HIV-positive patients, is the amniotic fluid infection syndrome. This is usually a sub-clinical chorioamnionitis, which occurs in malnourished or immuno-suppressed women. Placental studies in cases of stillbirth have suggested that chorioamnionitis is one of the most common causes of stillbirth, both in developed[6], and in developing countries[7]. However, in the Saving Babies survey, only 1.1% of deaths were ascribed to amniotic fluid infection. One can conclude that some of the unexplained stillbirths are due to unrecognised cases of amniotic fluid infection. It is not obvious to what extent deaths due to sub-clinical chorioamnionitis are avoidable, particularly as the condition is difficult to diagnose antenatally. Even if the diagnosis is made, will antibiotic treatment alter the course of the pregnancy? These are research questions that need to be pursued.

Although much research in South Africa these days tends to focus on HIV, very little is known about the importance of other viral or protozoal infections in causing stillbirth in the South African setting. This is another area worth researching.

Congenital anomalies

It is a plausible theory that a certain proportion of the unexplained stillbirths in this survey died due to unrecognised congenital abnormalities. This survey provides some indirect evidence to support this theory. Of the 698 deaths reported as being due to fetal abnormality, the majority (56.3%) were neonatal deaths, and the remainder stillbirths. However, it is well documented in the literature that the majority of lethal congenital abnormalities result in death before delivery (i.e. stillbirth) rather than neonatal death. This implies that we are missing congenital abnormality as a cause of intra-uterine death and labelling these cases as “unexplained”. There are a number of factors that could contribute to a failure to recognise the abnormal baby. Antenatal genetic screening and expert antenatal ultrasound is only available to a limited number of pregnant women. Following delivery, maceration of the fetus may make diagnosis difficult, and anyway the stillbirth is often not examined at all.

Although these deaths could not be prevented, it is important for the diagnosis of the congenital abnormality to be made, so that the mother has an explanation for her baby’s death and can be informed about the

implications for future pregnancies. The mother and partner might benefit from referral to a genetic counsellor.

It is, therefore, important for all stillbirths to be examined at birth, at least externally, looking specifically for any abnormalities. Post-mortem examination for macerated stillbirths is not routinely available at most centres in South Africa, due to a scarcity of pathologists with the necessary expertise. However, where that expertise is available, this is an area where a research project could yield valuable information about the extent and nature of unrecognised abnormalities in stillbirths.

Avoidable factors related to unexplained stillbirths

As these deaths were unexplained it is not surprising that health-worker related and administrative avoidable factors were infrequently documented as having contributed to the death. Even if there is substandard care, as long as the cause of death is unknown, it is difficult to relate the substandard care directly to the death. Some of the avoidable factors documented suggest that there was, in fact, a likely cause for the death. For example, "no response to poor uterine fundal growth" suggests that there was IUGR, and avoidable factors related to inadequate syphilis screening suggest that the cause of death was syphilis.

The most frequently cited patient-related avoidable factor was inappropriate response to poor fetal movements (28% of cases). The first question to ask here is whether these women were ever given advice about responding promptly when fetal movements decreased. If not, then rather than being a patient-related avoidable factor, the delayed response to poor fetal movement could be considered a health worker related factor. The second question to ask is whether encouraging all women to monitor their fetal movements from the time the fetus reaches a viable gestation (about 28 weeks), and to report decreased movements promptly would make an impact on reducing the stillbirth rate. In some cases, the fetus may die suddenly, and prompt reporting would make no difference. Thus inappropriate response to poor fetal movements should be documented as a possible rather than a probable avoidable factor in most cases. However, it is reasonable to assume that prompt reporting by the mother would allow at least a proportion of compromised fetuses to be delivered alive when they would otherwise have been stillborn. In support of this, Neldam[8] showed that formal scoring of fetal movements in a low-risk population resulted in significant reduction in perinatal mortality in Sweden in 1979. A larger trial conducted in England in the 1980s[9] found no difference between formal recording of fetal movements and no formal recording. However, a similar number of women reported poor fetal movements in each group, suggesting that even in the group without formal recording of fetal

movements there was an awareness of the importance of reporting poor fetal movements. Poor fetal movements are associated with two primary causes of death, namely IUGR and amniotic fluid infection syndrome. These two conditions are thought to contribute significantly to the unexplained stillbirths and this might partly explain the high rate of reporting of poor fetal movements.

In the South African setting, that awareness of fetal movements may not be so widespread, as evidenced by the large number of cases in which there was failure to report poor movements promptly. Thus education on monitoring fetal movements from 28 weeks' gestation and on reporting decreased movements promptly should routinely be part of antenatal education. There is no evidence from developing countries about whether a formal method of counting fetal movements, and well-defined criteria for deciding when the movements are poor, would be any better than giving general advice about the importance of acting on decreased fetal movements. This is another important area requiring research.

There was another patient-related factor that was frequently noted, being associated with 20% of unexplained stillbirths. This was no or infrequent attendance for antenatal care, which refers to un-booked cases or late bookers. In such cases, it would be wrong to say that being un-booked probably led to the death. For example, if the real cause of death was a chromosomal abnormality, then the death would have occurred irrespective of whether the woman had booked or not. On the other hand, if the death were due to post-maturity, then in all likelihood the death would have been prevented had she attended for antenatal care appropriately. Thus, in cases of unexplained stillbirth, the fact that the woman was unbooked or booked late, should only be put down as a possible avoidable factor rather than a probable one. This does not invalidate the message that early booking is important in reducing stillbirths.

Protocol for investigating the cause of intra-uterine deaths

The process of investigating the cause of an intra-uterine death (IUD) should begin as soon as the death is diagnosed, and should be completed while the woman who has suffered the loss is still under the care of the health facility in question. Discussions about the cause of death should not be left until a perinatal mortality meeting that occurs long after she has been discharged. This is because information that can only be obtained directly from the woman and her family might shed light on the cause of death. In addition, the woman needs as full an explanation as possible of the death, in order to cope with the loss, and because the cause of death may have implications for future pregnancies.

The investigation process should be conducted or overseen by someone with a clear understanding of the important aspects of antenatal care as well as of the possible causes of IUD. Each institution should have its own protocol for the management of an IUD, including how to investigate the cause of the IUD. The protocol should take into account what facilities for investigation are available at or accessible to the institution in question.

The first step in the investigation, and probably most important, is a careful scrutiny of the woman's antenatal record, taking further history from her where gaps need to be filled. Previously unrecognised IUGR or post-maturity can often be picked up by doing this. A thorough physical examination is also essential. Relevant findings might include evidence of IUGR, polyhydramnios, and various infections including intra-uterine infection. As an absolute minimum in South Africa, initial investigations should include syphilis serology, rhesus blood group testing, and a test to rule out overt diabetes. Subsequently, at the time of delivery, it is critical that fetus, cord, placenta and membranes are all examined carefully, looking specifically for possible causes of the IUD. Congenital anomalies, cord around the neck, and abruptio placentae could for example all be recognised at this stage if they had been missed earlier.

If this initial investigative process fails to reveal any obvious cause of death, several further investigations should ideally be conducted. The first of these is a full post-mortem examination of both fetus and placenta. This would be helpful in identifying many causes of IUD, including congenital anomalies, congenital infections, chorioamnionitis and IUGR. In most institutions in South Africa, it is unfortunately not possible to offer this investigation. This is because few institutions have access to a pathologist with the expertise or the time to conduct such post-mortems for macerated stillbirths. Placental histology alone may be more commonly available, and may provide more information than post-mortem of the stillbirth itself. It should not be neglected if it is feasible to do it.

Congenital infections that can cause IUD include toxoplasmosis, rubella, cytomegalovirus, herpes simplex 2 virus, and parvovirus. Serological tests from the mother can provide evidence of such infections, and should be conducted if the service is available.

Other potentially useful investigations include an antibody screen, looking for antibodies, such as anti-kell, which can cause iso-immunisation (even if the mother's rhesus blood group is positive), as well as the Kleihauer test, which can provide evidence that a large feto-maternal haemorrage has caused the IUD. After the puerperium, testing for anti-phospholipid antibodies and other autoantibodies could also reveal the likely cause of

death. As with the post-mortem and the viral studies, all these tests are available only at a small minority of institutions in South Africa, and their value in determining the cause of IUDs could perhaps best be assessed in research projects based at specific institutions.

A simple protocol that can be followed in cases of IUDs is given at the end of the chapter.

Conclusion

Unexplained stillbirths form the largest category of perinatal death in South Africa. This fact demands that research be conducted to identify the major causes of these deaths. However, there is no doubt that the cause of many of these deaths could be recognised if the case were reviewed more thoroughly and if some basic investigations, such as syphilis serology, were not neglected. Thus each institution should have a protocol for investigating the cause of an intra-uterine death, and perinatal mortality audits should include a thorough review of all cases of stillbirth, including macerated stillbirths.

There is already evidence that many of these deaths are caused by IUGR, post-maturity and syphilis, conditions which should be recognised if good antenatal care is provided. As long as the woman attends antenatal care, deaths resulting from these conditions are usually avoidable. In order to reduce the number of intra-uterine deaths, it is therefore recommended that in-service education about these conditions be given to all staff providing antenatal care. Quality assurance programmes should monitor the quality of antenatal care at each institution. On-site syphilis screening should be made available at all sites conducting antenatal care.

Delay in pregnant women reporting decreased fetal movements is the most frequently reported avoidable factor associated with unexplained stillbirth. It is therefore recommended that all pregnant women be taught to monitor their fetal movements from 28 weeks' gestation and to report decreased movements promptly.

References

1. Confidential Enquiry into Stillbirths and Deaths in Infancy: 8th Annual Report. Chapter 3. Maternal and Child Health Research Consortium. Sept 2001, London.
2. Richardus JH et al. Differences in perinatal mortality and suboptimal care between 10 European regions: results of an international audit. BJOG 2003; 110: 97-105.

3. Moran NF. Failure to diagnose IUGR: a major cause of avoidable perinatal death in Durban. Proceedings of the 21st Conference on Priorities in Perinatal Care in Southern Africa.
4. Pattinson RC. On-site screening for syphilis – the time has come. S Afr Med J 1998; 88:780.
5. 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.
6. Tolockiene E, Morsing E, Holst E, Herbst A, Ljungh A, Svenningsen N, Hägerstrand I, Nyström L. Intrauterine infection may be a major cause of stillbirth in Sweden. Acta Obstet Gynecol Scand; 80(6):511.
7. Ross SM, MacPherson TA, Naeye RL, Khatree MHD, Wallace JA. Causes of fetal and neonatal mortality in a South African Black community. S Afr Med J; 61: 905.
8. Neldam S. Fetal movements as an indicator of fetal well-being. Lancet 1980;I:1222-1224.
9. Grant A. Routine formal fetal movement counting and risk of antepartum late death in normally formed singletons. Lancet 1989;ii:345-349.

Investigating the Cause of an Intra-uterine Death (IUD)

IUD diagnosed	
↓	
Study antenatal record thoroughly Take further relevant history	Past obstetric history (e.g. previous big babies suggesting diabetes) Current obstetric history (include calculation of dates from LMP or **early** scan, has there been any discrepancy with fundal height?) Check investigations already done (Syphilis serology, rhesus group, HIV, ultrasound scan)
↓	
Physical examination of pregnant woman	Fundal height – does it correlate with dates? Evidence of sepsis, including intra-uterine sepsis (offensive PV discharge, tender uterus)
↓	
Minimum basic investigations	Syphilis serology (repeat if done earlier in the pregnancy) Rh group (if not already done) Random blood glucose If available, ultrasound scan (congenital abnormalities, hydrops) – can be done at time of diagnosis
↓	
At delivery: examine fetus, cord, placenta	Correlate birth weight to dates, compare fetal length and weight to look for asymmetrical IUGR Look for congenital anomalies, cord problems (e.g knots), placental abruptio, gross infection.
↓	
If death remains unexplained, and facility available: send placenta for histologypostmortem for fetusViral screen for mother (TORCH, parvovirus) In cases of recurrent unexplained IUDs (2 or more), discuss further investigations with specialist, preferably before patient gets pregnant again	

Chapter 3
Intrapartum asphyxia and birth trauma

Abstract

Aim: To identify the magnitude of deaths due to intrapartum asphyxia and birth trauma and determine what health system failures contributed to the deaths and where these can be modified.

Method: Analysis of deaths classified as being due to intrapartum asphyxia and birth trauma by the PPIP users.

Results: Deaths due to intrapartum asphyxia and birth trauma were the second most common cause of perinatal loss during the review period accounting for 18% of deaths. Seventy-five percent presented in labour alive on admission and 90% weighed 2.0 kg or more. Hypoxia was the most common cause of neonatal death, occurring in more than 80% of cases. Of these neonatal deaths about one in four was due to meconium aspiration syndrome. Traumatic breech delivery was the most common cause of birth trauma. The assessors were of the opinion that there were avoidable factors related to the health system in at least half of the deaths. The majority of factors were due to poor management of labour.

Conclusion: This is one area that proper implementation of labour ward protocols and partogram use could be expected to result in a marked decrease in perinatal mortality and morbidity.

Recommendations

1. Staffing norms for labour wards need to be established
2. The correct use of the partogram must be enforced. Audits on intrapartum care should be used as a method to ensure proper use of the partogram.
3. Amnioinfusion must be considered for use in cases with meconium stained liquor. Where the skill is not present in the labour ward, it must be acquired.
4. Where caesarean section is considered safe, caesarean section should be considered for term breech presentations if external cephalic version is contraindicated or failed.
5. Doctors working in labour wards and advanced midwives must have the skill to perform assisted deliveries. Where this is not present the skills must be acquired.

Introduction

Intrapartum asphyxia results from the fetus experiencing extreme hypoxia during labour. An antenatal insult like intrauterine growth restriction can predispose to intrapartum asphyxia, making its occurrence more likely with less of an intrapartum insult. The most common cause of intrapartum asphyxia is prolonged labour that should be avoidable with appropriate use of the partogram. Other causes of intrapartum asphyxia include prolapsed umbilical cord, cord around the neck and meconium aspiration all of which can be detected and the perinatal complications reduced by appropriate management.

This chapter examines deaths due to intrapartum asphyxia that were recorded by PPIP users from October 1999 to September 2003. For the first time the primary obstetric cause of death can be linked with the final neonatal cause of death by use of the new PPIP v2 software. This has allowed for a more detailed analysis of deaths due to intrapartum asphyxia and identifies modifiable factors.

Deaths due to intrapartum asphyxia and birth trauma accounted for 18% of all perinatal deaths recorded in the survey period. It is ranked second to unexplained intrauterine deaths accounting for 2281 perinatal deaths 1000g or more.

Primary obstetric cause of death

Table 3.1 lists the major causes of intrapartum asphyxia. Cord problems were reported in almost a quarter of deaths. Traumatic breech deliveries were responsible for the majority of deaths due to birth trauma. Coincidental trauma refers perinatal deaths due to events like motor vehicle accidents, burns and domestic violence.

When the sub-categories are analysed per area, the lack of specific diagnoses the further from metropolitan areas is noticeable. The high proportion of deaths allocated to meconium aspiration is worrying, especially in rural areas. Very few deaths were recorded as being due to assisted deliveries in all areas.

Table 3.1. Primary obstetric causes of death in the sub-categories

	n	%	Rate/1000 births
Intrapartum asphyxia			
Labour related intrapartum asphyxia	1357	66.7	
Cord around the neck	270	13.3	
Prolapsed cord	195	9.6	
Unclassified	213	10.5	
Total	2035	100.0	4.40
Trauma			
Ruptured uterus	69	28.0	
Traumatic breech delivery	94	38.2	
Traumatic assisted delivery	24	9.8	
Precipitous labour	19	7.7	
Coincidental trauma	15	6.1	
Unclassified	25	10.2	
Total	246	100.0	0.53
Intrapartum asphyxia and birth trauma	**2281**		**4.93**

Table 3.2. Areas and intrapartum asphyxia and birth trauma as primary cause of death

	Metropolitan		City and Town		Rural	
	n	%	n	%	n	%
Intrapartum asphyxia						
Labour related intrapartum asphyxia	489	71.3	483	67.4	385	60.9
Cord around the neck	96	14.0	93	13.0	81	12.8
Prolapsed cord	78	11.4	71	9.9	46	7.3
Unclassified	23	3.4	70	9.8	120	19.0
Total	686	100.0	717	100.0	632	100.0
Trauma						
Ruptured uterus	27	38.6	25	24.0	17	23.6
Traumatic breech delivery	20	28.6	43	41.3	31	43.1
Traumatic breech delivery 2.5 kg +	8		28		22	
Traumatic assisted delivery	6	8.6	13	12.5	5	6.9
Precipitous labour	4	5.7	9	8.7	6	8.3
Coincidental trauma	6	8.6	5	4.8	4	5.6
Unclassified	7	10.0	9	8.7	9	12.5
Total	70	100.0	104	100.0	72	100.0

Figure 3.1. Comparison of mortality rates due to intrapartum asphyxia and birth trauma

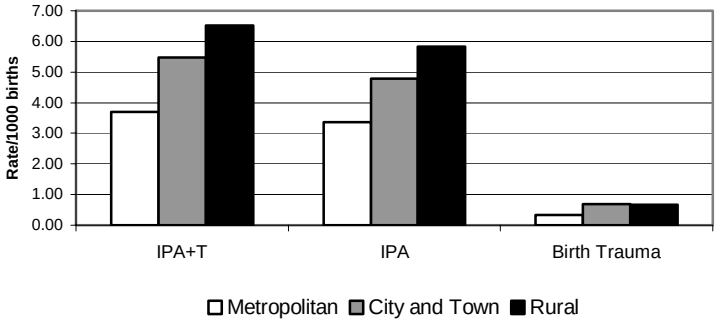


Figure 3.1 illustrates the perinatal mortality rates due to intrapartum asphyxia and birth trauma per area. The mortality rates are almost half those of the rural areas in metropolitan areas, and a third lower than city and towns.

Timing of perinatal deaths due to intrapartum asphyxia and birth trauma

Figure 3.2 illustrates the time of death in relation to admission to hospital. The majority of deaths occurred in the early neonatal period. Seventy-five percent of the deaths were alive on admission to hospital (Table 3.3).

Figure 3.2. Time of perinatal death in relation to admission to hospital

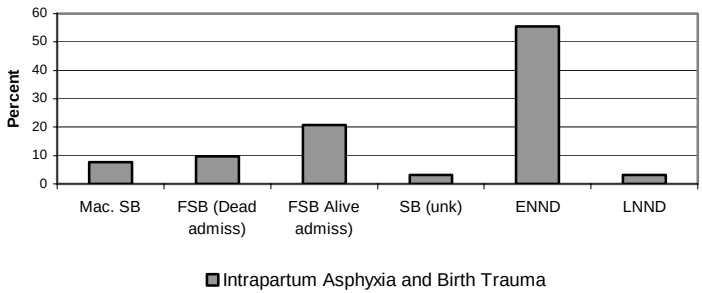


Table 3.3. Comparison of timing of perinatal deaths due to intrapartum asphyxia and birth trauma with respect to admission to hospital

	Mac. SB	FSB (Dead Admin)	FSB (Alive Admin)	SB (unk)	SB (Tot.)	ENND	LNND	NND (Tot.)
Metropolitan	9.0	14.6	18.9	6.1	48.5	47.9	3.6	51.5
City and Town	7.1	16.2	18.1	0.7	42.1	53.5	4.4	57.9
Rural	5.3	13.8	21.7	2.4	43.2	56.0	0.9	56.8
South Africa	7.1	14.9	19.5	3.0	44.6	52.4	3.0	55.4

Mac.SB – Macerated stillbirth, FSB – Fresh stillbirth, Admin – admission, unk. – unknown, - ENND – early neonatal death, LNND – late neonatal death, Tot – Total.

The deaths due to intrapartum asphyxia and birth trauma accounted to more than a third of fetuses that died after admission to hospital but before birth. It formed the biggest group by far for this category (Figure 3.3). Almost 90% of the deaths occurred fetuses with a birth weight of 2.0 kg or more (Figure 3.4). Deaths due to intrapartum asphyxia and birth trauma also provided the largest group (39%) of infants dying over 2.5 kg, and in rural areas they account for 45% of all deaths in this category. Expressed another way one of every 118 births over 2.5 kg in rural areas, resulted in a perinatal death due to intrapartum asphyxia and birth trauma (Figure 3.5), compared with one in every 313 births in metropolitan areas. Overall, 61.1% of deaths due to intrapartum asphyxia alone were alive on admission and had a birth weight of 2.5 kg or more.

Figure 3.3. Primary causes of deaths for fetuses alive on admission but stillborn

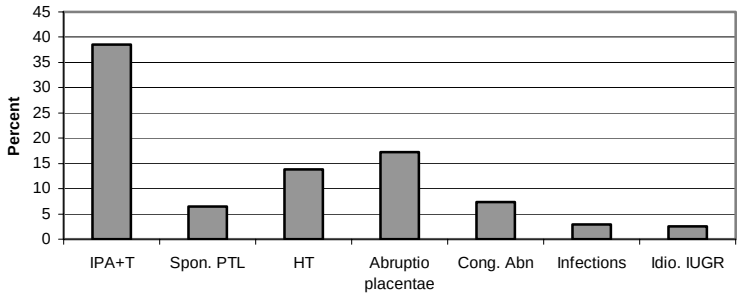


Figure 3.4. Distribution of deaths due to intrapartum asphyxia and birth trauma

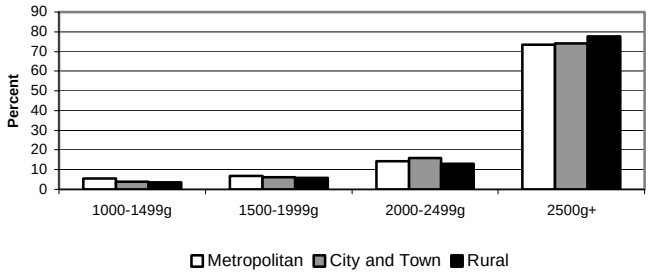


Figure 3.5. Distribution of primary causes deaths in the 2500g+ category

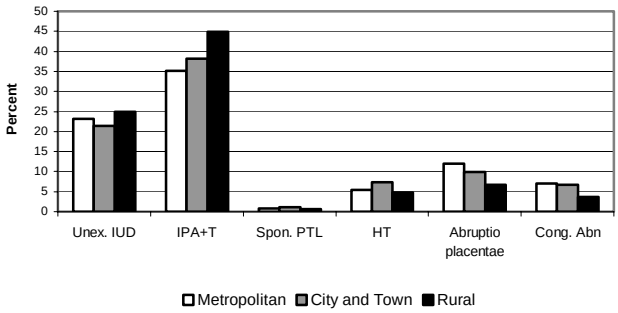
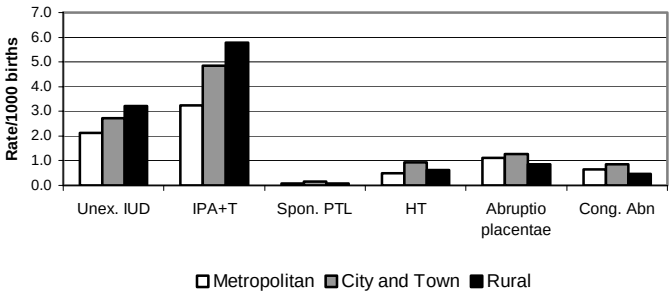


Figure 3.6. Mortality rates for primary causes of death: 2500g+



Final Neonatal causes of death

Figure 3.7 and Table 3.4 demonstrate the final neonatal causes of death due to intrapartum asphyxia and birth trauma. The vast majority (over 80% in all areas) were due to hypoxia. (Chapter 10 deals with the subcategories of death due to hypoxia). Between one in three and one in six of the neonatal deaths due to hypoxia were classified as being due to meconium aspiration syndrome.

Figure 3.7. Final Neonatal Cause of Death

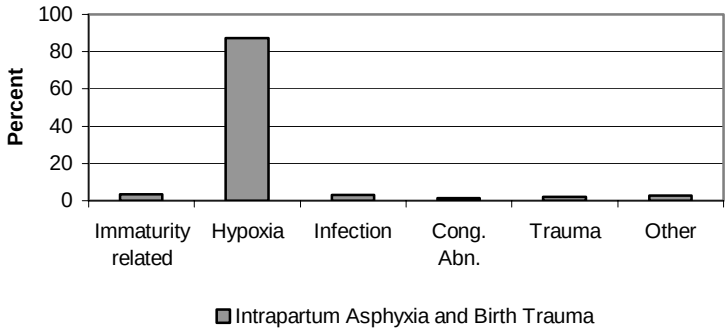


Table 3.4. Distribution of the final neonatal causes of death due to intrapartum asphyxia and birth trauma

	Metropolitan		City and Town		Rural	
	N	%	N	%	N	%
Hypoxia	321	83.8	415	88.5	353	88.7
*HIE	251	79.4	249	63.4	107	31.7
MAS	49	15.5	86	21.9	124	36.7
PFC	9	2.8	9	2.3	2	0.6
Other	4	1.3	4	1.0	2	0.6
Unclassified	3	0.9	45	11.5	103	30.5
Immaturity related	25	6.5	16	3.4	4	1.0
Infection	16	4.2	11	2.3	11	2.8
Congenital Abnormality	7	1.8	5	1.1	6	1.5
Trauma	6	1.6	10	2.1	11	2.8
Other	8	2.1	12	2.6	13	3.3
Total	383	100.0	469	100.0	398	100.0

* Includes data only for intrapartum asphyxia and excludes birth trauma
HIE – Hypoxia ischaemic encephalopathy, MAS – Meconium aspiration syndrome, PRC – persistent fetal circulation

Avoidable factors, missed opportunities and substandard care

Tables 3.5 and 3.6 give the avoidable factors, missed opportunities and substandard care related to intrapartum asphyxia and birth trauma. It is notable that at least one in two of deaths were thought to have preventable factors related to health workers that if they had responded in a different way might the perinatal death might have been avoided. This is the highest rate for any condition in this report. More avoidable deaths occurred due to birth trauma in the city and towns and rural areas than the metropolitan areas, where health system failures (administrative and health workers) were relatively low.

Table 3.5. All and probable avoidable factors, missed opportunities and substandard care for intrapartum asphyxia

	Metropolitan		City and Town		Rural	
	All % of IPA deaths	Prob. % of IPA deaths	All % of IPA deaths	Prob. % of IPA deaths	All % of IPA deaths	Prob. % of IPA deaths
Health worker related	56.1	32.3	63.9	37.8	66.8	25.0
Administrative related	45.9	14.5	21.2	7.7	24.1	8.5
Patient related	32.8	4.1	28.7	14.2	26.9	7.3
Insufficient information	3.6	0.3	4.7	0.6	8.9	0.3

Prob. - Probable

Table 3.6. All and probable avoidable factors, missed opportunities and substandard care for birth trauma

	Metropolitan		City and Town		Rural	
	All % of BT deaths	Prob. % of BT deaths	All % of BT deaths	Prob. % of BT deaths	All % of BT deaths	Prob. % of BT deaths
Health worker related	28.9	6.0	58.7	23.1	73.6	31.9
Administrative related	21.1	6.6	29.8	10.6	22.2	5.6
Patient related	62.0	34.9	46.2	28.8	40.3	12.5
Insufficient information	1.8	0	2.9	1.0	0	0

Prob. - Probable

Table 3.7 lists the common avoidable factors that if circumstances or behaviour had been otherwise the death would probably not have occurred.

Discussion

The majority of infants considered in this report on perinatal deaths due to intrapartum asphyxia and birth trauma were admitted to hospital alive (75%), and almost 90% had a birth weight of 2kg or more. Intuitively these babies should have survived. The assessors were of the opinion that there were avoidable factors related to the health system in at least half of the deaths. Clearly, of all the causes of perinatal deaths reported in this perinatal care survey, deaths due to intrapartum asphyxia and birth trauma

are the group that should and could be prevented. Most perinatal deaths due to intrauterine asphyxia and birth trauma occurred in the rural areas, lesser incidences in the city and town regions and the lowest incidence in the metropolitan districts.

Table 3.7. Probable avoidable factors, missed opportunities and substandard care with respect to health worker related problems for intrapartum asphyxia and birth trauma

	Intrapartum asphyxia (IPA)		Birth Trauma (BT)	
Probable Avoidable Factors	**n=2035**	**% of IPA deaths**	**n=246**	**% of BT deaths**
Health Worker Related	632	31.1	65	26.4
Fetal Monitoring inadequate	216	10.6	4	1.6
Poor or no partogram usage	79	3.9	6	2.4
Second stage mismanaged	85	4.2	9	3.7
Breech presentation missed	13	0.6	13	5.3
Underestimate fetal size	17	0.8	10	4.1
No response to apparent post-term pregnancy	16	0.8	2	0.8
Multiple pregnancy not diagnosed	17	0.8	1	0.4
Neonatal resuscitation inadequate	9	0.4	0	0.0
Delay in referring patient to 2 or 3 level of care	53	2.6	2	0.8
Delay in calling for assistance	53	2.6	7	2.8
Delay in doctor responding to call	11	0.5	4	1.6
Administrative problems	208	10.2	26	10.6
Inadequate facilities in neonatal unit	37	1.8	0	0.0
Inadequate theatre facilities & anaesthetic delays	19	0.9	5	2.0
Lack of transport: home to institution	18	0.9	6	2.4
Lack of transport: institution to institution	35	1.7	7	2.8
Insufficient nurses on duty	35	1.7	0	0.0
Insufficient doctors on duty	28	1.4	1	0.4
Personnel insufficiently trained or too junior	24	1.2	5	2.0
Patient related	196	9.6	59	24.0
Delay in seeking medical attention during labour	120	5.9	30	12.2
Inappropriate response to poor fetal movements	12	0.6	1	0.4

More than a third of the deaths due to birth trauma were traumatic breech deliveries, and 62% were in infants with a birthweight of 2.5kg or more. The Term Breech Trial[1] has demonstrated, in areas where it is safe to perform a caesarean section, that a planned caesarean section is preferable to a vaginal birth. Ideally, the breech will be detected in the antenatal

period and an external cephalic version attempted, provided there are no contraindications. Provided the breech is diagnosed early in labour and there is the ability to perform a safe caesarean section, a number of these deaths could be prevented.

Delay in intervening in the second stage was one of the common avoidable factors noted in deaths due to intrapartum asphyxia. In 85 cases, it was thought to contribute directly to the death of the infant. The instrumental delivery rate of between one and two percent in all areas is low. The low number of traumatic deliveries associated with assisted births suggests assisted delivery is not being performed as frequently as in previous generations. The implication is more unnecessary caesarean sections are being performed or the second stage is being prolonged unnecessarily to the detriment of the fetus because of lack of skill in instrumental deliveries. This aspect will need to be examined closer in future reports.

In the intrapartum asphyxia group of perinatal deaths, between 15% and 37% of the infants born alive died due to meconium aspiration syndrome. This amounts to 256 infants (6% of all neonatal deaths recorded), and is probably under-reported given the high number of final neonatal causes of death due to hypoxia being unclassified. Amnioinfusion is an intervention that has been shown to significantly reduce severe perinatal morbidity in circumstances of sub-optimal fetal monitoring in cases with meconium stained liquor in labour[2]. Given the findings of this report, sub-optimal fetal monitoring is widespread and amnioinfusion is a very valuable tool. Clinical staff managing labour should know how to perform the procedure, and where the skill is lacking it needs to be taught.

However, the bulk of the deaths were due to mismanaged labour. Buchmann and Pattinson[3] showed in a detailed analysis of 100 cases of perinatal death due to intrapartum asphyxia, the major avoidable factors related to not following basic management of labour in terms of monitoring and intervention. Since the initiation of The Perinatal Problem Identification Programme and the Confidential Enquiry into Maternal Deaths there has been a request for national staffing norms to be published. It is quite possible that there are staffing shortages but until staffing norms have been established it will not be possible to address this problem and define to what extent staff shortages are responsible for babies dying. Assuming adequate staffing levels, the next question that must be answered is the quality of care in the labour wards. This could be that protocols are not followed (partograms not used), staff are not diagnosing problems that arise during labour or are not obtaining the necessary support when a diagnosis is made. Barriers to transfer to the next level of care either because of lack of transport or unavailability of beds may also be

responsible. Poor neonatal resuscitation and care may also be implicated in these unacceptably high rates of perinatal loss. Examination of the avoidable factors in these cases implicate an unacceptably high rate of medical personnel associated cases which are highest in the categories of stillborn – alive on admission and early neonatal death. This problem is most prevalent in the rural areas and lowest in the Metropolitan areas.

The problems have been identified but it appears that little action has been taken to remedy the situation. The frightening possibility that inadequately trained doctors and midwives are being expected to perform above their capabilities must also be considered and the National Standards for qualification of both Midwives and Doctors questioned. Only audit of the labour management practices and holistic investigation of poorly performing institutions will give the answer and hopefully indicate what needs to be done to improve this most unsatisfactory state of affairs.

Conclusion

Intrauterine asphyxia and birth trauma is the second most common cause of perinatal loss in South Africa with a high proportion of cases being attributed to substandard care by the medical personnel. The problem is most prevalent in the rural areas and urgent attention needs to be given ensuring that basic labour ward protocols are followed and that the necessary in-service training is given. This is one area where the proper implementation of labour ward protocols and partogram use could be expected to result in a marked decrease in perinatal mortality and morbidity.

References

1. Hannah ME, Hannah WJ, Hewson SA, Hodnett ED, Saigal S, Willan AR. Term breech trial collaborative group. Planned caesarean section versus planned vaginal birth for breech presentation at term: randomised multicentre trial. Lancet 2000;356:1375-83.
2. Mahomed K, Mulambo T, Woelk G, Hofmeyr GJ, Gulmazoglu AM. The collaborative randomised amnioinfusion for mecomium project (CRAMP): 2. Zimbabwe. BJOG 1998;105:309-313.
3. Buchmann EJ, Pattinson RC. Babies who die from intrapartum hypoxia: a confidential enquiry in South African public hospitals. Tropical Doctor 2004 (in press).

Chapter 4
Spontaneous preterm birth

Abstract

Aim: To assess the extent of the problem of perinatal deaths due to spontaneous preterm births and suggest ways of reducing this mortality.

Method: Data collected in the Perinatal Problem Identification Programme (PPIP), from sentinel sites in South Africa from October 1999 – September 2003 was used. The primary obstetric cause of death and the avoidable factors, missed opportunities and substandard care were assessed.

Results: A total of 12773 perinatal deaths with a birth weight of 1000g and more out of a total of 462348 total births were assessed. Spontaneous preterm births were the third most common primary obstetric cause of death (16.1%). The majority of these spontaneous preterm births were classified as idiopathic preterm labour. Eighty two percent of these babies died in the neonatal period. Seventy three percent of neonatal deaths were ascribed to immaturity. Overall, surprisingly few avoidable factors were recorded. Delay in attending when in labour (4%), poor attendance for antenatal care (3%) and lack of adequate neonatal care facilities (2.7%) were recorded as the main avoidable factors.

Conclusion: Prevention of preterm birth is difficult, hence emphasis must be placed on appropriate care of these small neonates.

Recommendations

1. Prophylactic corticosteroids must be administered in cases of preterm labour.
2. Aggressive intrapartum management to try and prevent preterm birth should be practiced.
3. *In-utero* transfer of neonates is preferable to transfer of the neonate by ambulance.
4. Adequate neonatal bed space must be made available as a matter of urgency.
5. Neonatal facilities must be appropriately staffed and equipped for the level of care offered.
6. Staff must be appropriately trained in the care of the small infant.

Introduction

The PPIP users recorded 468872 births and perinatal deaths in 17525 infants over 500g from 1st October 1999 to 30th September 2003. Spontaneous preterm births were recorded as primary cause in 4210 infants (24.0% of all deaths). Just under half of these deaths 2060 (48.9%) were in infants 1000g or more (Table 4.1). Spontaneous preterm births made up 16.1% of all perinatal deaths 1000g or more. This chapter will examine in detail the deaths of the infants 1000g or more as these babies have traditionally been regarded as viable and those under 1000g as late abortions. However, this clearly underestimates the magnitude of the problem (Table 4.2).

Table 4.1. Distribution (in percent) of perinatal deaths due to spontaneous preterm births in birth weight categories

	500-999g	1000-1499g	1500-1999g	2000-2499g	2500g+
Metropolitan	66.7	22.3	8.1	2.1	0.7
City and Town	42.4	35.9	16.8	3.7	1.2
Rural	33.3	41.2	20.7	3.7	1.0
South Africa	51.1	31.1	13.8	3.0	1.0

Table 4.2. Ranking of spontaneous preterm birth as a primary cause of perinatal death for all birth weight categories.

Birthweight category	Metropolitan	City and Town	Rural	South Africa
	Rank	Rank	Rank	Rank
500g – 999g	1	1	1	1
1000g – 1499g	1	1	1	1
1500g – 1999g	3	2	2	2
2000g – 2499g	8	5	5	6
2500g +	12	11	11	11

Primary obstetric cause of death

Idiopathic preterm labour (54.5%) was the most common sub-category of types of spontaneous preterm birth (Table 4.3). It is probably artificially low because of the high number of unclassified spontaneous preterm birth in the city and town and rural areas. If the unclassified cases are excluded, idiopathic preterm labour accounts for 70.3% of spontaneous preterm birth. The prevalence of chorioamnionitis appears low in the city and town and rural areas, suggesting the diagnosis was not considered. It is disturbing to see 37 babies that were delivered prematurely by medical personnel with no clear indication and were premature, and subsequently died.

Table 4.3. Comparison of the sub-categories of spontaneous preterm birth

	South Africa		Metropolitan		City and Town		Rural	
	N	%	N	%	N	%	N	%
Idiopathic PTL	**1122**	**54.5**	380	63.8	520	55.3	222	42.4
PPROM	**295**	**14.3**	125	21.0	89	9.5	81	15.5
PPROM + chorioamnionitis	**79**	**3.8**	40	6.7	23	2.4	16	3.1
PTL (intact memb.) + chorioamnionitis	**42**	**2.0**	28	4.7	8	0.9	6	1.1
Cervical incompetence	**20**	**1.0**	2	0.3	12	1.3	6	1.1
Iatrogenic (no adequate indication for delivery)	**37**	**1.8**	8	1.3	16	1.7	13	2.5
Unclassified	**465**	**22.6**	13	2.2	272	28.9	180	34.4
Total	**2060**	**100.0**	596	100.0	940	100.0	524	100.0

Timing of Perinatal death

Table 4.4 details the time of death in relation to admission to hospital. Not surprisingly the majority of these babies die in the neonatal period. What is disturbing is the high proportion of stillbirths, (29% in metropolitan areas). The number of macerated stillbirths is surprising. In the rural areas, only 7% of the babies survive to the "late neonatal period".

Table 3.4. Deaths due to spontaneous preterm birth in relation to time of admission

	South Africa	Metro-politan	City & Town	Rural
Stillbirth	**18.3**	**29.4**	**13.8**	**13.7**
Macerated Stillbirth	6.5	11.4	3.8	5.7
Fresh Stillborn, dead on admission	5.6	7.9	5.7	2.7
Fresh Stillborn, alive on admission	3.6	3.7	3.4	4.0
Stillborn status on admission unknown	2.6	6.4	0.9	1.3
Neonatal Death	**81.7**	**60.6**	**86.2**	**86.3**
Early Neonatal Death	67.0	54.4	67.7	80.3
Late Neonatal Death	14.7	16.3	18.5	5.9

Figures 4.1 and 4.2 illustrate the distribution of deaths due to spontaneous preterm birth in the birth weight categories. Not surprisingly, most deaths are in the lower birth weight categories and the proportions are similar throughout the different areas. However, when the mortality rates are compared, the differences are dramatic. There is a large group of "salvageable" neonates dying outside of the metropolitan areas.

Figure 4.1. Distribution of death due to spontaneous preterm birth in birth weight categories

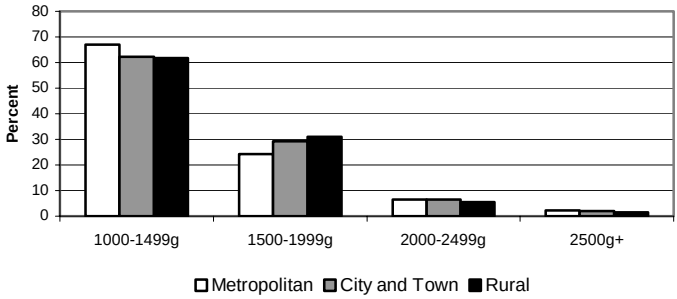
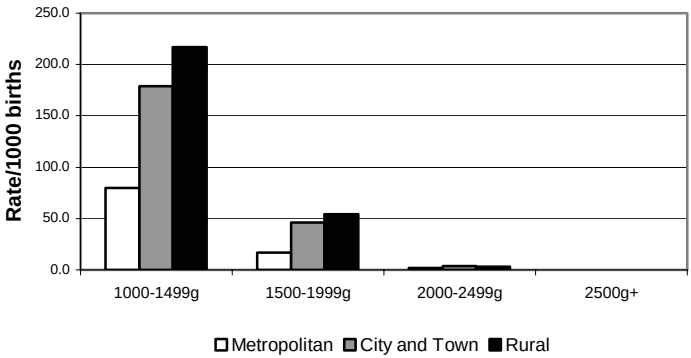


Figure 4.2. Mortality rate of deaths due to spontaneous preterm birth in each birthweight category



Final Neonatal causes of death

Analysis of the final cause of death in the 2060 neonates (above 1000g) classified as due to spontaneous preterm birth found the majority (73%) died as a result of complications of "immaturity" (Figure 4.3.). Only 15.2% are thought to have died as a result of infection and only 4.5% of these babies as a result of hypoxia, with as few as 2% with a detectable congenital abnormality (Figures 4.3). The percentage of deaths due to infection is significantly higher in the metropolitan areas. This occurred mainly in the late neonatal death group and was mainly due to nosocomial infections which accounted for just under a third of the "infective" deaths in the metropolitan areas, but only 2-4% in the others. Of the late neonatal

deaths, half were categorised as due to infection in the metropolitan areas, compared to 30% in the others.

Figure 4.3. Comparison of final causes of neonatal death in different areas

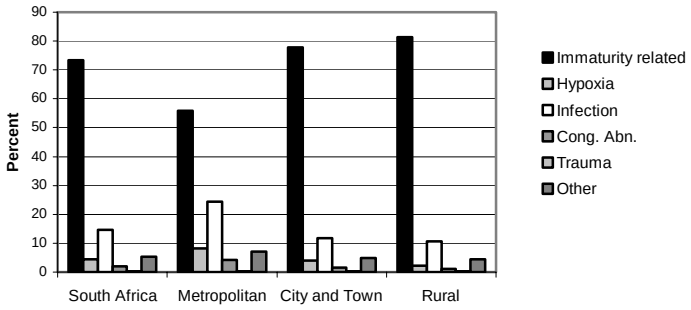
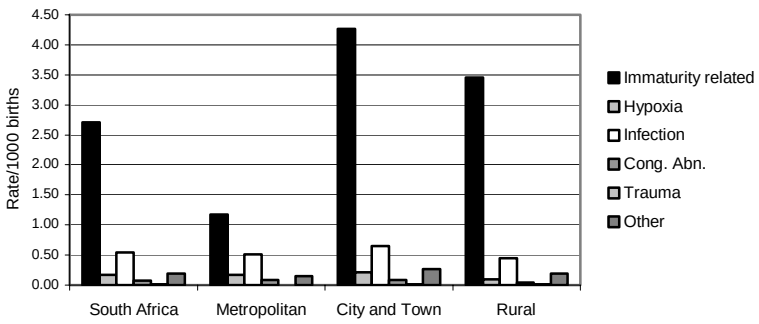


Figure 4.4, however, gives a completely different picture when the mortality rates are compared between the different areas. The mortality rates of deaths due to immaturity are more than three times lower than city and town and rural areas. There was no difference with respect to the other causes. The place for improvement is clearly demonstrated.

Figure 4.4. Comparison of mortality rates the final causes of death due to spontaous preterm birth



Avoidable factors, missed opportunities and substandard care

For each baby's death, avoidable factors, missed opportunities and substandard care were sought, and where found were recorded. An avoidable factor was assessed to be either possible or probable. A probable factor is considered if that factor is likely to have contributed directly to the

death of that baby, i.e. the death would not have occurred if this factor had been corrected /absent.

Table 4.5. All and probable avoidable factors, missed opportunities and substandard care for the spontaneous preterm births (<1000g).

	Metropolitan		City and Town		Rural	
	All % of deaths	Prob. % of deaths	All % of deaths	Prob. % of deaths	All % of deaths	Prob. % of deaths
Health worker related	16.1	4.4	15.9	6.3	17.7	6.5
Administrative related	18.5	3.2	16.5	5.4	35.3	10.3
Patient related	48.5	4.4	52.3	13.6	44.1	10.9
Insufficient information	5.9	0.7	6.3	0.3	8.6	0

Of the 2060 perinatal deaths (1000g or more) that were entered in this data set, only 460 probable avoidable factors were identified. More than one factor can be present in one case, but some of the categories are mutually exclusive. Table 4.5 gives the distribution of the avoidable factors per category for each area. As with the other categories of primary obstetric causes of death, most were attributed to patient related factors. This held true for the three areas. If only the probable factors were considered, then the patient related factors drop dramatically. The health worker related avoidable factors were few. Administrative factors rise as the distance from the metropolitan areas increases. Table 4.6 lists the most important avoidable factors.

It is noticeable that the health worker related avoidable factors judged to be directly related to the death were low. Surprisingly there were only 10 cases reported where the incorrect management of preterm labour was identified as a factor. This may be explained by one of the following: lack of knowledge by the assessors on the appropriate management; lack of thoroughness in assessing the care; there was no time to give the appropriate treatment; and the management was excellent in almost all cases. The lack of documentation of problems of neonatal care probably alludes to the lack of knowledge by the assessors of neonatal protocols and management.

In 59 cases, the death was directly attributed to a lack of neonatal facilities. Given the high rates of death in the city and towns and rural areas due to immaturity, this must be an underestimation.

Delay in seeking medical attention during labour was the most common avoidable factor. Lack of/or poor antenatal care was recorded as a common avoidable factor.

Table 4.6. Probable avoidable factors, missed opportunities and substandard care with respect to spontaneous preterm birth

Probable Avoidable Factors	Number	% of deaths due to spontaneous preterm birth
Health Worker Related	**123**	**6.0**
Multiple pregnancy not diagnosed	14	0.7
Incorrect management preterm labour	10	0.5
Neonatal care: management plan inadequate	13	0.6
Neonatal care: inadequate monitoring	11	0.5
Administrative problems	**124**	**6.0**
Inadequate facilities in neonatal unit	59	2.9
Lack of transport: home to institution	23	1.1
Lack of transport: institution to institution	14	0.7
Syphilis screening inadequate	13	0.6
Patient related	**213**	**10.3**
Delay in seeking medical attention during labour	78	3.8
Never initiated antenatal care	59	2.9
Booked late in pregnancy	28	1.4
Inappropriate response to rupture of membranes	22	1.1
Inappropriate response to poor fetal movements	10	0.5

Discussion

Spontaneous preterm births were the third most common cause regarding the primary obstetrical cause of death in infants with a birthweight more than 1000g being responsible for 16.1% of perinatal deaths. However, if the causes of death of infants 500g or more are examined they made up 24% of all perinatal deaths. Mortality from spontaneous preterm births was most common cause of death in infants being born below 1500g, and the second most common cause in the weight category 1500g – 1999g. Future reports will need to examine the 500-999g birthweight category in greater depth.

As expected the majority of deaths are early neonatal deaths and occur in the lowest birthweight categories. The relatively high proportion that presented as stillbirths was unexpected. One explanation is that the cases were misclassified as being due to spontaneous preterm birth rather than unexplained stillbirths. An alternative explanation is that these deaths were due to chorioamnionitis as maceration occurs earlier where infection is present. Acute placental oedema causing acute hypoxia to the fetus has

been well described by Naeye et al[1], and Ross and Naeye[2] and this could account for the high number of fresh stillbirths. Alternatively, the babies were born alive (i.e. with a heart beat or gasping and died very shortly thereafter) but were classified as stillbirths by the staff for convenience. The presence of infection in deaths due to spontaneous preterm birth was probably under-reported.

The great disparity between metropolitan and the other areas with respect to neonatal care was graphically demonstrated in relation to mortality rates, especially with regard to immaturity as a cause of death. (Discussed in Chapter 9).

The most common probable avoidable factor was delay in seeking help in labour. However, it is not clear what was the cause of the delay. For example, was it an inability to get transport to the hospital, did the patient not want care, or did the labour progress faster than expected. This may be a reflection on the problem of non-availability of transport rather than unwillingness on the part of the patient to come to hospital.

Lack of antenatal care was another commonly recorded avoidable factor, however, what role antenatal care could have played in preventing the death is unclear. Certain risk factors for preterm labour can be detected and treated, namely syphilis and asymptomatic bacteriuria. Perhaps the "un-booked" status is a reflection of socio-economic and cultural factors. The question of the "un-booked" patient has been discussed by Jeffrey et al[3] and Ndiweni and Buchmann[4].

The low number of neonatal avoidable factors recorded is most likely to be an indication of lack of knowledge on how to manage the low birth weight infant rather than the absence of poor management. The high neonatal mortality rates in the 1-2 kg categories in the city and towns and rural areas argue against adequate care. The number of health worker related probable avoidable factors was low, as was the administrative avoidable factors, although inadequate facilities were mentioned relatively commonly. This is most likely to be an indication of the rapidity of preterm labour. Infection contributes strongly to the late neonatal deaths, showing that should the fetus survive the initial phase of the neonatal life, it remains vulnerable to nosocomial infection while gaining weight in hospital.

From the data, a picture emerges of patients arriving at the nearest health institutions and delivering shortly thereafter, not allowing the labour ward staff time to prevent delivery or give cortiocsteroids. Thus the institution is faced with a small baby for whom it must, at least, provide initial resuscitation and management.

Chapter 9 on immaturity will deal with neonatal care in more detail.

Conclusion

Prevention of preterm birth is difficult and largely unsuccessful. Prevention of neonatal death is the strategy most likely to succeed in preventing deaths due to spontaneous preterm birth currently in South Africa. Improvement of the care of the small neonate must be the key strategy. This can be achieved by increasing and supporting the neonatal facilities available, improving knowledge of the health care workers in managing immature infants and introducing new strategies such as kangaroo mother care and nasal CPAP which have shown to be effective in reducing neonatal deaths. However, there must still be aggressive intrapartum management to try and prevent preterm birth, allowing at least time for administration of corticosteroids.

References

1. Ross, Macpherson, Naeye, Khatree, Wallace. SAMJ 1982 Naeye RL, Ross SM. Amniotic fluid infection syndrome. Clinics in Obstet and Gynecol 1982; 9:593-607
3. Jeffery BS, Tsuari M, Pistorius LR, Makin J, Pattinson RC. The impact of a pregnancy confirmation clinic on the commencement of antenatal care. S Afr Med J 2000;90:153-
4. Ndiweni Q, Buchmann EJ. Unbooked mothers and their babies – what causes the poor outcome. S Afr Med J 1998;88:192-199

Chapter 5
Hypertension and Abruptio placentae

Abstract

Aim: To assess the extent of the problem of perinatal deaths due to hypertension in pregnancy and abruptio placentae and suggest ways of reducing this mortality.

Method: Data collected in the Perinatal Problem Identification Programme (PPIP), from sentinel sites in South Africa from October 1999 – September 2003 was used. The primary obstetric cause of death and the avoidable factors, missed opportunities and substandard care were assessed. Hypertension in pregnancy and abruptio placentae were analysed together because of the close relationship between these conditions.

Results: Together they were responsible for almost one in every four perinatal deaths. The stillbirth:neonatal death ratio was 3.4:1 for hypertensive disorders with macerated stillbirths occurring most commonly and 6.3:1 for abruptio placentae, where fresh stillbirths formed the largest group. Approximately one in eight of all deaths were intra-uterine deaths where the fetus still lived at time of admission. Neonatal deaths were mostly related to immaturity or hypoxia. Health care related avoidable factors included non-response to clear risk factors and delay in referral to an appropriate level of care.

Conclusion: Perinatal outcome may be improved by strict adherence to management of mothers with hypertension or abruptio placentae and early recognition of warning signs accompanied by fitting advice, as well as appropriate management at each level of care. This also implies a well-developed system of referral to higher levels of care, which further implies the willingness to accept these referrals at level 2 or 3 hospitals.

Recommendations

1. The published guidelines for the management of pregnant mothers with hypertension or an abruptio placenta must be made available and followed.
2. Early recognition of warning signs is essential, as is correct management which will include advice to mothers at highest risk.
3. There is a need to develop guidelines for referral, which should include a commitment from the higher level of care to accept referrals.
4. Clear guidelines should indicate the management appropriate for each level of care.

Introduction

Hypertension in pregnancy is associated with increased perinatal morbidity and mortality. Pre-eclampsia, in particular, is a leading cause of perinatal mortality in developing countries[1,2]. The association between abruptio placentae and hypertensive diseases is well known[3,4]. However, it is not always easy to determine whether a perinatal death due to abruptio placentae occurred in association with hypertension, as most women with an intra-uterine death due to abruptio placentae will probably present with hypotension during the acute phase. Alternatively, hypertension can follow the release of vasoactive substances after an abruptio, resulting in the clinical syndrome of pre-eclampsia. Furthermore, there is ample evidence indicating that impaired placentation early in pregnancy plays an important role in the development of pre-eclampsia later during that pregnancy[5,6], which could explain a possible link between abruptio placentae and hypertension. We have, therefore, decided to assess losses due to abruptio placentae, irrespective of whether hypertension was also documented in those cases or not, and hypertension as a single group. This does not mean that other conditions associated with antepartum haemorrhage (eg. placenta praevia) is not important, but the underlying pathology is quite different and they were, for that reason, not included in this chapter.

Primary obstetric cause of death

Table 5.1. Primary obstetric causes of death in the sub-categories

Sub-category	**N**	**% of category**	% of all deaths	Rate/1000 births
Proteinuric hypertension	957	68.8		
Eclampsia	249	17.9		
Chronic hypertension	84	6.0		
Unclassified	102	7.3		
Total Hypertension	**1392**		**10.9**	**3.01**
Abruptio placentae with hypertension	636	40.1		
Abruptio placentae without hypertension	949	59.9		
Total abruptio placentae	**1585**		**12.4**	**3.43**
Total hypertension and abruptio placenta with hypertension	2028		15.9	4.39

Hypertension (11%) and abruptio placentae (16.4%) grouped together were responsible for 27.4% of all perinatal deaths during the study period. This is more than any other single cause of losses. Even if considered separately, both remain amongst the five most common groups of causes of PNM in South Africa. The primary obstetric causes of death in the various subcategories are summarised in Table 5.1. More than 90% of deaths due

to hypertensive diseases occur in women with proteinuric hypertension and eclampsia, while almost one third of cases with abruptio placentae are associated with hypertension.

Both abruptio placentae and hypertension in pregnancy caused a higher rate of perinatal deaths in metropolitan areas than in rural areas (Table 5.2). The rate of deaths due to abruptio placentae was similar in the Metropolitan and City and Town areas, but the rate due to hypertension in pregnancy was highest in the City and Town category.

Table 5.2. Areas and hypertension or abruptio placentae as primary cause of death

Primary cause	Metropolitan		City and Town		Rural	
	% of all deaths	Rate/ 1000 births	% of all deaths	Rate/ 1000 births	% of all deaths	Rate/ 1000 births
Hypertension	11.0	2.65	12.8	4.17	7.6	2.07
All abruptio placentae	16.4	3.92	11.6	3.76	7.1	1.94
Hypertension and abruptio placentae with hypertension	17.2	4.17	16.9	5.51	11.9	3.24

Timing of Perinatal death

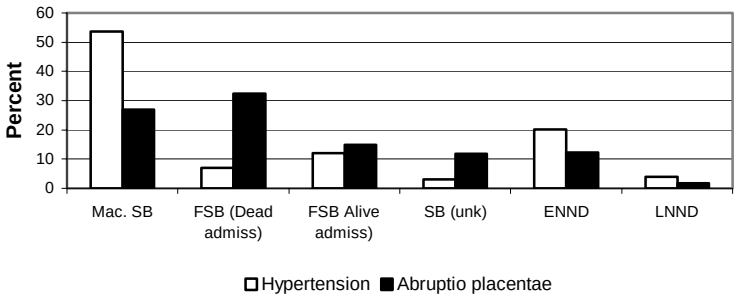
Table 5.3. Timing of deaths due to hypertension (HT) and abruptio placentae (AP)

	% all deaths due to hypertension		% all deaths due to Abruptio placentae	
Stillbirth	**77.2**		**81.1**	
Macerated Stillbirth		53.7		26.9
Fresh Stillborn, dead on admission		7.0		32.3
Fresh Stillborn, alive on admission		12.1		14.8
Fresh Stillborn status on admission unknown		3.0		11.9
Neonatal Death	**22.8**		**11.9**	
Early Neonatal Death		20.2		12.3
Late Neonatal Death		3.9		1.7

Stillbirths occurred significantly more often than neonatal deaths in perinatal losses caused by both abruptio placentae and hypertension in pregnancy (Table 5.3). The stillbirth:neonatal death ratio was 3.4:1 for hypertension in pregnancy and 6.3:1 for abruptio placentae. Two-thirds of stillbirths due to hypertension in pregnancy were macerated. In contrast, almost half of stillbirths caused by abruptio placentae were fresh with 27%

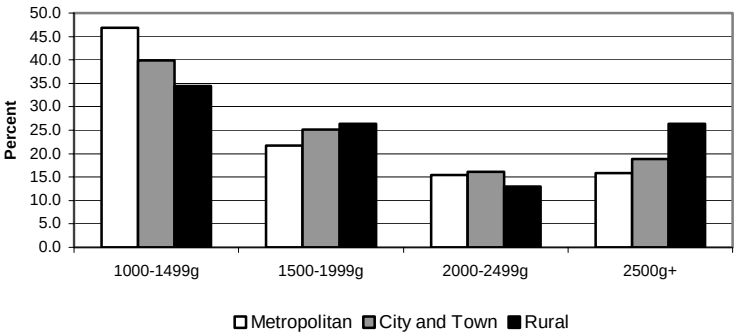
cases being macerated. More than 12% of all losses occurred at the health care centre after the fetal heart had been heard on admission.

Figure 5.1. Timing of perinatal deaths with respect to admission



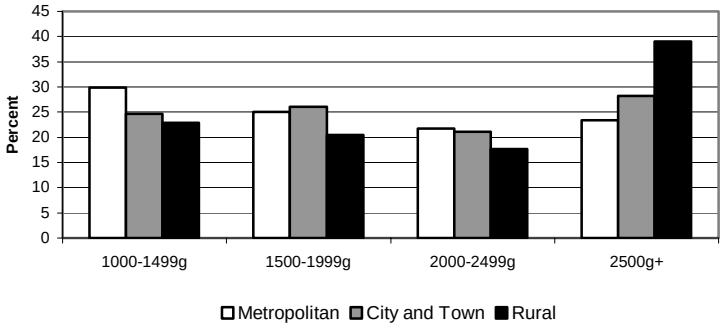
Figures 5.2, 5.3 and 5.4 illustrate the distribution of deaths with respect to the different weight categories.

Figure 5.2. Distribution of deaths in different weight categories for complications of hypertension in pregnancy



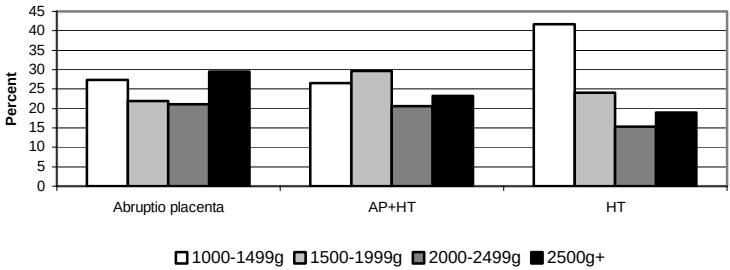
The weight category 1000-1499g was responsible for the majority of deaths in the hypertension in pregnancy group in all areas, but deaths were evenly distributed throughout the weight categories for abruptio placentae.

Figure 5.3. Distribution of deaths in different weight categories for abruptio placentae



The distribution of deaths, in cases of hypertension and abruptio placentae, followed more closely the pattern of abruptio placentae alone and hypertension alone.

Figure 5.4. Distribution of various weight categories in deaths due to abruptio placentae and hypertension

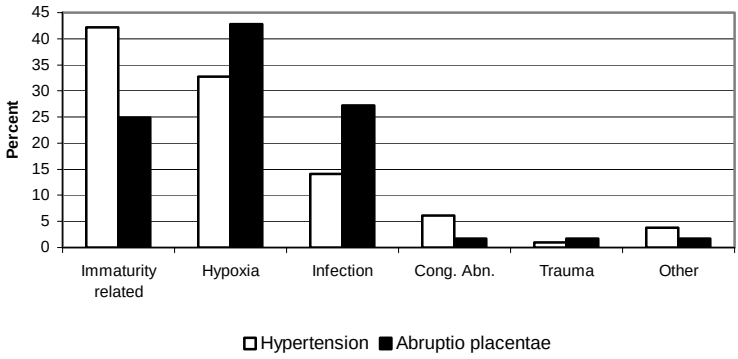


Final Neonatal causes of death

Table 5.4. Final neonatal causes of deaths for hypertension and abruptio placentae

	Hypertension		Abruptio placentae	
	Number	**%**	**Number**	**%**
Immaturity related	131	42.1	43	24.9
Hypoxia	102	32.8	74	42.8
Infection	44	14.1	47	27.2
Congenital Abnormalities	19	6.1	3	1.7
Other	15	4.9	6	3.4

Figure 5.5. Final neonatal causes of death



The majority of neonatal deaths due to hypertension in pregnancy were related to immaturity or hypoxia (Tables 5.4 and 5.5). The contribution of infection to neonatal deaths increased from Rural to City and Town, with the highest incidence occurring in the metropolitan areas. Immaturity and hypoxia remained the two most important final causes of neonatal deaths in the abruptio placentae groups in Rural and City and Town (Table 5.4 and 5.5). Infection was a more common cause than immaturity in Metropolitan areas, where hypoxia remained the most common cause.

Table 5.5. Final neonatal causes of deaths in areas for hypertension and abruptio placentae

	% of neonatal deaths due to primary cause: Hypertension			% of neonatal deaths due to primary cause: Abruptio placentae		
	Metropol	**City & Town**	**Rural**	**Metropol**	**City & Town**	**Rural**
Immaturity related	35.7	46.0	51.1	13.6	39.1	31.3
Hypoxia	29.3	36.5	33.3	54.2	39.1	43.8
Infection	19.3	12.7	2.2	28.8	17.4	12.5
Cong. Abn.	10.0	1.6	6.7	0.0	2.2	12.5
Other	5.7	3.2	6.7	3.4	2.2	0.0

Avoidable factors, missed opportunities and substandard care

Table 5.6 (a). All and probable avoidable factors, missed opportunities and substandard care for hypertension

	Metropolitan		City and Town		Rural	
	All % of death	Prob. % of death	All % of death	Prob. % of death	All % of death	Prob. % of death
Health worker related	33.0%	17.5%	41.9%	18.8%	34.8%	11.6%
Administrative related	21.0%	3.0%	9.7%	3.7%	17.0%	5.4%
Patient related	40.4%	5.0%	43.1%	15.5%	40.6%	11.6%
Insufficient information	2.2%	0.2%	4.2%	0.2%	6.7%	0.4%

Table 5.6 (b). All and probable avoidable factors, missed opportunities and substandard care for abruptio placentae

	Metropolitan		City and Town		Rural	
	All % of death	Prob. % of death	All % of death	Prob. % of death	All % of death	Prob. % of death
Health worker related	17.1%	7.0%	24.6%	9.6%	26.9%	11.5%
Administrative related	12.4%	2.2%	11.7%	4.4%	11.5%	3.1%
Patient related	31.3%	3.6%	37.4%	12.3%	41.9%	11.5%
Insufficient information	1.2%	0.2%	4.1%	0.2%	10.8%	0.8%

Table 5.7(a). Probable avoidable factors, missed opportunities and substandard care with respect to Health worker related problems for hypertension.

Probable Avoidable Factors	Hypertension	% of deaths due to HT
Health Worker Related	241	17.3
No response to maternal hypertension	70	5.0
No response to poor uterine fundal growth	19	1.4
Fetal monitoring inadequate	44	3.2
No response to poor obstetric history	9	0.6
Delay in referring patient to 2 or 3 level of care	33	2.4
Administrative problems	51	3.6
Inadequate facilities in neonatal unit	9	0.6
Lack of transport: home to institution	12	0.9
Patient related	154	11.1
Delay in seeking medical attention during labour	12	0.9
Inappropriate response to poor fetal movements	21	1.5

Table 5.7(b). Probable avoidable factors, missed opportunities and substandard care with respect to Health worker related problems for abruptio placentae.

Probable Avoidable Factors	Abruptio placentae	% of deaths due to AP
Health Worker Related	152	9.6
Fetal Monitoring inadequate	33	2.1
No response to maternal hypertension	33	2.1
No response to poor obstetric history	12	0.8
Delay in referring patient to 2 or 3 level of care	22	1.4
Administrative problems	55	3.5
Inadequate facilities in neonatal unit	7	0.4
Inadequate theatre facilities & anaesthetic delays	7	0.4
Lack of transport: home to institution	11	0.7
Lack of transport: institution to institution	15	0.9
Patient related	141	8.9
Delay in seeking medical attention during labour	18	1.1
Inappropriate response to poor fetal movements	10	0.6
Inappropriate response to APH	26	1.6

Discussion

Abruptio placentae, with and without hypertension, and hypertension in pregnancy were the primary obstetric causes of 23% of perinatal deaths recorded over the period of investigation. It is of interest that these two groups are also amongst the "big five" causes of maternal deaths in South-Africa[7]. While it was not possible from the available data to determine the relationship between maternal and perinatal outcome, it is quite clear that maternal condition will influence perinatal outcome. It is important that health workers involved with the management of pregnant mothers should be familiar with the guidelines regarding the management of these mothers. The recommended strategies for reducing maternal deaths due to haemorrhage and hypertension in pregnancy, appropriate to the level of care, have to be implemented and adhered to. Early recognition of signs and symptoms is essential, as well as the ability to give appropriate advice.

Both abruptio placentae and hypertension in pregnancy were more common causes of perinatal losses in metropolitan than in rural areas. This is true for the ratio of all deaths caused by hypertension (11% in the metropolitan

areas vs. 7.6% in rural areas), but also for the rates per 1000 births (2.52 in the metropolitan areas vs. 2.06 in rural areas). The difference was even more striking for abruptio placentae, (16.3% and 3.89/1000 in the metropolitan areas vs. 7.2% and 1.93/1000 in rural areas respectively). This could be because of referrals of some of the most severe cases to higher levels of care, but differences in the way abruptio placentae is diagnosed may also have played a role. It is difficult to explain why the rate for hypertension in "City and Town" is so much higher than in other areas (12.8%). This disparity is noted for all forms of hypertension (proteinuric hypertension, chronic hypertension and eclampsia).

The high rate of intrauterine to neonatal deaths in both groups could indicate sub optimal antenatal care. Possible causes could be unavailability of accessible antenatal care, lack of adequate resources or training where facilities do exist or inappropriate utilization of these facilities by pregnant women. All of these seem to have contributed to some extent when probable preventable factors are considered. While it is true that the assessment of avoidable factors may be very subjective, there are some apparent trends that cannot be ignored. Health care related probable avoidable factors are more commonly reported than patient related when deaths due to hypertension in pregnancy are considered. This is more evident in the non-rural areas. It is unfortunate that non-response to factors such as maternal hypertension, poor fundal growth and poor obstetric history should appear at all. This emphasizes the need for continuous professional development. However, when such basic aspects are not recognised as danger signs, a more thorough investigation of other aspects that may influence work performance, such as excessive workload or general working conditions, may be required. Patient related factors clearly require improved antenatal education to underline not only the importance of danger signs such as decreased fetal movements, but also the appropriate response when they occur. This will only be optimal if the community perceives antenatal care as beneficial and attempts should be made to determine obstacles at local level. Similar comments can be made regarding abruptio placentae.

Delay in referral of women to a higher level of care regularly results in perinatal deaths. Clear guidelines for referral, the willingness of the accepting institution to adhere to these guidelines as well as an adequate infrastructure are required.

Administrative problems involve mainly lack of potential life-saving equipment and facilities as well as inadequate transport services. These are not medical problems and health care workers can only be advocates who continuously bring these shortcomings to the attention of authorities.

There are striking differences in the timing of stillbirths due to abruptio placentae and hypertension. The high rate of macerated stillbirths in the hypertension groups may be related to placental insufficiency. Both caregivers and pregnant women should appreciate the relation between hypertension and poor placental function. This may lead to earlier appreciation of the importance of aspects such as poor fundal growth or decreased fetal movements. The picture is quite different with abruptio placentae where the higher incidence of fresh stillbirths is indicative of the acute onset with few if any warning signs. There is no reliable way of predicting this devastating complication. Again, high quality antenatal care with meticulous attention to detail, coupled with patient education will decrease but eliminate this problem.

The high percentage of intra-uterine deaths where the babies were alive on admission is a matter of concern (Table 5.3). While this may be a reflection of factors such as lack of the ability to perform caesarean sections (early enough), lack of equipment to diagnose fetal distress or lack of knowledge, solving these problems will not necessarily have saved all these babies. We do not know the interval between presentation and time of eventual intra-uterine death. Some mothers may have been admitted for some time before the intra-uterine death occurred. Factors such as the level of care and the (estimation of) gestational age at the time would have influenced the chance of neonatal survival. The distribution of deaths in different weight categories differs for abruptio placentae and hypertension (Figures 5.3 and 5.4). Almost half of deaths due to hypertension in the Metropolitan areas, occurred in babies with birth weight <1500 grams, with a similar trend in the other areas. In contrast, the distribution was more equal within weight categories amongst losses caused by abruptio placentae. It is disturbing to note that amongst perinatal losses due to abruptio placentae in rural areas, almost 40% had a birth weight above 2500 grams. The corresponding statistics for the Metropolitan and City and Town regions were no more encouraging, both being around 25%. The estimation of fetal viability by the managing physician is critical for perinatal survival[8].

The single most common cause of neonatal death in the hypertension group is immaturity related. We do not have data on the indications for delivery. It may be that some of these mothers may have qualified for expectant management. Expectant management of carefully selected mothers with severe pre-eclampsia, remote from term, may benefit the fetus without harming the mother[9]. Odendaal and co-workers performed a randomised controlled trial where 58 patients with severe pre-eclampsia who presented between 28 and 34 weeks' gestation were either electively delivered 48

hours after administration of betamethasone or managed expectantly till a maternal or fetal reason necessitated delivery[9]. Expectant management resulted in a significant prolongation of pregnancy of seven days as well as a reduction in the requirement for ventilation and also neonatal complications. This was accomplished without an increase in maternal complications. This group reported a further decrease in perinatal mortality as they managed to prolong pregnancy even further by more aggressive treatment of maternal hypertension[10]. In a later study, perinatal survival improved to 92% at 28 weeks' gestation, which was maintained till 34 weeks' gestation[11]. Eighty seven and a half percent (87.5%) of neonates required intensive care admission at 28 weeks' gestation, decreasing to 10.7% at 34 weeks' gestation. However, such management should take place at a referral hospital where experience exists. Likewise, termination of pregnancy for severe hypertension in pregnancy should not be performed in peripheral units before liasing with the nearest referral centre. The nature of fatal infections indicates that some of these deaths may also be related to immaturity (Table 5.4). Hypoxia may have followed placental insufficiency and possibly undiagnosed abruptio placentae. The relative high incidence of congenital abnormalities amongst hypertension in pregnancy cases is difficult to explain.

While the prevention of pre-eclampsia should theoretically eradicate these complications, there are no indications at present that pre-eclampsia as such is an entirely preventable disease. It should be borne in mind that hypertension and proteinuria, the traditional diagnostic requirements, represent only two aspects of a complex pathophysiological process characterised by widespread vascular endothelial damage and dysfunction in many systems, including platelet function[12]. Even the effective prevention of hypertension and proteinuria may still be associated with increased morbidity and mortality. If any intervention decreases the occurrence of antepartum hypertension and proteinuria and has no documented impact on maternal and fetal morbidity and mortality, or on the cost of hospitalisation, it will probably not be considered useful.

Various methods to prevent or decrease the incidence of pre-eclampsia have been investigated. The methods were mostly used in an attempt to rectify the underlying pathophysiological abnormalities to prevent the development of the disease or to postpone its clinical appearance for as long as possible where prevention is unsuccessful.

Several possible dietary measures in the prevention of pre-eclampsia were investigated, the most promising being calcium supplementation[13]. In a recent meta-analysis, it was concluded that calcium supplementation may reduce the risk of high blood pressure in pregnancy, particularly for women

at high risk of gestational hypertension and in communities with low-dietary calcium intake. However, the optimum dosage and the effect on more substantive outcomes have still to be determined. Further studies are taking place and the results are keenly awaited.

The role of low-dose aspirin was also investigated on a very large scale. The present Cochrane review includes more than 36000 women who participated in randomised controlled trials[14]. There was a 19% (13 – 25%) reduction in the risk of pre-eclampsia associated with the use of antiplatelet agents, the number needed to treat being 69 (51, 109). The authors conclude that antiplatelet agents have small-moderate benefits when used for prevention of pre-eclampsia, that more information is required to determine which women are most likely to benefit, when treatment is best started, and at what dose.

Placenta praevia and antepartum haemorrhage of unknown origin were responsible for 1% of all perinatal deaths. All cases of antepartum haemorrhage should be considered as particularly high-risk cases. The initial management should essentially consist of assessment aimed at stabilising the mother and the exclusion of abruptio placentae as cause. Thereafter, the patient should be referred to the level of care where a diagnosis can be made. This will direct the specific further management.

Conclusion

Hypertension and abruptio placentae are major causes of maternal and perinatal mortality in South Africa. It is, therefore, important that health professionals involved in care of pregnant mothers are aware of the dangers of these conditions, that they are able to recognise early warning signs and advise women accordingly and that they are able to manage the complications when they occur. This will require that clear guidelines are available for appropriate management at each level and that a smoothly functioning system for referral is available.

References

1. Naidu S, Moodley J, Adhikari M, Ramsaroop R, Morar N, Dunmoye OO. Clinico-patholigical study of causes of perinatal mortality in a developing country. *J Obstet Gynaecol* 2001; 21: 443–447.
2. Duley L. Maternal mortality associated with hypertensive disorders of pregnancy in Africa, Asia, Latin America and the Caribbean. Br J Obstet Gynaecol. 1992; 99: 547-553.
3. Pattinson R.C., Greyling K., de Jong G., Kotze T.J. van W. Risks for developing abruptio placentae. In: Proceedings of the Eleventh Conference on Priorities in Perinatal Care in Southern Africa, Caledon. University of the Witswatersrand Press, Johannesburg 1992; 42-44.
4. Ananth C.V., Savitz D.A., Williams M.A. Placental abruption and its association with hypertension and prolonged rupture of membranes: A methodologic review and meta-analysis. *Obstet Gynecol* 1996; 88: 309-318.
5. Brosens I.A, Robertson Weeks B., Dixon H.G. The role of spiral arteries in the pathogenesis of pre-eclampsia. In: Wynn RM (ed). *Obstetric & Gynaecology Annual,* Appleton-Century-Crofts, New York 1972; 177-191.
6. Matijevic R., Meekins J.W., McFadyen I.R., Pijnenborg R. Physiological changes of spiral arteries and blood flow in the placental bed during early pregnancy. *Contemp Rev Obstet Gynaecol* 1996; 8: 127-131.
7. Department of Health. Saving mothers. Report on Confidential Enquiries into Maternal Deaths in South Africa 1999 - 2001. Pretoria: Government Publishers, 2002.
8. Vansteenkiste MA, Pattinson RC, Kirsten GF. The role of obstetric factors in determining fetal viability. S Afr Med J 1992; 81: 508–511.
9. Odendaal H.J., Pattinson R.C., Bam R., et al. Aggressive or expectant management for patients with severe pre-eclampsia between 28 - 34 weeks' gestation: A randomized controlled trial. *Obstet Gynecol* 1990; 76: 1070-1075.
10. Odendaal H.J., Steyn D.W., Norman K., Kirsten G.F., Smith J., Theron G.B. Improved perinatal outcome in 1001 patients with severe pre-eclampsia. *S Afr Med J* 1995; 85: 1071-1076.
11. Hall DR, Odendaal HJ, Kirsten GF, Smith J, Grove D. Expectant management of early onset, severe pre-eclampsia: perinatal outcome. *Br J Obstet Gynaecol* 2000; 107:1258-1264.
12. Roberts J.M., Taylor R.N., Musci T.J., et al. Preeclampsia: an endothelial cell disorder. *Am J Obstet Gynecol* 1989; 161: 1200-1204.
13. Atallah AN, Hofmeyr GJ, Duley L Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems (Cochrane Review). In: *The Cochrane Library*, Issue 2, 2004. Chichester, UK: John Wiley & Sons, Ltd.
14. Duley L, Henderson-Smart DJ, Knight M, King JF Antiplatelet agents for preventing pre-eclampsia and its complications (Cochrane Review). In: *The Cochrane Library*, Issue 2, 2004. Chichester, UK: John Wiley & Sons, Ltd.

Chapter 6
Congenital Abnormalities

Abstract

Aim: To describe perinatal deaths due to congenital abnormalities and determine the magnitude of the problem.

Method: Data entered by PPIP users from October 1999 to September 2003 was amalgamated and analysed with respect to congenital abnormalities.

Results: Fetal abnormalities were the sixth most common primary obstetric cause of perinatal deaths (5.5%, rate 1.51/1000 births) and the third cause among early neonatal deaths, with the highest number of these deaths coming from the metropolitan areas. The most common congenital abnormality resulting in stillbirths was neural tube defects (25% and 0.38/1000 births). Chromosomal abnormalities were diagnosed in 13% of all deaths due to congenital abnormalities (rate 0.20/1000 births). Contrary to expectations there were more neonatal deaths due to congenital abnormalities than stillbirths. Congenital abnormalities are the second most important cause of neonatal deaths above 2 kg (15%) in South Africa.

Conclusion: There was considerable under-reporting of congenital abnormalities. Neural tube defects were the commonest congenital abnormality reported. Many opportunities for intervention are being lost by the lack of diagnosis of congenital abnormalities at birth or antenatally.

Recommendations

1. All stillbirths must be examined fully for congenital abnormalities by the clinician responsible for the birth.
2. Pictures of the common congenital abnormalities should be available in all labour wards.
3. Staff should be sent on training courses to recognise abnormalities.
4. Folic acid should be given to all pregnant women, preferably in the three months before conception and throughout the first trimester.
5. Women who have had congenitally abnormal babies previously should be offered specific counselling and testing.
6. Women over 35 years should be offered screening for chromosomal abnormalities.

Introduction

According to the World Health Organization causes of infantile death due to congenital abnormalities start to appear in the statistics when the infant mortality rate is lower than 40/1000. Congenital abnormalities reach the status of first cause when the infant mortality rate falls below 20/1000[1]. The South African infant mortality rate for the calendar period 1993 – 1998 is 45/1000 live births and it was 40.7/1000 live births in the calendar period 1983 – 1987[2].

As public health interventions are implemented to reduce perinatal and neonatal mortality rates from causes like pre-term labour and asphyxia, the mortality rates will fall lower. Congenital abnormalities will then start appearing in the statistics as second or even first cause of deaths. The public healthcare system will thus need to be prepared to deal with these conditions as outlined in the "Policy Guidelines for the Management and Prevention of genetic disorders, birth defects and disabilities".

The paper will discuss the following questions: "How prepared is the basic primary healthcare system to deal with such conditions?" and "What more can be done for these children in accordance with the National Policy Guidelines for the Management and Prevention of Genetic Disorders, Birth Defects and Disabilities?"

Primary obstetric cause of death

Table 6.1 gives a breakdown of the categories of congenital abnormalities, the proportion of stillbirths and neonatal deaths, their distribution within the group and the rate per 1000 births. Neural tube defects were the most common type of congenital abnormality identified. Table 6.2 gives the distribution in the different areas. The rate of congenital abnormalities per 1000 births declines and proportion of unclassified cases increases the greater the distance from metropolitan areas.

Timing of Perinatal death

Table 6.1 illustrates the time when the infants with congenital abnormalities died in relation to admission to hospital. The majority died in the neonatal period. Only 23.7% were known to be dead prior to admission.

Table 6.1. Primary obstetric causes of death in the sub-categories (>1000g)

	Stillbirth	Neonatal death (%)	Total	% of total	Rate/1000 births
Neural tube defects	112	63 (36.0)	175	25.1	0.38
Hydrocepalus	16	4 (20.0)	20	2.9	0.04
Renal	6	29 (82.9)	35	5.0	0.08
Cardiovascular	6	39 (86.7)	45	6.4	0.10
Multiple structural abnormalities	33	78 (70.3)	111	15.9	0.24
Non-specific (syndromal)	30	30 (50.0)	60	8.6	0.13
Chromosomal abnormalities	38	53 (58.2)	91	13.0	0.20
Non-immune hydrops fetalis	11	20 (64.5)	31	4.4	0.07
Not classified	53	77 (59.2)	130	18.6	0.28
Total	305	393 (56.3)	698	100.0	1.51

Table 6.2. Areas and fetal abnormalities as primary cause of death

>1000g	Metropolitan			City and Town			Rural		
	n	%	rate	n	%	rate	n	%	rate
Neural tube defects	97	27.8	0.48	50	21.7	0.33	28	23.5	0.26
Hydrocepalus	11	3.2	0.05	7	3.0	0.05	2	1.7	0.02
Renal	28	8.0	0.14	6	2.6	0.04	1	0.8	0.01
Cardiovascular	21	6.0	0.10	20	8.7	0.13	4	3.4	0.04
Multiple structural abnormalities	67	19.2	0.33	35	15.2	0.23	9	7.6	0.08
Non-specific (syndromal)	28	8.0	0.14	20	8.7	0.13	12	10.1	0.11
Chromosomal abnormalities	48	13.8	0.24	26	11.3	0.17	17	14.3	0.16
Non-immune hydrops	14	4.0	0.07	15	6.5	0.10	2	1.7	0.02
Not classified	35	10.0	0.17	51	22.2	0.34	44	37.0	0.41
Total	349	100.0	1.71	230	100.0	1.53	119	100.0	1.10

Figure 6.1. Distribution of deaths due to congenital abnormalities in relation to time of admission

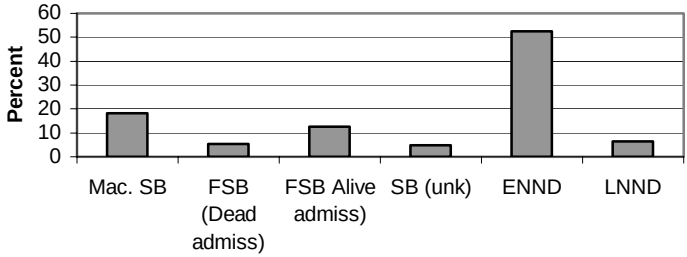


Figure 6.2. Distribution of deaths due to congenital abnormalities in birthweight categories

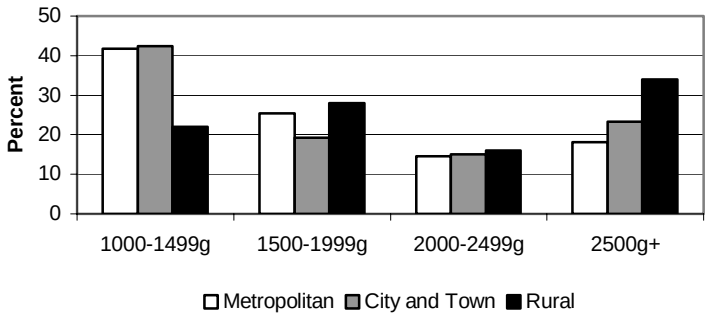


Figure 6.2 illustrates the distribution of deaths due to birthweight category. The normal pattern of deaths would be similar to that of the metropolitan areas. However, the pattern in rural areas is clearly contrasting, with the majority of deaths in the higher birthweight category. This is probably a reflection of the lack of recognition of congenital abnormalities by health workers.

Figure 6.3. Distribution of mortality rates of congenital abnormalities in relation to birthweight categories

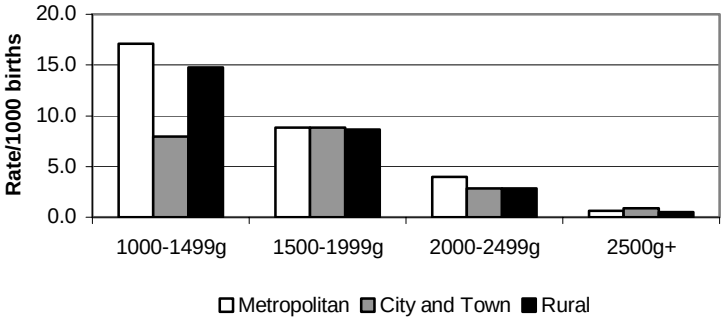


Figure 6.3 illustrates the rates of deaths due to congenital abnormalities in relation to birthweight categories.

Final Neonatal causes of death

Table 6.3 gives the final neonatal causes of death in those neonates with congenital abnormalities. Central nervous system defects, renal failure and cardiovascular failure were the most common causes. There was, again, a large proportion of deaths being unclassified, especially in the rural areas.

Table 6.3. Final neonatal causes of deaths for congenital abnormalities (primary cause – congenital abnormalities)

	Metropolitan		City and Town		Rural	
	N	%	N	%	N	%
Central Nervous System	30	18.5	21	14.3	11	17.2
Renal	27	16.7	3	2.0	0	0.0
Cardiovascular	20	12.3	19	12.9	4	6.3
Respiratory	17	10.5	7	4.8	0	0.0
Gastrointestinal	2	1.2	4	2.7	4	6.3
Chromosomal	23	14.2	13	8.8	6	9.4
Other	35	21.6	30	20.4	9	14.1
Non-immune hydrops fetalis	5	3.1	7	4.8	1	1.6
Unclassified	23	14.2	43	29.3	29	45.3
Total	162	100.0	147	100.0	64	100.0

Discussion

A quarter of all fetal abnormalities reported in the time period September 1999 – October 2003 from PPIP sites, were due to neural tube defects (NTDs). The incidence of NTDs varies according to geographical location, ethnicity and socio-economic status. NTD incidences are generally described as lower in rural areas than in urban populations, and higher in lower socio-economic groups[3]. The South African incidence of NTDs is approximately 2.5 per 1000 livebirths and varies greatly between urban and rural areas[4].

Based on this estimate, it would be expected that approximately 1137 NTD deliveries would be observed from the 454639 live births reported from the PPIP data. This dataset reports a total of 175 NTD perinatal deaths (15% of expected cases). Thus the 175 cases reported, represent gross under reporting of NTDs. The same can be said for birth defects in general. It must be noted, that the prevalence of live-born abnormalities is always less than the stillborn prevalence as the more severe lesions are likely to die and the less severe lesions survive. In the public sector, there is no effective screening programme for neural tube defects, hence termination of pregnancy is very unlikely to have had any effect on the prevalence. The most likely reason for the very low prevalence found is the lack of recognition of the cases by the health worker conducting the birth of the infant. This is made more likely by the very high prevalence of unexplained stillbirths recorded in this perinatal survey. (See Chapter 2 - Unexplained stillbirths).

NTDs result from failure of the neural tube to close between 21 - 28 days of embryonic development. NTDs are known to have very different aetiologies, and most occur without prior family history[5]. Women with a previous NTD pregnancy have a ten times greater risk of having an NTD fetus in subsequent pregnancies[6]. The risk is also increased in women on anti-epileptic medications. NTDs are multi-factorial in origin, resulting from the interaction between genetic and environmental factors, including nutritional factors[7].

The risks of a first occurrence and a recurrence of NTDs have been shown to be reduced by periconceptional folic acid supplementation - by taking folic acid three months before conception to three months after conception[8]. The Medical Research Council conducted a study in seven European countries between 1983 and 1991, where it was found that periconceptional folic acid reduced NTD occurrence risk by 70% and the NTD recurrence risk by about 50%[9].

One of the most important enzymes in the metabolism of folic acid is 5,10 methylenetetrahydrofolate reductase (MTHFR). The mechanism by which reduced folate status may cause NTDs has been suggested to involve impaired homocysteine metabolism. Several studies have shown that individuals with mutations in the MTHFR gene that alter its function are at increased risk of having a fetus with a NTD. Pre- and periconception ingestion of increased amounts of folate overcomes the altered function of this gene thus reducing the NTD occurrence or recurrence rate.

The prevalence of the MTHFR mutation varies amongst various populations, with low allelic frequencies in some groups of Africans. In a South African study conducted by Ubbink et al., it was reported that homozygosity for the MTHFR 677C→T mutation does not constitute a genetic risk factor for NTDs in rural South Africa[10].

Based on the above information, it is very unlikely that NTDs in the South African population are due to the above-mentioned genetic factors. These NTDs could have resulted from spontaneous mutations or more likely nutritional status of pregnant women, particularly lack of folic acid. During antenatal care, it is compulsory for pregnant women to be given folic acid tablets, but if these are given after the first six weeks of pregnancy they will have no effect in reducing or preventing NTDs. Every effort should be made to give folic acid to women prior to conception, especially those who have had a NTD previously. Fortunately this group is readily identifiable, provided the health worker examines the fetus/neonate, makes the diagnosis and gives the mother the information.

Fetal chromosomal abnormalities were diagnosed in 13% of all congenital abnormalities (91 cases, 0.20/1000 births). This is a very low rate. The majority of deaths due to chromosomal abnormalities occur prior to delivery, however, in this survey the majority (58.2%) of cases were diagnosed in the neonatal period. This clearly demonstrates that the diagnosis was missed in a large number of stillbirths. Chromosomal abnormalities include conditions like Down syndrome, Edward syndrome, Patau syndrome, Turner syndrome, Klinefelter and Fragile X syndromes among others. The most common chromosomal abnormality is Down syndrome at an incidence rate of 1 in 500 live births[14]. Based on this estimate, it would be expected that from the 454369 live births reported from the PPIP data approximately 900 of these deliveries, would be Down syndrome babies.

Each Down syndrome patient requires an average of R15 000 – R20 000 per year for basic medical care. If cardiac or gastrointestinal malformations are present, there are additional costs for the management of these. . For a

cohort of 967 Down syndrome patients, it would cost R15 000 x 967 = R 14 505 000 per year for basic medical care. The cost of care for children with Down syndrome varies depending on the type of treatment. This includes physiotherapy, speech therapy, occupational therapy, surgery if indicated, medication, grommets and blood tests[14].

According to the Guidelines for Maternity Care in South Africa, information on risk factors for genetic disorders and birth defects should be given before conception and during antenatal care. This includes information on risk factors related to advanced maternal age, previous miscarriages, previous birth defects or genetic disorders, alcohol or drug exposure and consanguineous relationships[15].

The human genetics policy guidelines states a number of prevention strategies that can be implemented to prevent Down's syndrome and other genetic conditions. These include the type of services that can be offered at different levels of care including offering genetic counselling, community education and genetic testing[14].

Conclusion

This survey clearly demonstrates the under-reporting of congenital abnormalities in South Africa. The common conditions are not being recognised and the opportunity to intervene for subsequent pregnancies is being lost. This is particularly true of NTDs, where administration of folic acid would drastically reduce the chances of another NTD in the subsequent pregnancy. Training of all health care workers who conduct births in recognition of the common congenital abnormalities is essential. Pictures of these abnormalities should be available in the labour wards, and specific health workers should be delegated to go on training courses offered to recognise congenital abnormalities. The clinician in charge of the birth must conduct a full clinical examination of stillbirths.

It would seem that there are a number of missed opportunities in the healthcare system that could have been utilised to prevent some of the congenital abnormalities that are seen in facilities. There are guidelines available that clearly state which services should be provided at different levels to prevent these conditions. But clearly what is outlined in these documents is not being implemented. The following are some of the missed opportunities for preventing these conditions:

Before conception

Women of advanced maternal age or who have had a child or a pregnancy with a genetic disorder could be educated on risks which make them

susceptible to genetic disorders. This would involve: appropriate history taking, counselling and the availability of genetic tests, provision of folic acid supplementation for women planning pregnancies. Adequate family planning services should be available to prevent unplanned pregnancies, particularly in women over the age of 35.

During pregnancy

Services during pregnancy should include: genetic counselling, ascertainment of genetic risk based on family history, pre-natal testing and diagnosis, genetic counselling and options on termination of pregnancy, continuation of folic acid supplementation. This would require women to start attending antenatal clinics in the first trimester. Most women confirm their pregnancies within the first three months of amenorrhoea. The establishment of pregnancy confirmation clinics would use current behaviour to achieve early initiation of antenatal care as antenatal care is started immediately once the pregnancy is confirmed. This will allow enough time for counselling and referral for invasive fetal genetic testing for women in whom it is indicated. The current antenatal care policy makes provision for screening or testing for fetal aneuploidy for women over the age of 35. Most infants with chromosome anomalies, particularly trisomy 21, are born to women under 35, thus consideration should be given to providing aneuploidy screening to all women by means of Nuchal Translucency measurement followed by the offer of invasive testing to those with increased risk. Although this will mean invasive tests being offered to women under the age of 35 who would not previously have had these tests in the absence of other risk factors, it will reduce the number of invasive tests for women over the age of 35 as many of these women will have a reduction of their aneuploidy risk on screening. The number of invasive tests offered and thus the cost of such a program could also be limited by changing the cut-off at which invasive testing is offered, although the effects of this on the detection rate of the program would have to be considered.

Services at birth

Parents of newborns/stillborns with genetic disorders should be provided with the following services at birth: appropriate physical examination, referral for genetic testing and for medical care and referrals to local support groups.

References

1. Guidelines for the Development of National Programmes for Monitoring of Birth Defects, World Health Organisation, Heredity Disease Programme, 1993. WHO/HDP/ICBDMS/GL/93.4.

2. National Department of Health, MRC and Measure DHS+. The South African Demographic and Health Survey 1998.
3. Robertson H, Steyn NP, Venter PA, Christianson AL. Neural Tube Defects And Folic Acid - A SA Perspective. SAMJ 1997; 87 (7): 928-931.
4. School of Public Health and Primary Health Care, The University of Cape Town & the National Department of Health. South African Birth Defects Surveillance System (SABDSS). 2002.
5. Rimoin DL, Connor JM, Pyeritz RE. Emery and Rimoin's Principles and Practice of Medical Genetics. (Churchill Livingstone). (1996).
6. Heil SG, van der Put NMJ, Trijbels FJM, Gabreels FJM, Blom HJ. Molecular Genetic Analysis of Human Folate Receptors in Neural Tube Defects. Eur J Hum Gen. 1999; 7: 393 - 396.
7. Czeizel AE, Dudas I. Prevention of the First Occurrence of Neural Tube Defects by Periconceptional Vitamin Supple-mentation. N Eng J Med 1992; 327 (26): 1832-1835.
8. Kadir RA, Sabin C, Whitlow B, Brockbank E, Economides D. Neural Tube Defects and Periconceptional Folic Acid in England and Wales: Retrospective Study. BMJ 1999; 319: 92-93.
9. Medical Research Council Research Group: Prevention of Neural Tube Defects: Results of the Medical Research Council Vitamin Study. Lancet. 1991; 338 (8760): 131–137.
10. Ubbink JB et al. Folate Status, Homocysteine Metabolism and 5,10 Methylenetetrahydrofolate Reductase Genotype in Rural South African Blacks with A History of Pregnancy Complicated by Neural Tube Defects. Metabolism. 1999; 49 (2): 269-274.
11. Wenstrom KD et al. Role of Amniotic Fluid Homocysteine Level and of Fetal 5,10-Methylenetetrahydrofolate Reductase Genotype in the etiology of Neural Tube Defects; 2000; 90: 12–16.
12. Daly SF et al. The Influence of 5,10 MTHFR Genotypes on Enzyme Activity in Placental Tissue. BJ Obst Gynae 1999; 106: 1214-1218.
13. Johanning GL et al. Comorbidity of 5,10-Methylene-tetrahydofolate Reductase and Methionine Synthase Gene Polymorphism and Risk for Neural Tube Defects. J Med Gen 2000; 37: 949–951.
14. National Department of Health. Policy Guidelines for the Management and Prevention of Genetic Disorders, Birth Defects and Disabilities. 2001.
15. National Department of Health. Guidelines for Maternity Care in South Africa. 2000.

Chapter 7
Infections

Abstract

Aim: To describe the perinatal deaths due to infection as primary obstetric cause.

Method: Data from PPIP users was amalgamated and the sub-set of data with infection as the primary obstetric cause of death was analysed.

Results: Among 12773 perinatal deaths 1kg or more, infection was given as the primary obstetric cause of death in 634 (5.0%). Syphilis was the most common cause being allocated the cause in 38.5% of cases. Syphilis testing was not performed in 40% of unexplained intrauterine deaths hence deaths due to syphilis were under reported. The majority of deaths due to infection as primary cause were stillbirths (56%) and 38% were more than 2.5kg. A further 121 cases were classified as having chorioamnionitis and preterm labour with or without rupture of membranes. It is probable that these cases had infection causing the preterm labour or rupture of membranes. Most cases were diagnosed in metropolitan areas, suggesting that lack of recognition of infection is a major problem. The most common avoidable factor was lack or late attendance for antenatal care, although lack of syphilis testing and lack of response to positive tests was also prominent.

Conclusion: Perinatal infections are an important cause of perinatal death. They are being under-reported. Syphilis is still a major cause of perinatal death.

Recommendations

1. Encourage early attendance at antenatal care by pregnant women.
2. Early reporting of complications like rupture of membranes.
3. On-site routine syphilis screening and treatment is essential.
4. Training for clinicians on recognition of amniotic fluid. infection syndrome and chorioamnionitis is essential.

Introduction

Maternal infections can cause perinatal deaths directly by transmitting the infection to the fetus (as in the case of syphilis) and indirectly by creating maternal complications that result in a preterm labour or placental insufficiency, ultimately causing fetal or neonatal complications and death. Blood born infections such as syphilis, HIV, rubella, cytomegalovirus, toxoplasmosis, malaria and tuberculosis can cross the placenta and infect the fetus directly. The only protection against this is the maternal immune system, the placental barrier and the fetal immune system. Congenital infections due to malaria and tuberculosis are being diagnosed more often now in immono-compromised pregnant women.

Bacterial infections ascending the lower genital tract more often result indirectly in perinatal deaths. The fetus is protected by numerous defence mechanisms that prevent organisms ascending from the lower genital tract to ultimately infect the fetus, namely cervical mucus containing antibodies, the fetal membranes and bactericidal amniotic fluid. Ascending bacterial infections cause an inflammatory response precipitating the prostaglandin cascade ultimately resulting in uterine contractions and preterm birth. The neonate, although not infected with the bacteria, might die from complications of immaturity.

Worldwide, the magnitude of the effect of infections on perinatal deaths is underestimated. It is estimated that at least half of idiopathic spontaneous preterm labour under-33 weeks gestation is thought to be due to ascending infections. That might even be an underestimate. MacParland et al[1] has demonstrated that 8 out of 10 cases of idiopathic spontaneous preterm labour demonstrated microbial 16S rRNA genes on PCR techniques in placenta and neonatal gastric aspirates as opposed to 1 in 11 delivered by caesarean section before 33 weeks due to severe pre-eclampsia. The PCR-detected microbial 16s rRNA gene is specific to bacteria and humans do not have the gene.

HIV infections seldom cause perinatal death directly, but are associated with a two times greater risk of preterm birth and four times greater risk of stillbirths[2]. Both can be partly explained by an increased prevalence of ascending infections in the immuno-compromised patients. This hypothesis has not yet been proven. Other viral infections as a cause of perinatal deaths are also underestimated, as diagnosis is difficult. Again they can be increased in immuno-compromised patients.

The classic perinatal infection causing death is syphilis. The last decade has seen a dramatic drop in the prevalence of syphilis, which has coincided

with the syndromic approach to sexually transmitted infections and the rise in HIV prevalence. Perinatal deaths due to syphilis have correspondingly declined over the decade[3].

This chapter examines the perinatal deaths recorded as being due to infections.

Methods

Data from the PPIP users throughout the country were amalgamated using the PPIP v2 programme. In each case, the primary obstetric cause (i.e. the event that initiated the process that resulted in the death of the fetus or neonate) and if the infant was born alive, a final neonatal cause of deaths was allocated. Each case was analysed with respect to avoidable factors, missed opportunities and substandard care. Factors related to the patient and her environment, administrative and health worker related factors were assessed. Overall 52 infants were misclassified as being both an intrauterine death and neonatal death. These deaths have been excluded from the analysis of neonatal deaths.

Results

Table 7.1 gives the break down of the causes of perinatal death due to infection as primary obstetric cause.

Table 7.1. Subcategories of perinatal deaths due to infection as primary obstetric cause

	Metropolitan		City and Town		Rural		South Africa	
Sub-category Infection	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Syphilis	83	35.5	107	38.1	54	45.4	244	38.5
AFIS	56	23.9	58	20.6	21	17.6	135	21.3
HIV/AIDS	27	11.5	40	14.2	9	7.6	76	12.0
Beta Haemolytic streptococci	9	3.8	0	0.0	0	0.0	9	1.4
Malaria	1	0.4	0	0.0	2	1.7	3	0.5
Unclassified	58	24.8	76	27.0	33	27.7	167	26.3
Total	234	100.0	281	100.0	119	100.0	634	100.0
Sub-category preterm birth								
PPROM + Chorioamnionitis	40		23		16		79	
PTL + Chorioamnionitis	28		8		6		42	
Total	68		31		22		121	

AFIS – Amniotic fluid infection syndrome, PPROM – Preterm premature rupture of membranes, PTL – preterm labour

Syphilis was reported as the most common cause of death in the infection category, however syphilis testing was not performed in 40% of unexplained intrauterine deaths hence deaths due to syphilis were under reported. There were 121 perinatal deaths where ascending infections were primarily the cause and reported under the category spontaneous preterm birth (Table 7.2). This represents 5.9% of all deaths in this category. The diagnosis varied considerably in the different areas with metropolitan areas reports 11.4%, city and towns 3.2%, and rural areas 4.2% of all deaths due to spontaneous preterm birth.

Figure 7.1. Timing of perinatal deaths due to infection in relation to time of admission

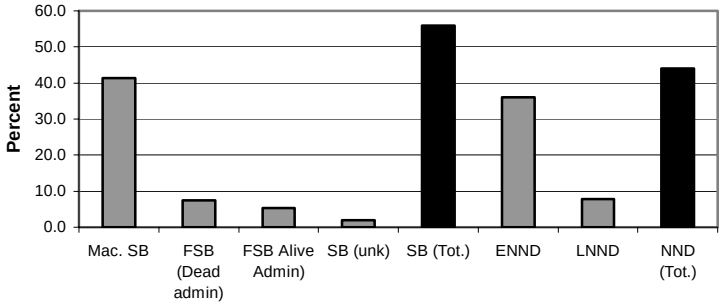
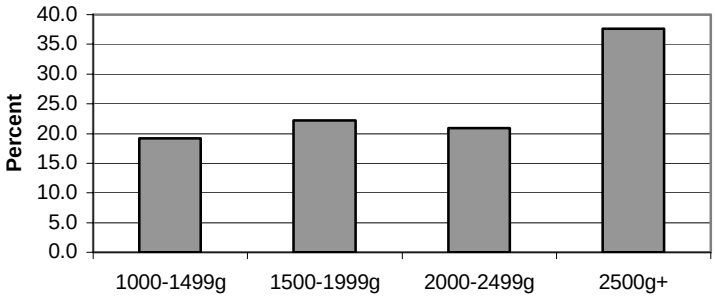


Figure 7.1 illustrates the timing of perinatal deaths due to infection. The majority were macerated stillborn babies. Figure 7.2 illustrates the distribution of deaths in relation to birth weight categories. The majority were 2.5kg or more.

Figure 7.2. Distribution of perinatal death due to infection in birthweight categories



Final neonatal cause of death

Table 7.2. Final neonatal causes of death due to infection as primary obstetric cause

	Metropolitan		City and Town		Rural		South Africa	
	N	%	N	%	N	%	N	%
Infections	53	54.6	92	68.7	28	59.6	173	62.2
Immaturity related	27	27.8	23	17.2	7	14.9	57	20.5
Hypoxia	12	12.4	14	10.4	6	12.8	32	11.5
Congenital Abnormalities	4	4.1	1	0.7	1	2.1	6	2.2
Other	1	1.0	4	3.0	5	10.6	10	3.6
Total	97	100.0	134	100.0	47	100.0	278	100.0

Table 7.2 lists the final neonatal causes of death. The majority were due to a congenital infection that is the fetus was infected prior to birth. A significant proportion of the deaths were due to immaturity.

Avoidable factors, missed opportunities and substandard care

Table 7.3 lists the distribution of avoidable factors, missed opportunities and substandard care for the various areas in deaths due to perinatal infections. About 1 in 5 of the deaths were directly attributed to patient related factors.

Table 7.3. All and probable avoidable factors, missed opportunities and substandard care for perinatal infection.

	Metropolitan		City and Town		Rural	
	All % of deaths	Prob. % of deaths	All % of deaths	Prob. % of deaths	All % of deaths	Prob. % of deaths
Health worker related	10.7	3.0	20.3	8.5	14.3	6.0
Administrative related	15.4	5.6	13.2	5.7	18.5	10.0
Patient related	53.0	20.1	38.4	19.2	14.4	17.6

Table 7.4 lists the factors that probably resulted in the death of the infant. More than 1 in 3 were related to no or lack of attendance at antenatal clinics. The majority of these deaths were due to syphilis. One in six of the deaths due to syphilis were due to problems in the health system, either not treating a patient with positive syphilis serology or not testing a patient who attended antenatal clinic.

Table 7.4. Probable avoidable factors, missed opportunities and substandard care for neonatal infection

Probable Avoidable Factors	Infection (n=634)	Percentage of deaths
Patient related		
Never initiated antenatal care	176	27.8
Infrequent visits to antenatal clinic/ booked late	47	7.4
Inappropriate response to ruptured membranes	8	1.3
Delay in seeking medical attention during labour	13	2.0
Inappropriate response to poor fetal movements	22	3.5
Health Worker Related		
No response to positive syphilis serology test	18	2.8*
Delay in referring patient for 2nd or 3rd level of care	8	1.3
Neonatal care inadequate	5	0.8
Administrative problems		
Inadequate facilities/ equipment in neonatal unit	11	1.7
No syphilis screening performed at hospital or clinic	19	3.0**
Lack of transport	8	1.3

* 7.3% of deaths due to syphilis; ** 7.8% of deaths due to syphilis

Discussion

Perinatal deaths due to infections were the sixth most common category of primary obstetric causes of death. This is an underestimation. Diagnosis of infections can be difficult and require expensive tests like culture of organisms that are not that reliable. However, in syphilis the diagnosis is simple and inexpensive. Therefore it is disappointing that syphilis screening is not being performed in 40% of unexplained stillbirths. This reflects upon the functioning of the health system and clearly it is not functioning very well. The prevalence of syphilis in the pregnant population varies between 1.8% in KwaZulu-Natal and 6.2% in North West Province (Chapter 12). Thus syphilis is still a very important disease and a clearly avoidable cause of perinatal death. On-site testing for syphilis is a simple, inexpensive method for screening for syphilis and has been shown to work[4].

Diagnosing the amniotic fluid infection syndrome (AFIS) is difficult and antenatally currently requires an amniocentesis to obtain amniotic fluid for examination. This is problematic in HIV infected women; the specific cases where AFIS is thought to have the highest prevalence. Bacterial vaginosis is associated with AFIS, and patients have a risk twice that of women without bacterial vaginosis of having a stillbirth[5]. However, treatment of women with bacterial vaginosis has not shown to be effective

in preventing preterm labour or perinatal death[5]. Currently most of these deaths will be recorded under the unexplained stillbirth category. Further research is needed to establish ways of diagnosing and treating AFIS.

The impact of HIV infections on perinatal deaths in this survey is unknown, as the HIV status of the patients was not being recorded. PPIP v2 has the ability to record the patient's status, and as the cases are later anonymised information can be gleaned as to HIV infection's impact on perinatal death. Importantly, the impact of the use of antiretroviral treatment can also be assessed on perinatal deaths. This should be a priority for future reports.

However, the impact of infections is probably highest on spontaneous preterm labour. If it is accepted that at least half of idiopathic preterm labour under 33 weeks is due to infections, then at least 1000 perinatal deaths classified as being due to spontaneous preterm labour were the result of ascending infections.

In addition to the thousand perinatal deaths due to preterm birth, if we conservatively assume 1 in 10 of the unexplained stillbirths resulted from infections, then approximately 2000 infants died as a result of infection, namely about 1 in 6 of all perinatal deaths were due to infections, not 1 in 20 as currently reported. Infection, in reality, is in the top 3 causes of perinatal death in South Africa.

Conclusion

Infections are underestimated as primary causes of perinatal deaths because the methods of detection are limited and treatment options unclear. Methods of preventing, detecting and treating infections before complications occur should be a research priority.

References

1. MacParland PC, Miralles R, Hodge R, et al. Comparison of inflammation and infection as assessed by polymerase chain reaction (PCR) detection of microbial genes in early preterm delivery. British Congress Obstetricians, Glasgow 7-9 July 2004.
2. 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.
3. Pattinson RC, Delport SD. Two steps forward, one step back: A decade of perinatal care in Atteridgeville. Priorities in Perinatal Care Conference, Bela Bela, March 2004.

4. Pattinson RC. On-site screening for syphilis – the time has come. S Afr Med J 1998; 88:780.
5. McDonald H, Brockelhurst P, Parsons J, Vigneswaran R. Antibiotics for treating bacterial vaginosis in pregnancy (Cochrane Review). In: The Cochrane Library, Issue 1, 2004 Chichester, UK John Wiley & Sons, Ltd.

Chapter 8.
Idiopathic Intrauterine Growth Restriction and Post-maturity

Abstract

Aim: To describe the perinatal deaths due to idiopathic intrauterine growth restriction and post-maturity as primary obstetric cause.

Method: Data from PPIP users was amalgamated and the sub-set of data with idiopathic intrauterine growth restriction and post-maturity as the primary obstetric cause of death was analysed.

Results: There were 403 perinatal deaths in babies 1kg or more, in this category, representing 3.2% of all perinatal deaths. Idiopathic intrauterine growth restriction was responsible for 70% of the deaths recorded, and post-maturity 23%, 7% were unclassified. There are gross discrepancies in prevalence between the different areas. Seventy-four percent of the deaths (1.46/1000 births) were recorded in the metropolitan areas, 19% (0.50/1000 births) in city and towns and 7% (0.23/1000 births) in rural areas. Post-maturity was given as the most common cause of death in city and towns (45%), but idiopathic intrauterine growth restriction was the most common in the metropolitan areas with post-maturity representing only 17.8% of deaths, however the rates were similar 0.23/1000 births and 0.26/1000 births respectively. In rural areas, the rates of death reported as being due to post-maturity (0.05/1000 births) and idiopathic intrauterine growth restriction (0.16/1000 births) was very low. The majority were stillborn (76%) and 39% were over 2.5kg. Over 40% of deaths in all areas were thought to be probably preventable, either due to or in response to poor symphysis-fundal growth or no response to apparent post-term pregnancy.

Conclusion: Idiopathic intrauterine growth restriction and post-maturity are not being diagnosed as causes of death. Idiopathic intrauterine growth restriction does not seem to be recognised as a condition outside of metropolitan areas, and post-maturity is not being diagnosed. Deaths due to both conditions are eminently preventable.

Recommendations

1. Encourage early attendance at antenatal care by our patients.
2. Concentrate on establishing an accurate gestational age as an important first step in antenatal care.
3. Ensure accurate measuring and plotting of the symphysis-fundal height as a first step in diagnosing intrauterine growth restriction.
4. Where the gestational age is uncertain use sonar to estimate gestational age.
5. Encourage the use of Doppler ultrasound to identify fetuses at risk of complications due to placental insufficiency.
6. In post-dates pregnancies with uncertain gestational age use the amniotic fluid index to time induction of labour.

Introduction

Intrauterine growth restriction (IUGR) is defined as a fetus not reaching its full genetic potential. Inadequate supply of nutrients is the most common cause, but infections are also an important cause of IUGR. Small for gestational age (SGA) babies are defined as having a birthweight below either the 10th, 5th or 3rd centile for gestational age depending on the institution. Not all of these babies are growth restricted. Similarly, some babies with a birth weight over the 10th centile are growth restricted. Post-mature babies are the most common category in this group. It is the growth restricted babies that develop complications and it is in these fetuses where intervention can have a dramatic effect on outcome.

There are four common causes of SGA babies: placental insufficiency, congenital infections, congenital abnormalities and perfectly normal genetically small babies. (If a birthweight under the 10th centile for gestational age is taken as the definition of a SGA baby, then by definition 10% of all babies will fall into this category, however, clearly 10% of all babies are not sick). However, if post-term babies are excluded, most IUGR babies are SGA. The group of babies where medical intervention will alter the outcome is in the placental insufficiency group and in the treatable congenital infections (namely syphilis).

The causes of placental insufficiency can be divided into three categories, pre-placental (environmental factors e.g. smoking, nutrition, etc.) placental (most commonly pre-eclampsia) and post-placental (post-mature babies where the baby outgrows the placenta). In most cases of placental insufficiency, detection and intervention will result in a live health baby.

This chapter deals with the cases reported as dying due to idiopathic IUGR or post-maturity.

Methods

Data from the PPIP users throughout the country were amalgamated using the PPIP v2 programme. In each case, the primary obstetric cause (i.e. the event that initiated the process that resulted in the death of the fetus or neonate) and if the infant was born alive a final neonatal cause of deaths was allocated. Each case was analysed with respect to avoidable factors, missed opportunities and substandard care. Factors related to the patient and her environment, administrative and health worker related factors were assessed. Overall 52 infants were misclassified as being both an intrauterine death and neonatal death. These deaths have been excluded from the analysis of neonatal deaths.

In PPIP, idiopathic IUGR was defined as a primary cause of death if the baby had a birthweight less than the 10th centile for gestational age and had no obvious cause of IUGR such as hypertension or congenital infection. An infant was classified as dying due to post-maturity if it had a gestational age of more than 42 weeks and there was no other obvious cause such as abruptio placentae or intrapartum asphyxia.

Results

Table 8.1 gives the break down of the causes of perinatal death due to IUGR as primary obstetric cause.

Table 8.1. Distribution of perinatal deaths due to IUGR

	Metropolitan		City and Town		Rural		South Africa	
IUGR	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Idiopathic	239	80.2	24	32.0	17	56.7	280	69.5
Rate/1000		1.17		0.16		0.16		
Post-maturity	53	17.8	34	45.3	5	16.7	92	22.8
Rate/1000		0.26		0.23		0.05		
Unclassified	6	2.0	17	22.7	8	26.7	31	7.7
Total	298	100.0	75	100.0	30	100.0	403	100.0
Rate/1000		1.46		0.50		0.23		

Figure 8.1 illustrates when the infants die in relation to time of admission. Seventy-six percent were stillborn.

Figure 8.1 Distribution of perinatal deaths due to intrauterine growth restriction in relation to timing of admission

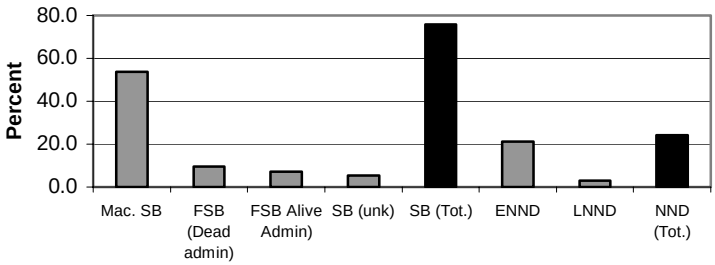
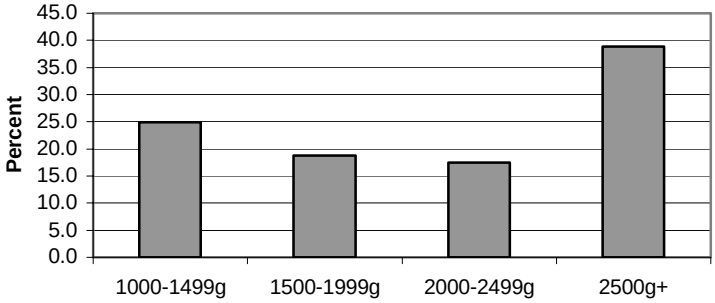


Figure 8.2 illustrates the birth weight categories of the infants. Thirty-nine percent were 2.5kg or more and all of these must have been post-mature. If diagnosed earlier, these babies should definitely have survived.

Figure 8.2. Distribution of perinatal deaths due to IUGR in birthweight categories



Final neonatal cause of death

Table 8.2 lists the final neonatal causes of death for those infants with idiopathic IUGR and post-maturity born alive.

Table 8.2. Final neonatal causes of deaths – idiopathic IUGR and post-maturity

	Metropolitan		City and Town		Rural		South Africa	
	N	%	N	%	N	%	N	%
Hypoxia	22	40.7	12	50.0	4	26.7	38	40.9
Infections	14	25.9	5	20.8	4	26.7	23	24.7
Immaturity related	1	1.9	3	12.5	2	13.3	6	6.5
Congenital Abnormalities	8	14.8	3	12.5	2	13.3	13	14.0
Other	9	16.7	1	4.2	3	20.0	13	14.0
Total	54	100.0	24	100.0	15	100.0	93	100.0

Hypoxia was the major final cause of neonatal death. Meconium aspiration was responsible for more than half of the neonatal deaths due to hypoxia in the post-mature pregnancies.

Avoidable factors, missed opportunities and substandard care

Table 8.3 gives the avoidable factors for deaths recorded as being due to IUGR. This category has the highest proportion of probably avoidable deaths overall. Table 8.4 lists the most common avoidable factors.

Table 8.3. All and probable avoidable factors, missed opportunities and substandard care for IUGR

	Metropolitan		City and Town		Rural	
	All % of deaths	Prob. % of deaths	All % of deaths	Prob. % of deaths	All % of deaths	Prob. % of deaths
Health worker related	66.1	45.3	73.3	54.7	66.7	40.0
Administrative related	10.1	6.0	2.7	-	20.0	3.3
Patient related	40.9	8.1	28.0	12.0	23.3	3.3

Table 8.4. Probable avoidable factors, missed opportunities and substandard care for IUGR

	N	% of deaths due to IUGR
No response to poor uterine fundal growth	48	11.9
No response to apparent post-term pregnancy	25	6.2*
Poor fetal monitoring	26	6.5

* 27.2% of deaths due to post-maturity

Discussion

The pattern of disease recorded in an area is dependent on the diagnoses made by the clinician classifying the deaths. If the clinician is unaware of a certain disease, it is impossible for that clinician to diagnose that condition. Hence, a disease profile is dependent on the knowledge of those making the diagnosis, the greater the knowledge, the closer the pattern of disease will be to reality, the less the knowledge, the closer the pattern of disease will be to the knowledge of the classifying clinician. It would appear that idiopathic IUGR falls into this category. Geographical variation cannot explain the seven times greater prevalence of death due to idiopathic IUGR in the metropolitan areas than both the cities and towns and rural areas. There is also a 4-5 times difference in prevalence of death due to post-maturity in the rural areas compared with the metropolitan and city and town areas. The prevalence of unexplained intrauterine deaths in the metropolitan areas was 5.38/1000 births, compared with 7.60/1000 births for city and towns and 7.57/1000 births for rural areas. (See chapter 2 Unexplained Stillbirths). The forty percent higher rate of unexplained stillbirths in the city and towns and rural areas compared with metropolitan areas, can be partly explained by the inability to identify idiopathic IUGR and post-maturity in infants. Hence, one of the areas where there is a major potential for saving babies namely in diagnosing and managing IUGR and post-maturity was omitted, as the condition was not recognised and its importance not appreciated.

One of the prime aspects of antenatal care is to determine the expected date of delivery accurately. The best time to establish the expected date of delivery is at the first meeting with the patient. Establishing the last normal menstrual period and hence gestational age is very important. The clinical examination of the size of the uterus if done early in pregnancy, and if the size coincides with the estimated gestational age, is the easiest method of accurately determining estimated date of delivery. Knowing the accurate expected date of delivery allows for determining if a patient is post-dates and for estimating if the fetus is growing as expected *in-utero*. The first meeting of a pregnant woman with the health services is usually at time of confirmation of the pregnancy. In the majority of cases, this occurs within three months of missing a period, giving a wonderful opportunity to establish accurate gestational age, without any special investigations such as sonar.

Fetal growth can be accurately assessed by use of serial symphysis-fundal (SF) measurements, and where this falls off, assessment of the fetus can be performed by simple continuous wave Doppler ultrasound. SF measurements followed by umbilical artery Doppler flow velocimetry in cases with poor SF growth are reliable to detect small for gestational age (SGA) babies at risk for complications of placental insufficiency. All fetuses with possible placental insufficiency were identified. SGA babies with normal SF growth did not develop complications from placental insufficiency except when pre-eclampsia or post-term pregnancy developed. It is not indicated to do further tests for fetal growth in uncomplicated pregnancies with normal SF growth[1]. The MRC Unit for Perinatal Motality, the MRC and CSIR worked together to develop a novel and affordable continuous wave Doppler analyser (Umbiflow) for use with a standard personal computer (PC). The required software was developed and the Doppler probe housing the electronics is powered and connected via the USB port of a PC. The software is user-friendly and allows input of patient, fetal and neonatal data. The flow velocity waveforms are recorded on the computer screen. The resistance index (RI), calculated from the waveform, is then plotted on an appropriate centile graph against the estimated gestational age[2]. Doppler technology to measure flow in the umbilical artery will become available at an affordable price. Midwives could be taught to use and interpret this technology at primary care level during a two-day training course[3].

In cases of post dates or where the dates are uncertain, and it is thought that the fetus might be post-mature, sonar estimation of the amniotic fluid has been shown to be effective in deciding whether to induce labour or not, thereby preventing the complications of post-maturity. AFI is a simple procedure and as most district hospitals now have ultrasound, this

intervention is both practical and feasible. Routine early pregnancy ultrasound reduces the incidence of post-term pregnancy significantly (odds ratio 0.68, 95% confidence interval 0.57 to 0.82)[2]. Patients who booked early in pregnancy for antenatal care and whose uterine size corresponded with the gestational age as determined by the last normal menstrual period must be induced at 42 weeks. This measure also applies to patients whose gestational age has been confirmed by early ultrasound (prior to 24 weeks). Routine induction of labour after 41 weeks reduces perinatal mortality (odds ratio 0.20, 95% confidence interval 0.06 to 0.70), without increasing the caesarean section rate[4].

However, patients often book late in pregnancy and/or are uncertain about the date of their last menstrual period. When these women reach 42 weeks, it is most likely due to uncertain gestational age and not a post-term pregnancy. Additional information is required regarding their further management. Ultrasound determined amniotic fluid volume is of great value to select patients requiring induction of labour. Patients with an amniotic fluid index of <5cm or a largest pool of amniotic fluid with a vertical measurement <3cm do require induction of labour. The pregnancies of those patients with adequate amniotic fluid according this criterion and with a reactive CTG, can be allowed to continue. They must be reassessed a week later[5].

Meconium aspiration syndrome is a major cause of neonatal death in the post-mature fetus. The risk of meconium stained liquor can be reduced with routine induction of labour at 42 weeks[4]. In addition, amnioinfusion in the presence of meconium-stained liquor during labour reduces the risk of meconium aspiration syndrome (relative risk 0.24, 95% confidence interval 0.12 to 0.48)[6]. Amnioinfusion is associated with improvements in perinatal outcome, particularly in settings where facilities for perinatal surveillance are limited.

Moran[6] demonstrated the making the correct diagnosis can impact on the pattern of disease and ultimately on the potential for preventing deaths. Data from the first seven months of an audit performed at Mahatma Gandhi Memorial Hospital, which started in July 2001, revealed a total of 6296 births, including 234 perinatal deaths[1]. Of these deaths, 51 (21.8%) were initially classified as unexplained macerated stillbirths (MSB), while 8 (3.4%) were classified as IUGR, either by a junior doctor or a midwife. However, after consultant review, these figures changed to 31 (13.2%) for unexplained MSB, and 28 (12.0%) for IUGR. In other words, after careful assessment by an experienced obstetrician, 20 out of the 51 “unexplained” MSBs (39%) were in fact found to be deaths due to IUGR.

Another important finding, of this Durban audit, was that in 21 of the 28 cases (75%) of deaths due to IUGR, there were mistakes made by medical personnel (doctors and midwives) during antenatal care, which directly led to these deaths. In other words, these 21 deaths would definitely have been avoided if appropriate antenatal care had been provided. Furthermore, IUGR (including post-maturity) was by far the most common cause of definitely avoidable perinatal death[1].

Conclusion

Deaths due to IUGR are being under-diagnosed. If diagnosed, the majority of these deaths could be prevented. It is essential that more attention be focused on accurately establishing the gestational age and monitoring the growth of the fetuses appropriately so that growth restriction and post-maturity can be diagnosed. Once diagnosed the appropriate management is available and inexpensive and will save many lives. We cannot afford to ignore these problems any longer.

References

1. Theron GB, Theron AM, Odendaal HJ. Symphysis-fundus growth measurement followed by Doppler velocimetry to screen for placental insufficiency. Int J Gynaecol Obstet 2002; 79: 263-264.
2. Theron GB, Theron AM, Odendaal HJ, Bunn AE. Comparison of a newly developed PC based Doppler umbilical artery waveform analyser and a commercial unit. Submitted for publication in the S Afr Med J, February 2004.
3. Odendaal HJ. Clinical use of a Doppler waveform analyser. 15th Congress of the International Perinatal Doppler Society. Prague, Czech Republic, September 2002.
4. Crowley P. Interventions for preventing or improving the outcome of delivery at or beyond term (Cochrane Review). In: The Cochrane library, Issue 1, 2001. Oxford: Update Software.
5. Brand E, Norman K, Rossouw M, AM Theron, Fetal evauation and neonatal outcome in post dates pregnanacies at Tygerberg Hospital. Proceedings of the 12th Conference on Priorities in Perinatal Care in Southern Africa.
6. Hofmeyer GJ. Amnioinfusion for meconium-stained liquor in labour (Cochrane Review). In: The Cochrane library, Issue 3, 2001. Oxford: Update Software.
7. Moran NF. Failure to diagnose IUGR: a major cause of avoidable perinatal death in Durban. Proceedings of the 21st Conference on Priorities in Perinatal Care in Southern Africa.

Chapter 9.
Immaturity

Abstract

Aim: To assess the extent of the problem of neonatal deaths due to immaturity and suggest ways of reducing this mortality.
Method: Data collected in the Perinatal Problem Identification Programme (PPIP) from sentinel sites in South Africa from October 1999 – September 2003 was used. The primary obstetric cause of death and the avoidable factors, missed opportunities and substandard care were assessed.
Results: A total of 4052 neonatal deaths with a birth weight of 1000g and more out of a total of 453649 live births were assessed. Deaths resulting from complications of immaturity were the commonest cause of neonatal deaths (35.2%) in South Africa. The neonatal mortality rate due to immaturity country-wide appears to be decreasing, year on year over the last 4 years. Spontaneous preterm birth was the commonest cause of death due to immaturity (78.2%). Poor or no attendance for antenatal care (4.7%), lack of adequate neonatal care facilities (3.7%), delay in attending when in labour (4.0%) and transport delays (2.2%) were the main avoidable factors. Very few health worker avoidable factors were recorded in neonatal care, probably indicating lack of knowledge in managing premature neonates rather than lack of substandard care.
Conclusion: Complications of immaturity are the commonest cause of neonatal death in South Africa. Knowledge on managing premature infants appears weak. Reducing deaths due to immaturity will impact positively on the perinatal mortality rate.

Recommendations

1. No infant is too small or immature to receive good basic resuscitation.
2. Every infant must receive essential basic care:
   a. Warmth;
   b. Kangaroo Mother Care (KMC) is good for almost all infants;
   c. Maintaining a normal blood glucose level;
   d. Maintaining adequate oxygenation. Level 2 and regional hospitals need to be able to administer nasal CPAP;
   e. Careful observation of the infant. A suggested observation chart is attached.
3. Adequate neonatal bed space must be made available as a matter of urgency.
4. Neonatal facilities must be appropriately equipped for the level of care offered.
5. The use of breastfeeding or expressed breast milk whenever possible.
6. KMC should be come the normal way for caring for a small infant.
7. Clear management protocols must be developed and used.
8. Clear referral criteria must be established, and referrals cannot be refused if the patient fulfils the appropriate criteria.

Introduction

The PPIP programme has been used over the past 4 years (since 2000) to provide data on perinatal mortality from sentinel sites throughout South Africa. Throughout this time, the commonest final neonatal cause of death has been "immaturity related". The second commonest primary obstetric cause of death, after "unexplained intrauterine death", has been "spontaneous preterm birth"[1,2,3]. This applies to infants with a birth weight of 1000g or more. During this time there have been some fluctuations in the neonatal mortality rates for "immaturity".

Several other studies in Southern Africa confirm that immaturity related deaths are the major cause of neonatal mortality[4–8]. In these studies, the percentage of deaths, which were immaturity related, varied between 30 and 60%.

Infants with a birth weight of 1000g or more generally have a good outcome if they are managed correctly. These deaths, therefore, represent an area where appropriate interventions could result in a significant decrease in mortality, and probably morbidity. Providing good care for these infants can, therefore, be expected to have a significant impact on reducing the neonatal mortality rate from immaturity. This chapter analyses the deaths due to complications of immaturity in depth.

Methods

Data collected from the PPIP sentinel sites in South Africa, and aggregated from the time that the programme was started in 2000, was used for this analysis. This data was collated by the MRC Unit for Maternal and Infant Health Care Strategies. Analyses of the data were performed on PPIP v2.

Results

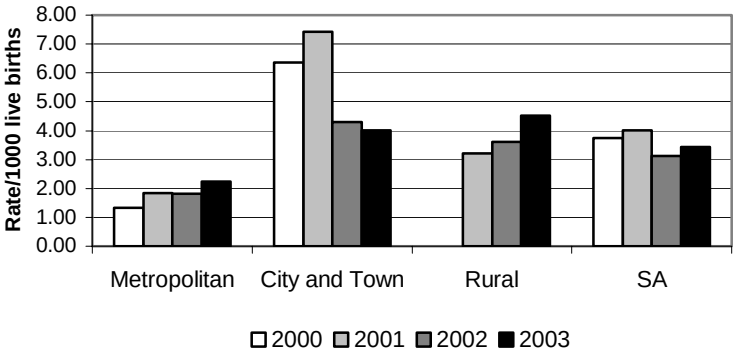
Deaths due to complications of immaturity accounted for 35.2% of all neonatal deaths recorded in the database. This is the most common cause of neonatal death.

Neonatal mortality rates

Table 9.1. Neonatal mortality rates 2000 – 2003 for all neonates >1000g and low birth weight babies

	Metropolitan NNDR		**City and Town NNDR**		**Rural NNDR**	
	>1000g	LBW	>1000g	LBW	>1000g	LBW
2000	5.7	25.9	14.3	68.6		
2001	6.9	30.6	16.0	67.0	8.8	53.8
2002	7.1	30.6	11.7	49.6	11.7	56.3
2003	9.1	39.0	13.6	54.3	10.3	52.1
Over all	7.5	32.7	13.6	58.3	10.7	53.8

Figure 9.1. Trends in neonatal deaths due to immaturity



The trend over the last four years has been an increase in NNDR in the metropolitan areas with, perhaps, a decrease in the city and towns and static in the rural areas. The NNDR in the low birth weight category (1000g-2499g) for the metropolitan areas is almost half that of the city and towns and rural areas. If deaths specifically related to immaturity are analysed (Figure 9.1), there has been a significant drop in the city and towns, but increases in the metropolitan and rural areas. Overall, there may have been a slight reduction. (Caution must be used in interpreting this data as over the last four years the number of PPIP sites has increased from 27 in 2000 to over 120 in 2003).

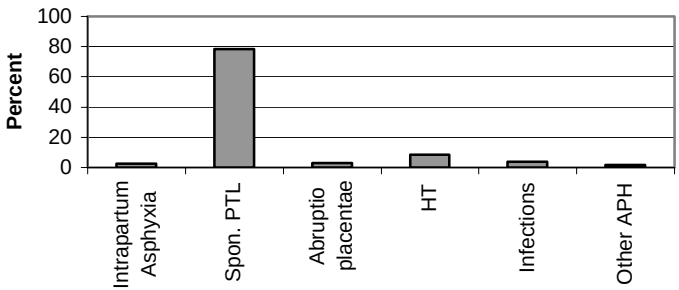
Primary obstetric cause of death

Table 9.2 and Figure 9.2 illustrate the primary obstetric causes of death due to immaturity. The vast majority are due to spontaneous preterm birth, but a not inconsiderable proportion is due to complications of hypertension and antepartum haemorrhage. Other antepartum haemorrhage consists of deaths due to placenta praevia and antepartum haemorrhage of unknown origin.

Table 9.2. Primary obstetric causes of death due to immaturity

Primary obstetric cause	Number	%
Spontaneous preterm birth	1232	78.2
Hypertension	131	8.3
Antepartum haemorrhage		
Abruptio placentae	47	3.0
Other APH	24	1.5
Infections	57	3.6
Intrapartum asphyxia and birth trauma	45	2.8
Others	47	3.0
Total	1583	100.0

Figure 9.2. Primary obstetric causes of deaths due to immaturity



Timing of Perinatal death

Table 9.3. Timing of deaths due to immaturity for infants 1000g or more

	Metropolitan		City and town		Rural	
	N	%	N	%	N	%
ENND	324	85.3	642	82.5	408	95.3
LNND	56	14.7	136	17.5	20	4.7

As expected the majority of deaths were within the first 7 days, but an unexpectedly high proportion were late neonatal deaths in the city and town areas. Ideally, there should be no late neonatal deaths in the rural areas as these should have been transferred to higher levels of care.

Final Neonatal causes of death

Table 9.4 lists the sub-categories of immaturity and compares their distribution and rate/1000 live births for all neonates 500g or more and 1000g or more. The higher mortality rate in neonates more than 500g compared with 1000g or more is not surprising. However, the high proportion of cases where the sub-category was not specified was unexpected. Tables 9.5 and 9.6 give the distribution of sub-category causes for each area. The high proportion of cases unclassified in the rural areas (40.8%) and city and towns (18.3%) explains the overall high proportion. This is probably an indication of the lack of knowledge of caring for premature infants and their pathology. This is supported by the high rate of deaths allocated the sub-category "extreme immaturity". By definition the use of "extreme immaturity" is restricted to neonates less than 1000g. Those neonates dying above 1000g should have a specific cause allocated.

Table 9.4. Sub-categories of final neonatal causes of deaths due to immaturity

	>500g			>1000g		
	n	**%**	**rate**	**n**	**%**	**rate**
Total	**3172**	**100.0**	**6.94**	**1583**	**100.0**	**3.49**
Extreme Immaturity	1557	49.1	3.41	459	29.0	1.01
HMD	741	23.4	1.62	535	33.8	1.18
NEC	117	3.7	0.26	92	5.8	0.20
IVH	63	2.0	0.14	47	3.0	0.10
PH	85	2.7	0.19	57	3.6	0.13
Unclassified	565	17.8	1.24	362	22.9	0.80
Other	44	1.4	0.10	31	2.0	0.07

Table 9.5. Causes of death due to immaturity in various areas >500g

>500g	Metropolitan		City and Town		Rural	
	n	%	n	%	n	%
Immaturity	**1251**	**100.0**	**1296**	**100.0**	**625**	**100.0**
Extreme Immaturity	698	55.8	653	50.4	206	33.0
HMD	293	23.4	306	23.6	142	22.7
NEC	56	4.5	54	4.2	7	1.1
IVH	36	2.9	24	1.9	3	0.5
PH	61	4.9	19	1.5	5	0.8
Unclassified	73	5.8	237	18.3	255	40.8
Other	34	2.7	3	0.2	7	1.1

Table 9.6. Causes of death due to immaturity in various areas >1000g

>1000g	Metropolitan		City and Town		Rural	
	n	%	n	%	n	%
Immaturity	**380**	**100.0**	**778**	**100.0**	**425**	**100.0**
Extreme Immaturity	50	13.2	280	36.0	129	30.4
HMD	177	46.6	265	34.1	93	21.9
NEC	38	10.0	48	6.2	6	1.4
IVH	23	6.1	21	2.7	3	0.7
PH	38	10.0	14	1.8	5	1.2
Unclassified	31	8.2	149	19.2	182	42.8
Other	23	6.1	1	0.1	7	1.6

Table 9.7. Comparison of neonatal mortality rates for the different areas with respect to complications of immaturity

	Metropolitan		City and Town		Rural	
	n	rate	n	rate	n	rate
>500g	1251	6.17	1296	8.78	625	5.85
>1000g	380	1.89	778	5.31	425	3.99

Table 9.7 gives the mortality rates for immaturity for neonates 500g or more and for 1000g or more. The low rates noted in the rural areas are most likely to be due to incomplete recording of the births and deaths of neonates less than 1000g than actual low rates.

Table 9.8. Comparison of neonatal mortality rates per birthweight category for the different areas with respect to complications of immaturity

	1000-1499g		1500-1999g		2000-2499g		2500g+	
	Rate	%	Rate	%	Rate	%	Rate	%
Metropolitan	67.85	72.6	8.58	17.9	0.65	3.2	0.14	6.3
City and Town	212.70	68.9	37.86	25.3	0.19	3.7	0.13	2.1
Rural	362.09	65.2	49.82	28.7	2.29	4.7	0.06	1.4

The rate of death in the metropolitan areas for the 1000-1499g category was three times lower than the city and town areas and five times lower in the rural areas. For the 1500-1999g birth weight category, the rates of neonatal death for metropolitan areas were four times and seven times lower for city and towns and rural areas respectively.

Avoidable factors, missed opportunities and substandard care

The avoidable factors recorded were low in each of the areas was low. This is astonishing given the great magnitude of differences in rates of neonatal deaths for each birth weight category. The almost total lack of neonatal care avoidable factors listed is note worthy. Clearly, the clinicians assessing the deaths of the neonates are not able to assess neonatal care, either due to lack of knowledge or lack of information.

Table 9.9. All and probable avoidable factors, missed opportunities and substandard care for Immaturity

Neonatal deaths from immaturity	**Metropolitan 380**		**City and Town 778**		**Rural 425**	
	All % of death	**Prob. % of death**	**All % of death**	**Prob. % of death**	**All % of death**	**Prob. % of death**
Health worker related	17.6	3.8	16.4	5.4	16.2	5.1
Administrative related	34.8	5.5	16.8	5.5	35.0	9.6
Patient related	40.0	3.3	48.7	11.6	41.4	11.7
Insufficient information	3.3	1.0	5.9	0.5	9.0	0

Table 9.10. Probable avoidable factors, missed opportunities and substandard care for immaturity.

Probable Avoidable Factors	Immaturity (n=1583)	% of deaths
Health Worker Related	97	6.1
Delay in referring patient to 2 or 3 level of care	13	0.8
No response to history of stillbirths, abruptio etc.	9	0.5
Multiple pregnancy not diagnosed	11	0.7
Administrative problems	124	7.8
Inadequate facilities in neonatal unit	58	3.7
No accessible NICU bed with ventilator	11	0.7
Lack of transport: home to institution	22	1.4
Lack of transport: institution to institution	12	0.8
Patient related	172	10.9
Delay in seeking medical attention during labour	64	4.0
Never initiated antenatal care	46	2.9
Booked late	29	1.8

Discussion

The neonatal mortality rate for low birthweight neonates appears to be increasing, but that for immaturity, decreasing slightly. The decrease is restricted to the city and town areas, and may reflect better care or better ability to transfer neonates out. This is encouraging.

The neonatal mortality rates for immaturity in the city and town group, however, still remains the highest, with the rural rate also being higher than those in the Metropolitan areas. One explanation for the lower neonatal mortality rates in the metropolitan areas is because of better access to higher levels of neonatal care and better facilities than for those living further away. Alternatively it may be due to lack of knowledge on how to manage immature infants and hence the appallingly high neonatal mortality rates outside of the metropolitan areas. Furthermore, the figures for the rural areas may be falsely low, if preterm infants are being delivered and possibly dying at home, or because the mother has been correctly identified as having a high risk pregnancy and being appropriately referred. This could also account for the high neonatal mortality in the cities and towns.

Many of the infants who die from infection are also low birth weight or immature infants so that the deaths from immaturity do not reflect the whole picture of mortality in immature infants

The majority of these immature infants were born as the result of spontaneous preterm labour. This is something that is mostly not preventable. Many patients who are in preterm labour often only arrive at a health facility when already in advanced labour. It is, then, too late for suppression of labour and administration of corticosteroids, so that it is essential to provide good care for the preterm infant. (See Chapter 4, Spontaneous Preterm Birth).

Almost 10% of the deaths were related to complications of hypertension, and a further approximately 5% were due to complications of antepartum haemorrhage. Delivery in these cases is often iatrogenic. The use of expectant management in cases with severe pre-eclampsia and placenta praevia must not be ignored. (See Chapter 5, Hypertension and abruptio placentae)

Avoidable factors which have been identified, as expected, are very similar to those of spontaneous preterm birth:

Patient related: Inadequate antenatal care, mainly failure to initiate antenatal care
Delays in attending when in labour or with ruptured membranes.
Administrative: Inadequate neonatal facilities
Transport problems, both inter-institutional and from home to institution.
Medical personnel related: Delays in referral or calling for expert help.

The problem of inadequate neonatal facilities comes up as a significant problem in the avoidable factors. It is not clear from these data what exactly the deficiencies were, but it is a problem that needs urgent attention. It is a problem which has previously been identified in South Africa[1,2,3]. This is mainly at City and Town and Rural facilities. The requirements for the care of newborn infants at all levels of care need to be laid out and both clinicians and managers held responsible for ensuring that they are in place. Together with the equipment, must go the training of the personnel in the correct use and maintenance of this equipment and in the management of these immature infants.

Some of the “inadequate neonatal facilities” are because of the refusal to accept transfers because there are “no beds”. If there are indeed insufficient neonatal beds available, this refusal can and should be used to motivate for an increase in the number of high care beds.

Transport of the newborn infant remains a major problem in almost all areas of the country. There does not appear to be a short-term solution to this problem. It needs to be addressed at provincial, regional and district levels and real solutions found. It is also going to need significant funding.

Delays in taking action by medical staff are best addressed at a local level at the perinatal meetings and in-service training, together with clear and appropriate management and referral protocols for preterm labour and preterm and sick infants.

Avoidable factors recorded, however, were relatively few, especially when related to clinical management of the neonate. The neonatal care areas of substandard care are grouped into: inadequate resuscitation; inadequate monitoring, and inadequate management plan. The quality of care related to a specific neonate should be relatively easy to assess, provided the basic standard protocols are present and adequate notes made. The extraordinarily high differences in neonatal death rates between metropolitan and other areas indicate that the assessment of the neonatal deaths is not being performed adequately. The most likely explanation is the lack of knowledge on how to manage immature infants and consequently the lack of detection of avoidable factors. The exposure of medical students and student nurses to neonatology is extremely limited. This is particularly worrying when seen in the light of almost half of all deaths in childhood take place in the first month. Are the lives of newborn infants taken seriously? Curricula of health sciences faculties must be urgently reviewed and appropriate emphasis given to neonatal care.

The following are care practices which will help to reduce neonatal mortality:

1. Kangaroo Mother Care (KMC) has been shown[9,10] to be a safe and effective way of keeping even very small infants warm. It can be done even if the infant is receiving intravenous fluids and oxygen in a primary care setting. KMC should become the normal way of nursing a small infant wherever possible.
2. Nasal prongs continuous positive airways pressure (CPAP)[11] is a relatively inexpensive method of administering oxygen to infants who cannot receive intermittent positive pressure ventilation, but who need more than head box oxygen administration. It should be introduced as a matter of urgency at all level 2 and regional hospitals.
3. Blood glucose levels need to be monitored using a heel prick blood sample and reagent strip. Hypoglycaemia must be avoided and actively treated when it occurs. Early breastfeeding (breast milk is best

for all feeds, if possible), and if feeding is not possible, the establishment of an intravenous line is essential.

4. Appropriate observations must be done in order to detect changes in the condition of the infant. A suggested suitable observation chart is attached.
5. All infants, no matter how small, should be given basic resuscitation before decisions are made about further management. Once in the nursery area, the basic minimum care must always be given, even if the outcome is not expected to be good.

Conclusion

The neonatal mortality rate due to immaturity is very high, especially away from the metropolitan areas. These figures relate only to those sites using PPIP for recording and analysing perinatal deaths and represent the best-case scenario. The above recommendations must be implemented as a matter of great urgency.

References

1. Pattinson RC (ed). Saving babies: A Perinatal Care Survey of South Africa, 2000. MRC Unit for Maternal and Infant Health Care Strategies, Pretoria.
2. Pattinson RC (ed). Saving babies 2001: 2nd A Perinatal Care Survey of South Africa. MRC Unit for Maternal and Infant Health Care Strategies, Pretoria.
3. Pattinson RC (ed). Saving babies 2002: Third Perinatal Care Survey of South Africa. MRC Unit for Maternal and Infant Health Care Strategies, Pretoria.
4. de Groot van C HA. Trends in perinatal mortality in Cape Town: 1967–1977. S Afr Med J 1979; 76: 1087–1092.
5. Delport SV, Howland R. Perinatal Mortality in the Midwife Obstetric Units in Cape Town. Proceedings of the Ninth Conference on Priorities in Perinatal Care in Southern Africa 1990: 6–9.
6. Greenfield DH et al. Perinatal Mortality in Midwife Obstetric Units – Causes and avoidable factors. Proceedings of the Thirteenth Conference on Priorities in Perinatal Care on South Africa 1994; 42–43.
7. Gupta V, Bonduelle M, Iliff P. An Analysis of Perinatal Mortality at the Greater Harare Unit. Proceedings of the Eleventh Conference on Priorities in Perinatal Care on South Africa 1992; 75–77.
8. Pattinson et al. The importance of incorporating Avoidable Factors into Perinatal Audits. S Afr Med J 1995; 85(3): 145–147.

9. Charpak N et al. Kangaroo-mother versus traditional care for infants < 2000 grams: a randomised controlled trial. Pediatrics 1997; 100: 682–688.
10. Bergman N. Kangaroo mother care from birth compared with conventional incubator care. Proceedings of the Twenty Second Conference on Priorities in Perinatal Care in South Africa 2002: 75–81.
11. Ho JJ et al. Continuous distending pressure for respiratory distress syndrome in preterm infants. (Cochrane review) In: The Cochrane Library, Issue 2, Oxford; Update Software.

Newborn Observation Chart

Name:	Hospital No.	Wt.	Date:

	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	12am	1:00	2:00	3:00	4:00	5:00	6:00
Resp rate																								
Grunting																								
Recession																								
Apnoea																								
Heart rate																								
Temp infant																								
incubator																								
Oxygen:																								
Amt administered																								
Baby's colour																								
SATS																								
Blood glucose																								
Urine amount																								
Blood																								
Protein																								
Vomits																								
Stools																								
Feed: amt given																								
Seizures																								

Feed	**IV fluids**
Type	Type
Amount	Drip rate
Frequency	
Amount given in 24 hours	**Amount given in 24 hours**
Total fluid intake in 24 hours	

Chapter 10
Neonatal deaths due to perinatal asphyxia/ hypoxia

Abstract

Objectives: To determine the primary obstetric causes, final neonatal causes, avoidable factors associated with deaths due to perinatal asphyxia.

Design: Is an observational study. All deaths due to perinatal asphyxia were recorded. Primary obstetric causes, neonatal causes and factors associated with these deaths were identified.

Results: Among 4502 neonatal deaths weighing >999g, 1459 (32.4%) were identified to be related to asphyxia/ hypoxia. The common primary obstetric causes of death were intrapartum asphyxia, hypertensive disorders and antepartum haemorrhage. Intrapartum asphyxia was the most common cause accounting for 64.6% (1.56/1000 live births) in Metropolitan areas, 71.1% (2.67/ 1000 live births) in City and Town and 81.3% (3.21/ 1000 live births) in Rural areas. Eighty-five percent occurred in neonates with a birthweight of 2000g or more. Hypoxic ischaemic encephalopathy was identified as the main neonatal cause of death due to hypoxia. The most common category of probable avoidable factors were health worker related (18% metropolitan, 30% city and town and 21% rural areas), followed by administrative related in Metropolitan areas (12%) and patient related in City and Town (15%) and Rural areas (8%). Delays in seeking medical care during pregnancy or labour and inadequate fetal monitoring were the top two probable avoidable factors in all areas. Substandard care related to resuscitation of the hypoxic neonates was recorded infrequently, most likely due to lack of ability to assess neonatal resuscitation, whether due to lack of information for or lack of knowledge of assessors.

Conclusions: Hypoxia is responsible for about one in three neonatal deaths, labour related intrapartum asphyxia is the major primary obstetric cause of deaths, and 85% occurred in neonates more than 2.0 kg. At least one third of the deaths were judged to have been preventable if the health system had functioned properly.

Recommendations

In addition to those recorded in the Intrapartum asphyxia and birth trauma chapter, the following are regarded as vital:

1. Adequate equipment for neonatal resuscitation must be available in all sites conducting births. Facility audits must be conducted to ensure the equipment is available.
2. All health workers involved in conducting births must be able to perform the basic resuscitation of hypoxic neonates. Training must be given to those with insufficient skills. Compulsory certification of the skills should be considered by the Health Professions Council of South Africa
3. Amnioinfusion should be made available for all cases where there is meconium stained liquor and where necessary skills are lacking the training in the skills should be performed.

Introduction

Perinatal asphyxia/hypoxia is the state in which placental or pulmonary gas exchange is compromised or ceases altogether during the perinatal period. Biochemically this is defined as fetal or neonatal hypoxia, hypercarbia and acidosis. If asphyxia is severe or persistent, it may result in death or hypoxic ischaemic brain injury presenting as encephalopathy in the early neonatal period. The other complications associated with perinatal asphyxia include meconium aspiration syndrome and persistent pulmonary hypertension of the newborn that on their own are associated with high mortality[1,2]. Hypoxic ischaemic encephalopathy is a major clinical concern because it may result in death or severe neurological impairment resulting in cerebral palsy long term. Therefore it is of paramount importance that we vigilantly monitor factors that might be associated with occurrence of fetal and neonatal hypoxia.

In the first Perinatal Care Survey in South Africa in 2000, intrapartum asphyxia and birth trauma were identified as the most common primary causes of perinatal death in rural hospital (rate 6.92/1000 births) and second primary cause in City and Town hospitals (rate 6.5/1000 births)[3]. The perinatal mortality rate due to intrapartum asphyxia alone was 4.8/1000 births[4]. Therefore ongoing audit of perinatal deaths due to asphyxia is critical, to be able to identify preventable factors contributing to these deaths. The aim of the survey was to determine: 1) the primary obstetric causes of neonatal deaths due to asphyxia/hypoxia; 2) neonatal causes of death in infants born asphyxiated; 3) avoidable factors associated with these deaths.

Methods

Data from the PPIP users throughout the country were amalgamated using the PPIP v2 programme. In each case, the primary obstetric cause (i.e. the event that initiated the process that resulted in the death of the fetus or neonate) and if the infant was born alive a final neonatal cause of deaths was allocated. Each case was analysed with respect to avoidable factors, missed opportunities and substandard care. Factors related to the patient and her environment, administrative and health worker related factors were assessed. Overall 52 infants were misclassified as being both an intrauterine death and neonatal death. These deaths have been excluded from the analysis of neonatal deaths.

Results

Primary obstetric causes of neonatal deaths due to hypoxia

There were 462348 births weighing >999g from October 1999 to September 2003 amongst all the hospital that were surveyed. There were 12773 deaths identified, of which 4502 occurred during the neonatal period. Thirty two percent (1459) of

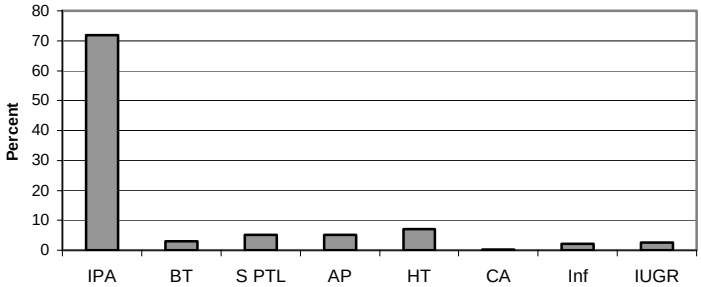
the neonatal deaths were related to asphyxia/hypoxia, second to deaths due to immaturity (35.2%).

The most common primary obstetric causes of neonatal deaths due to asphyxia/ hypoxia were intrapartum asphyxia and birth trauma (74.7%), complications of hypertension in pregnancy (7.0%) and abruptio placentae (5.1%) (Figure 10.1). Intrapartum asphyxia accounted for more than 60% of all the neonatal deaths due to asphyxia/hypoxia in all the different groups of hospitals, with the rural hospitals reaching 81% (Table 10.1). It is important to note in metropolitan areas, that a third of neonatal deaths due to asphyxia-hypoxia were due to causes other than intrapartum asphyxia and birth trauma. Notably, complications of hypertension in pregnancy, abruptio placentae, spontaneous preterm birth and idiopathic intrauterine growth restriction were important causes.

Table 10.1. Comparison of the primary obstetric causes of neonatal death due to hypoxia in the different areas.

Primary obstetric cause	Metropolitan %	City and Town %	Rural %
Intrapartum Asphyxia	64.6	71.1	81.3
Birth Trauma	1.0	4.0	3.6
Spontaneous preterm labour	7.0	5.8	2.4
Abruptio placentae	8.4	3.8	2.9
Hypertension	8.4	8.3	3.6
Cong. Abnormalities	0.2	0.5	0.2
Infections	2.5	2.5	1.4
Idiopathic IUGR	4.5	2.2	1.0
Other Antepartum haemorrhage	0.2	0.9	1.0
Pre-existing maternal disease	0.6	0.4	0.7
Other	2.7	0.5	1.9

Figure 10.1. Primary obstetric causes of death due to neonatal hypoxia



Sub-categories of neonatal death due to hypoxia

The sub-categories identified of hypoxia as the final neonatal causes of death were hypoxic-ischaemic encephalopathy (HIE), meconium aspiration and persistent pulmonary hypertension of the newborn (PPHN) also commonly known as persistent fetal circulation (PFC) (Table 10.2). In metropolitan, and in city and town hospitals, the major neonatal cause of death was HIE. In rural areas, the final neonatal cause of death was not properly identified or recorded, thus the majority of these were unclassified (Table 10.3). If these were properly recorded, one would not expect the rural areas to be any different from other groups of hospitals in terms of distribution of the final neonatal causes of death. However, there were a significant proportion of deaths due to meconium aspiration syndrome in all areas.

Table 10.2. Final neonatal causes of deaths for neonatal hypoxia in South Africa

	Number	%	Rate/1000 Live births
SOUTH AFRICA			3.21
Hypoxic ischaemic encephalopathy (HIE)	854	58.5	
Meconium aspiration syndrome (MAS)	321	21.7	
Persistent fetal circulation (PFC)	40	2.7	
Other	32	2.2	
Unclassified	222	15.2	

The neonatal mortality rate for asphyxia-hypoxia was more than 60% higher and 50% higher in the rural and city and towns respectively when compared with metropolitan areas.

Table 10.3. Final neonatal causes of deaths for neonatal hypoxia in different areas

	METROPOLITAN		CITY AND TOWN		RURAL	
	%	Rate /1000 Live births	%	Rate /1000 Live births	%	Rate /1000 Live births
HIE	77.6		62.6		30.8	
MAS	13.1		19.2		33.9	
PFC	3.7		3.4		0.7	
Other	3.9		1.4		1.2	
Unclassified	1.8		13.4		33.4	
Total		2.44		3.76		3.96

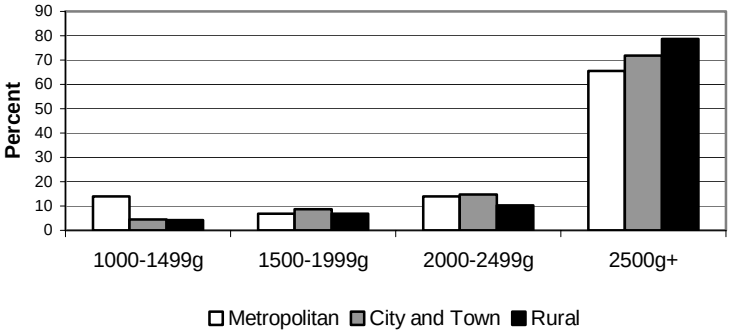
Timing of neonatal death due to hypoxia in relation to birth and birth weight category

Table 10.4. Timing of deaths due to hypoxia

		Number	%
SOUTH AFRICA			
	Early Neonatal Death	1382	94.9
	Late Neonatal Death	74	5.1
METROPOLITAN			
	Early Neonatal Deaths	462	94.3
	Late Neonatal Deaths	28	5.7
CITY AND TOWN			
	Early Neonatal Deaths	515	93.1
	Late Neonatal Deaths	38	6.9
RURAL			
	Early Neonatal Deaths	408	98.1
	Late Neonatal Deaths	8	1.9

Table 10.4 give the distribution of neonatal deaths due to asphyxia-hypoxia in relation to whether they occurred early within 7 days or late (8-28 days). The vast majority of neonates that died due to asphyxia-hypoxia in all areas died in the early neonatal period.

Figure 10.2. Distribution of neonatal deaths due to hypoxia in birthweight categories



The vast majority of neonatal deaths due to asphyxia-hypoxia are in the category above 2.5 kg (Figure 10.2). Overall 85% of all deaths due to asphyxia-hypoxia occurred in neonates 2 kg or more.

Avoidable factors, missed opportunities and substandard care related to neonatal deaths due to hypoxia

Table 10.5. All and probable avoidable factors, missed opportunities and substandard care for neonatal hypoxia.

	Metropolitan		City and Town		Rural	
	All % deaths	Prob. % deaths	All % deaths	Prob. % deaths	All % deaths	Prob. % deaths
Health worker related	44.5	18.4	59.6	30.5	59.1	21.4
Administrative related	53.3	11.5	20.3	6.9	22.9	7.4
Patient related	33.2	5.1	33.5	14.7	32.1	8.0
Insufficient information	4.9	0.1	5.6	0.4	7.9	0.4

Table 10.5 shows the proportion of all (possibly and probable) and only probable avoidable factors, missed opportunities and substandard care for the different group of hospitals. In metropolitan areas, the most common avoidable factors were administrative related whereas in city and towns and in rural areas they were health worker related. Neonates dying due to asphyxia-hypoxia were thought to have been probably avoidable in between 1 in 2 and 1 in 4 deaths. The most common category of probable avoidable factors was the health worker related group in all areas. The spread of other categories of probable avoidable factors varied according to group of hospitals, with administrative related being second in the

Metropolitan areas, whereas patient related were the second in city and town and in rural areas. In just 12 cases (0.8% of all neonatal deaths due to hypoxia), it was considered that neonatal resuscitation was inadequate and this contributed directly to the death of the infants. This is most likely an underestimation as one would expect difficulties experienced by health workers in neonatal resuscitation to be much more than 12, proportional to the number of neonates with asphyxia-hypoxia.

Table 10.6. Probable avoidable factors, missed opportunities and substandard care for neonatal asphyxia-hypoxia in all areas

Probable Avoidable Factors	n = 1459	Percentage of NND due to hypoxia
Health Worker Related		
Fetal Monitoring inadequate	190	13.0
Partogram usage	65	4.4
Second stage mismanaged	81	5.6
Breech presentation missed	13	0.9
Underestimate fetal size	20	1.4
Multiple pregnancy not diagnosed	13	0.9
No response to maternal hypertension	21	1.4
No response to apparent postterm pregnancy	17	1.2
Neonatal resuscitation inadequate	12	0.8
Delay in referring patient to 2 or 3 level of care	50	3.4
Delay in calling for assistance	45	3.1
Delay in doctor responding to call	9	0.6
Administrative problems		
Inadequate facilities in neonatal unit	33	2.3
Inadequate theatre facilities & anaesthetic delays	20	1.4
Lack of transport: home to institution	20	1.4
Lack of transport: institution to institution	33	2.3
Insufficient nurses on duty	27	1.9
Insufficient doctors on duty	23	1.6
Personnel insufficiently trained or too junior	29	2.0
Patient related		
Delay in seeking medical attention during labour	111	7.6
Inappropriate response to poor fetal movements	18	1.2
Inappropriate response to APH	10	0.7

Table 10.7. Top 10 probable avoidable factors in contributing to deaths due to asphyxia in each hospital group.

Metropolitan
1. Fetal monitoring inadequate
2. Delay in seeking medical care antenatally or during labour
3. Second stage mismanaged
4. Lack of transport-home or institution to institution
5. Inadequate facilities in theatre or in neonatal unit/nursery
6. Insufficient doctors available to manage the patient
7. Insufficient nurses available to manage the patient
8. Partogram usage inadequate
9. Delay in calling for assistance or referral to 2 or 3 level of care
10. Inadequate neonatal resuscitation or care

City and Town
1. Fetal monitoring inadequate
2. Delay in seeking medical care antenatally or during labour
3. Delay in calling for assistance or referral to 2 or 3 level of care
4. Second stage mismanaged
5. Partogram usage inadequate
6. Lack of Transport – home or institution to institution
7. Insufficient nurses available to manage the patient
8. Inadequate facilities in theatre or in neonatal unit/ nursery
9. Inadequate neonatal resuscitation or care
10. Personnel not sufficiently trained to manage the patient

Rural
1. Fetal monitoring inadequate
2. Delay in seeking medical care antenatally or during labour
3. Second stage mismanaged
4. Partogram usage inadequate
5. Inadequate facilities in theatre or in neonatal unit/ nursery
6. Delay in calling for assistance or referral to 2 or 3 level of care
7. Lack of transport – home or institution to institution
8. Inadequate neonatal resuscitation or care
9. No response to maternal hypertension
10. Insufficient nurses available to manage the patient

The breakdown of probable avoidable factors according to the three categories is shown in Table 10.6 and was mostly related to events prior to birth. Inadequate monitoring and poor use of the partogram were the most common avoidable factors related to health workers. Amongst the administrative related group, inadequate facilities (neonatal unit and theatres) and transportation between institutions were the most common avoidable factors. Delay in seeking medical attention during labour was identified as the most common factor that was patient related. Table 10.7 shows a list of top ten avoidable factors, missed opportunities and substandard care that were classified as probable among the different hospital groups. This list looks at all the factors irrespective of the category of avoidable factors. Delays in patients seeking medical assistance, inadequate monitoring of the fetus during labour, deficiencies in partogram usage and inadequate management of second stage of labour were amongst the top five avoidable factors. Delays in seeking

medical care antenatally or during labour was either number one or two in the list. Inadequate facilities or equipment in neonatal unit/nursery also featured high on the list especially in rural hospitals.

Discussion

Perinatal asphyxia contributes greatly to neonatal mortality and morbidity in developing countries. Asphyxia is the second most common neonatal cause of death after prematurity.[5,6] It may be associated with severe neurological outcomes in those who survive. Therefore ongoing assessment of risk factors associated with development of asphyxia is critical especially in areas where its incidence is high. In this report, we have analysed the factors that might contribute to deaths due to asphyxia at different levels of care.

Intrapartum asphyxia was the most common primary obstetric cause of deaths related to asphyxia-hypoxia. The occurrence of asphyxia during labour in patients delivering within the health system affords one an opportunity to intervene, especially as the vast majority of cases occur in infants more than 2 kg and are normal healthy infants at the start of labour. Unfortunately, about one third of deaths (of essentially normal healthy term fetuses), were thought to be probably preventable. Identification of factors contributing to these deaths is therefore vital before an intervention measures are put in place.

In this perinatal survey, areas where improvement could be made, were found both within the health system (health worker and administrative related) and with the patient, but mainly with the health system. Some of the avoidable factors that were classified under the patient can also be explained by deficiencies in the health system. A significant number of deaths were found to be probable, related to the patient seeking medical care late during labour. This occurred in all areas. This delay could be explained by lack of transport from home to hospital or clinic, lack of awareness to use health care facilities, lack of trust on the health system therefore patients only going to hospital when there are complications. Therefore provision of ambulance services and health promotion could reduce deaths thought to be due to patient related factors. It is important that the government, communities and health workers develop strategies that will help to promote women and child health issues. One also needs to be realistic as it might be impossible for the government to provide transport/ambulances for every patient in labour, but could rather manage to transport those presenting with emergencies e.g. antepartum haemorrhage or cord prolapse. It is important that patients prepare themselves antenatally as to how they will get to the health facilities when they are in labour. Health workers could assist with this preparation by discussing transportation during labour in the antenatal clinics. .

Monitoring of fetus during labour, use of partogram and management of labour were the main areas where health workers were found to be inadequate in delivering appropriate obstetric care. It has been shown that poor monitoring of foetus during labour is associated with poor outcome even in pregnancies that are assessed as being low risk pregnancies[7]. The inadequate management of labour is most likely due to a number of factors including inadequate training, poor application of the knowledge or skills, lack of commitment, and high workload (See Chapter 3, Intrapartum asphyxia and birth trauma).

Not all neonatal deaths due to asphyxia-hypoxia are due to poor management of labour. In areas where labour management is better (metropolitan areas), a third of neonatal hypoxia deaths were due to other causes, like hypertension and abruptio placentae. Careful antenatal fetal heart monitoring in women with hypertension and prompt delivery will be necessary to prevent deaths due to asphyxia-hypoxia. As the management of labour improves, these other conditions will become more important.

The high number of deaths due to meconium aspiration syndrome is also a cause for concern. The use of amnioinfusion for meconium stained liquor has been shown in a randomised trial in Harare to reduce perinatal mortality[8]. Amnioinfusion should be a skill that all midwives and doctors are familiar with. Its use could significantly reduce the number of neonatal deaths due to meconium aspiration syndrome.

In this survey, inadequate neonatal facilities including equipment and intensive care unit beds, featured in the top ten probable avoidable factors in deaths due to hypoxia. Inadequate facilities in neonatal resuscitation and neonatal care will definitely make the outcome of a compromised neonate with asphyxia even worse. A surprisingly low number of cases were recorded as having died as a result of poor neonatal resuscitation. Given the large number of neonatal deaths due to hypoxia, it's inconceivable that this is a true reflection of the actual circumstances. The most likely reasons for detailed analysis of the neonatal resuscitation being absent are: lack of notes; lack of knowledge on neonatal resuscitation; lack of involvement of the clinicians involved; and a sense of futility and the feeling nothing could have been done. A culture of in-depth evaluation of the neonatal management of neonatal deaths must be included in the perinatal mortality meetings. This will bring aspects of neonatal resuscitation to the fore and act as a good vehicle for training of all health workers involved in the birth and neonatal care. Review of curricula in nursing colleges and health sciences faculties should be undertaken to ensure graduates are adequately equipped to resuscitate neonates. The Health Professions Council of South Africa should consider certification of the skills before allowing registration of nurses in midwifery and doctors to register.

Immediate initiation of proper resuscitation could save a lot of lives. Birth asphyxia accounts for about 19% of the approximately 5 million deaths that occur each year worldwide[9]. This suggests that the outcome of approximately 1 million newborns can be improved by proper resuscitation. Neonatal resuscitation is a skill that can be taught and applied easily. It should be put as a requirement that everyone who is involved in the birth of an infant and its neonatal care should have a certification in neonatal resuscitation. Infants who require neonatal resuscitation need supportive and/or ongoing care, as they are at risk of developing complications related to asphyxia. This care includes maintaining normal temperature, maintaining normal circulation (monitoring vital signs), maintaining ventilation and oxygenation, and glucose levels, observing for seizures and other neurological disturbances or delays namely poor feeding.

This survey reports on neonatal deaths due to asphyxia-hypoxia in which the common neonatal final cause of death was hypoxic ischaemic encephalopathy. It is certain that there were a large number of infants who have survived with moderate to severe encephalopathy. About a quarter of infants who have moderate encephalopathy will develop neurological impairment and almost all those with severe encephalopathy that survive, will have severe neurological impairment[10]. The neurological impairment could be of a severe form of cerebral palsy. Infants with cerebral palsy will need ongoing social and health care support and become a burden to their families and the state. This situation must be prevented from occurring by improving intrapartum care and neonatal resuscitation.

Conclusion

Intrapartum asphyxia is the major cause of neonatal deaths due to asphyxia-hypoxia in South Africa. The avoidable factors contributing to perinatal asphyxia are mainly deficiencies within the health system and few are patient related. The finding that it involves essentially normal, healthy term infants who would otherwise have been normal health children and adults makes it imperative to solve this problem urgently. Provision and promotion of health to women and children should be taken as a major priority by all stakeholders, namely the government, training institutions, healthcare workers and communities. Immediate attention should be put on improving the management of labour, and care and management of a newborn.

References

1. Adhikari M, Gouws E, Velaphi S, Gwamanda P. Meconium aspiration syndrome: importance of the monitoring of labor. J Perinatol 1998; 18: 55-60.

2. Walsh-SukysMC, Tyson JE, Wright LL, et al. Persistent pulmonary hypertension of the newborn in the era before nitric oxide: practice variation and outcomes. Pediatrics 2000; 105: 14-20.
3. Saving Babies 2002: 3rd Perinatal Care Survey of South Africa. Perinatal Care Surveys 2000-2002: An Overview of the Challenges. The MRC Unit for Maternal and Infant Health Care Strategies, PPIP Users, and the National Department of Health.
4. Buchmann EJ, Pattinson RC, Nyathikazi N. Intrapartum-related asphyxia in South Africa—lessons from the first national perinatal care survey. S Afr Med J 2002; 92: 897-901.
5. Ellis M, Manandhar DS, Manandhar N, et al. Stillbirths and neonatal encephalopathy in Kathmandu, Nepal: an estimate of the contribution of birth asphyxia to perinatal mortality in a low-income urban population. Paediatr Perinat Epidemiol 2000; 14: 39-52.
6. Campbell O, Gipson R, Mohandes AE, et al. The Egypt National Perinatal/ Neonatal Mortality Study 2000. J Perinatol 2004; 24: 284-289.
7. Sameshima H, Ikenoue T, Ikeda T, et al. Unselected low-risk pregnancies and the effect of continuous intrapartum fetal heart rate monitoring on umbilical blood gas and cerebral palsy. Am J Obstet Gynecol 2004; 190: 118-123.
8. Mahomed, K., T. Mulambo, et al. (1998). "The Collaborative Randomised Amnioinfusion for Meconium Project (CRAMP): 2. Zimbabwe." Br J Obstet Gynaecol 105(3): 309-13.
9. World Health Report. Geneva, Switzerland: World Health Organization; 1995.
10. Robertson C, Finer N. Term infants with hypoxic-ischemic encephalopathy: Outcome at 3.5 years. Dev Med Child Neurol 1985; 27: 473-84.

Chapter 11
Neonatal infections

Abstract

Objectives: To determine the primary obstetric and neonatal causes and avoidable factors associated with deaths due to perinatal infections.

Design: It is an observational study. All deaths due to perinatal infections were recorded. Maternal diagnoses, neonatal cause of death and factors associated with these deaths were identified.

Results: There were 642 neonatal deaths weighing >999g with the final cause being infection (14.3% of all neonatal deaths) and giving a neonatal mortality rate of 1.41/1000 live births. The common primary obstetric causes of death were maternal infections and spontaneous preterm labour. The neonatal mortality rate for infections was highest in city and town hospitals at 1.72/1000 live births. Most of the deaths occurred during the early neonatal period suggesting maternal acquisition. The common final neonatal causes of death were septicaemia, pneumonia and nosocomial sepsis. There were more deaths due to nosocomial sepsis in Metropolitan hospitals than in other group of hospitals (23.4% vs. 1-2.1%). Congenital syphilis was the cause in 6-9% of neonatal deaths. Probable avoidable factors were health system related in 58-63% and patient related in 32-40% of deaths. Non-attendance of antenatal care and inadequate neonatal care were the common avoidable factors in all groups of hospitals.

Conclusions: Infections are the major cause of neonatal death during the perinatal period. Most of the deaths due to infections are related to preterm labour and maternal infections. Majority of probable avoidable factors are found within the health system. Inadequate neonatal care is a major contributor to these deaths and this problem is found in all levels of care. Syphilis is still a major cause of death and is preventable.

Recommendations

1. Encourage early attendance at antenatal care by our patients.
2. Early reporting of complications like rupture of membranes.
3. On-site routine syphilis screening and treatment is essential.
4. Providing appropriate neonatal care can substantially reduce deaths from perinatal infections.
5. All hospitals must be encouraged to promote breastfeeding and Kangaroo mother care as strategies to reduce neonatal infections.

Introduction

Infections during pregnancy may have a negative impact on the mother, foetus and the newborn. The care and wellbeing of the mother is linked to the health of a newborn. Infections acquired by the newborn during delivery are associated with high morbidity and mortality.[1,2] Untreated infections in newborns can rapidly become severe and life-threatening. Appropriate and timely management of the mother diagnosed with infection may prevent infection of the foetus and neonate. Congenital infections like syphilis are preventable and should not be occurring in a situation where there are simple, accurate, inexpensive and rapid screening tests and highly effective inexpensive and simple treatment. Therefore, it is important that perinatal infections are diagnosed early and treated promptly.

It is important to obtain accurate information on the causes of death so that we can evaluate the interventions or health programs that are in place. To evaluate the impact of infection on neonatal deaths, neonatal mortality rates need to be reviewed at regular intervals. The immediate direct medical causes of neonatal deaths related to infections include sepsis, pneumonia and meningitis. However, there are indirect causes of neonatal deaths due to infections[3]. These non-medical causes could either be health system related or patient related. These contributory causes include inadequate access to medical care or lack of medical supplies, inappropriate management of labour and delivery, and inability to recognize danger signs of infection in the newborn. The aim of this survey was to determine perinatal deaths related to infections and to evaluate factors associated with these deaths.

Methods

Data from the PPIP users throughout the country were amalgamated using the PPIP v2 programme. In each case, the primary obstetric cause (i.e. the event that initiated the process that resulted in the death of the fetus or neonate) and if the infant was born alive a final neonatal cause of deaths was allocated. Each case was analysed with respect to avoidable factors, missed opportunities and substandard care. Factors related to the patient and her environment, administrative and health worker related factors were assessed. Overall 52 infants were misclassified as being both an intrauterine death and neonatal death. These deaths have been excluded from the analysis of neonatal deaths.

Results

There were 642 neonatal deaths (1.41/1000 live births) due to infections among births weighing >999g in the hospitals that were surveyed across the country. The common primary obstetric causes that were associated with these deaths were maternal infections and spontaneous preterm labour in all hospitals (Table 11.1).

The most common primary obstetric cause was spontaneous preterm labour in metropolitan hospitals (35.2%) whereas maternal infection was the most common cause in town and city (31.5%), and rural hospitals (32.5%). Most of the neonatal deaths occurred within the first week of life suggesting maternal acquisition or early acquisition of infection within the neonatal unit (Table 11.2). There were fewer late neonatal deaths in the rural hospitals at 13% compared to 33% and 28% respectively in metropolitan, and city and town hospitals.

In more than 60% of deaths due to infection, septicaemia and pneumonia were the immediate medical causes (Table 11.3). Less than 5% of neonatal deaths in city and town, and rural areas were documented to be due to nosocomial sepsis compared to 23% in metropolitan areas. Congenital syphilis was the cause of death in 6-9% of all deaths due to infection. Surprisingly human immunodeficiency virus was documented as the cause of death in about 18% of neonatal deaths in city and town hospitals.

The categories of avoidable factors, missed opportunities and substandard care for neonatal infection are shown in Table 11.4. About a third of avoidable factors were classified as probable that means 1 in 3 deaths due to infection could be prevented. The distribution of probable avoidable factors varied according to different areas, the common one being administrative related in metropolitan areas, patient related in city and town hospitals and health worker related in rural hospitals. The common probable avoidable factors related to the health system were: inadequate neonatal facilities and neonatal care; inadequate screening and management of syphilis during pregnancy; lack of transport and insufficient medical and nursing staff available to manage patients (Table 11.5). Lack or delay in antenatal care, delay in seeking medical assistance during labour or when baby is ill are the common patient related probable avoidable factors. The top eight probable avoidable factors according to different group of hospitals are listed in Table 11.6. Inadequate neonatal care and patients not seeking medical care antenatally were the top two avoidable factors in all groups of hospitals. Inadequate screening and management of syphilis also featured high in the list of avoidable factors. In city and town, and rural areas the top eight avoidable factors showed that the staff that was available to manage patients, was assessed not to be sufficiently trained whereas in metropolitan the staff was assessed not to be adequate.

Table 11.1a. Primary obstetric causes of perinatal deaths due to infection in the sub-categories in South Africa

	Number	%	Rate/ 1000 live births
Infection	221	34.5	0.49
Spontaneous preterm labour	212	33.0	0.47
Antepartum haemorrhage	50	7.7	0.11
Hypertensive disorders	41	6.5	0.09
Intrapartum asphyxia	34	5.3	0.07
Intrauterine growth retardation	20	3.1	0.04
Intrauterine death	13	2.1	0.03
Fetal abnormalities	12	1.9	0.03
Maternal disease	12	1.9	0.03
Trauma	3	0.5	0.01
Other	2	0.4	0.01
Obstetric causes	22	3.4	0.05
TOTAL	642	100.0	1.41

Table 11.1b. Primary obstetric causes of perinatal deaths due to infection in the sub-categories in different areas

	Metropolitan	City and Town	Rural
Infection	22.9	41.7	41.8
Spontaneous preterm labour	35.2	31.5	32
Antepartum haemorrhage	14.3	3.4	3.9
Hypertensive disorders	10.3	5.3	1.3
Intrapartum asphyxia	5.3	4.7	6.5
Intrauterine growth retardation	4.7	1.6	3.3
Intrauterine death	1.7	3.4	0
Fetal abnormalities	1.7	2.5	1.3
Maternal disease	1.7	2.2	2
Birth Trauma	0	0.9	0.7
Other	0	0.3	1.3
Obstetric causes	3.0	2.5	5.9

Table 11.2. Timing of deaths due to infection

	Number	%	Rate/1000 live births
SOUTH AFRICA (454639 live births)			
Early Neonatal Death	431	67.1	0.95
Late Neonatal Death	211	32.9	0.46
METROPOLITAN (200736 live births)			
Early Neonatal Deaths	175	63.6	0.87
Late Neonatal Deaths	100	36.4	0.50
TOWN AND CITY (147559 live births)			
Early Neonatal Deaths	163	64.2	1.10
Late Neonatal Deaths	91	35.8	0.62
RURAL (106342 live births)			
Early Neonatal Deaths	93	82.3	0.87
Late Neonatal Deaths	20	17.7	0.19

Table 11.3a. Final neonatal causes of deaths for perinatal infection in South Africa

SOUTH AFRICA (454639 live births)	Number	%	Rate/1000
Septicaemia (including GBS)	294	45.8	0.65
Pneumonia	111	17.3	0.24
Nosocomial infection (including meningitis)	78	12.1	0.17
HIV infection	49	7.6	0.11
Congenital syphilis	48	7.5	0.10
Congenital infection	25	3.9	0.05
Other/Unclassified	37	5.8	0.08

Table 11.3b. Final neonatal causes of deaths for perinatal infection in different areas

	Metropolitan		City & Town		Rural	
	%	Rate/ 1000	%	Rate/ 1000	%	Rate/ 1000
Septicaemia (including GBS)	49.5	0.67	44.3	0.71	53.0	0.50
Pneumonia	15.8	0.21	18.3	0.29	25.0	0.23
Nosocomial infection (including meningitis)	23.4	0.32	2.1	0.03	1.0	0.01
HIV infection	2.2	0.03	17.9	0.29	1.0	0.01
Congenital syphilis	6.2	0.08	8.5	0.14	9.0	0.08
Congenital infection	2.9	0.04	5.1	0.08	5.0	0.05
Other	-	-	0.4	0.01	6.0	0.06

Table 11.4. All and probable avoidable factors, missed opportunities and substandard care for perinatal infection.

	Metropolitan		City and Town		Rural	
	All % of deaths	Prob. % of deaths	All % of deaths	Prob. % of deaths	All % of deaths	Prob. % of deaths
Health worker related	19.5	5.9	19.0	8.1	24.2	13.1
Administrative related	19.5	7.3	11.8	4.4	25.5	9.8
Patient related	35.0	6.6	33.0	8.7	38.6	12.4
Insufficient information	5.9	1.0	7.2	0.3	7.2	0.7

Table 11.5. Probable avoidable factors, missed opportunities and substandard care for neonatal infection

Probable Avoidable Factors	Infection	Percentage of deaths
Health Worker Related	64	10.0
Neonatal care: Management plan inadequate	21	3.3
Neonatal care: inadequate monitoring	9	1.4
No response to positive syphilis serology test	5	0.8
Delay in calling for assistance	4	0.6
Delay in referring patient for 2nd or 3rd level of care	2	0.3
Neonatal resuscitation inadequate	2	0.3
Delay in doctor responding to call	2	0.3
Obstetric related: antenatal	11	1.7
Obstetric related: intrapartum	8	1.2
Administrative problems	53	8.3
Inadequate facilities/ equipment in neonatal unit	11	1.7
No syphilis screening performed at hospital or clinic	9	1.4
Lack of transport	8	1.2
Insufficient doctors available to manage the patient	4	0.6
Insufficient nurses on duty to manage the patient	4	0.6
Personnel insufficiently trained to manage patient	4	0.6
No accessible neonatal ICU bed with ventilator	3	0.5
Other	3	0.5
Patient related	69	10.7
Never initiated antenatal care	30	4.7
Delay in seeking medical attention during labour	13	2.0
Booked late in pregnancy	11	1.7
Inappropriate response to ruptured membranes	3	0.5
Attempted termination of pregnancy	2	0.3
Delay in seeking help when baby ill	2	0.3
Infrequent visits to antenatal clinic	3	0.5
Inappropriate response to antepartum haemorrhage	1	0.2
Inappropriate response to poor fetal movements	1	0.2
Other	3	0.5
Insufficient notes to comment on factors	5	0.8

Table 11.6. Top 8 probable avoidable factors in contributing to deaths due to infection in each hospital group.

Metropolitan
1. Never initiated antenatal care or booked late in pregnancy
2. Neonatal care inadequate
3. Insufficient doctors or nurses to manage the patient
4. Lack of transport
5. Syphilis screening and management inadequate
6. Inadequate facilities/ equipment in neonatal units
7. Delay in seeking medical help during labour or when baby ill
8. Delay in medical personnel calling for expert assistance

City and Town
1. Never initiated antenatal care or booked late in pregnancy
2. Neonatal care inadequate
3. Delay in seeking medical help during labour or when baby ill
4. Syphilis screening and management inadequate
5. Delay in referring or calling for expert assistance
6. Inadequate resuscitation equipment
7. Personnel not sufficiently trained to manage patient
8. Delay in doctor responding to call

Rural
1. Neonatal care inadequate
2. Never initiated antenatal care or booked late in pregnancy
3. Syphilis screening and management inadequate
4. Inadequate facilities/ equipment in neonatal units/ nursery
5. No accessible neonatal ICU bed with ventilator
6. Delay in seeking medical help during labour or when baby ill
7. Lack of transport
8. Personnel not sufficiently trained to manage patient

Discussion

In this report, maternal infection and spontaneous preterm labour were the most common primary obstetric causes of perinatal deaths due to infection. Infectious diseases, birth asphyxia and prematurity are major causes of death during the neonatal period[4]. Preterm deliveries often result from preterm premature rupture of membranes (PPROM). It has been shown that PPROM affects 32 to 40% of preterm deliveries, with 60 to 80% of these patients having spontaneous labour within 48 hours[5,6]. Rupture of membranes allows for ascending infection leading to chorioamnionitis and fetal infection by ingestion or aspiration of infected amniotic fluid or haematogenous spread. Prolonged rupture of membranes is associated with increased risk of perinatal infections. Subclinical infection may be present before PPROM and may actually be the cause of PPROM. Therefore separation of maternal intrauterine infection and spontaneous preterm labour as different entities causing neonatal deaths due to infection may be difficult. Prophylactic use of antibiotics has been shown to reduce the risk of chorioamnionitis and neonatal sepsis[7,8]. Therefore early detection of PPROM or

preterm labour and diagnosis of possible chorioamnionitis might help in reducing deaths related to infection.

Deaths associated with spontaneous preterm labour may not only be related to PPROM and infection but also to low gestational age at delivery. Infants at lower gestational age tend to stay longer in hospital and are, therefore, at risk of nosocomial sepsis. Nosocomial or hospital acquired infection is often associated with overcrowding, understaffing and lack of proper hand hygiene. The low rates of nosocomial sepsis observed in the rural, and city and town hospitals could either be explained by fewer premature infants surviving, observation of good infection control measures, or misclassification of infants with nosocomial infection. Both septicaemia and pneumonia can be nosocomial or intrapartum acquired infections, therefore it is possible that some deaths due to nosocomial infection were classified under these causes. Low rates of nosocomial infection and fewer premature infants surviving can explain the relatively low rates of late neonatal deaths in rural areas.

About eighteen percent of deaths in city and town hospitals were recorded to be due to human immunodeficiency virus (HIV). It is not clear how this diagnosis was made. The definite diagnosis of HIV infection in neonates is made using PCR or viral load and these were not readily available at the time of this perinatal survey, therefore this makes one doubt the accuracy of this diagnosis in this report. This most likely reflects deaths among births that were HIV exposed rather than HIV infected. This highlights the need of using clear definitions of medical neonatal conditions that are recorded as final causes of death for the future surveys. Congenital syphilis was a cause of death in 6-9% of neonatal deaths. This is of major concern as diagnosis and treatment of the mother to prevent congenital syphilis should be easily achievable. Probable factors that might have caused this high percentage of deaths due to syphilis have actually been identified within the health system.

Approximately a third of avoidable factors, missed opportunities and substandard care for neonatal infection were assessed as probable, meaning that 1 in 3 of deaths due to perinatal infections could be prevented. The distribution of categories of probable avoidable factors varied with the group of hospitals. This variation can possibly be explained by presence of more than one avoidable factor for each death. Therefore the allocation of which is the primary avoidable factor might be biased by the attitude of an individual doing the entry. Overall 58–60% and 32–40% of probable avoidable factors were health system and patient related respectively. Inadequate neonatal care has featured prominently among the avoidable factors that contributed to these deaths irrespective of the type of hospital. This means more attention is required in improving facilities, equipment and setting up protocols in management of the newborn especially the low birth weight infants who are at risk of developing infection. Basic interventions like breastfeeding and kangaroo mother care have been shown to significantly reduce

neonatal infections[9,10]. These interventions are less expensive and can easily be achieved in any part of the country. The inadequate screening and management of syphilis also requires urgent attention. Though booking late in pregnancy and non-initiation of antenatal care might be contributing to high number of deaths due to congenital syphilis, the health system is failing patients who have attended clinics or hospital and were not offered screening, testing and treatment for syphilis. Both health workers and hospital administrators need to make sure that basic facilities required for managing women during pregnancy and labour are available.

Conclusions

This report has shown that infections are major contributors to neonatal deaths. The deaths due to perinatal infections can be substantially reduced by simple known interventions during pregnancy, labour and delivery and in the early days of life. Obtaining information on the causes of death related to infection is important for health care workers, government, and communities so that current strategies can be enforced or new strategies or interventions can be put in place to reduce these deaths.

References

1. Dommisse J. The causes of perinatal deaths in the Greater Cape Town area: A 12 month survey. S Afr Med J 1991; 80; 270-5
2. Singh M. Hospital-based data on perinatal and neonatal mortality in India. Indian Pediatr 1986: 23; 579-84
3. Stoll BJ. The global impact of neonatal infection. Clin Perinatol 1997:24;1-21
4. Ravikumara M, Bhat BV. Early neonatal mortality in an intramural birth cohort at a tertiary care hospital. Indian J Pediatr 1996: 63: 785-9
5. Arias F, Tomich P. Etiology and outcome of low birth weight and preterm infants. Obstet Gynecol 1982; 60: 277-81
6. Mercer BM, Goldenberg RL, Meis PJ, et al. The Preterm Prediction Study. Prediction of preterm premature rupture of membranes through clinical findings and ancillary testing. Am J Obstet Gynecol 2000; 183: 738-45
7. Mercer BM, Miodovnik M, Thurnau GR, et al. Antibiotic therapy for reduction of infant morbidity after preterm premature rupture of the membranes: A randomized controlled trial. JAMA 1997; 278: 989-995
8. Mercer BM. Antibiotic therapy for preterm premature rupture of membranes. Clin Obstet Gynecol 1998; 41: 461-468
9. Kirsten GF, Bergman NJ, Hann FM. Kangaroo mother care in the nursery. Pediatr Clin North Am 2001; 48: 443-452
10. Schanler RJ, Hurst NM, Lau C. The use of human milk and breastfeeding in premature infants. Clin Perinatol 1999; 26: 379-398

Chapter 12
Provincial Reports

The use of PPIP has expanded over the past year, but the data from the minimum perinatal data set has not been as successful.

Table 1. Comparison of the provincial perinatal care indices

Province	Minimum Perinatal Data Set			
	Deliveries	PNMR >1000g	LBWR	PCI
Eastern Cape[#]				
Free State	45 978	46.1	15.5%	3.0
Gauteng	100 955	30.7	18.0%	1.7
KwaZulu-Natal[*]	67 554	49.6	*7.8%*	-
Limpopo[**]	97 408	28.8	12.3%	2.3
Mpumalanga[**]	26 617	34.3	15.3%	2.3
North West	57 056	41.1	11.8%	3.5
Northern Cape	11 130	30.0	22.8%	1.3
Western Cape	72 993	19.0	16.9%	1.8

[#] - No report received at the time of going to press
[*] - Six months data from 48 hospitals, uncertain if babies 500-999g have been included, LBWR is for babies <2kg, PCI cannot be calculated.
[**] - Data from PPIP sites only

There is considerable variation in the quality and presumed accuracy of the data between the provinces and in-depth comparison between provinces is not possible. A number of provinces commented on the lack of accuracy of their data sets. The understanding of the importance of accurate data on which to plan has not yet penetrated all levels of the health system. Perhaps this is the most important aspect that needs changing amongst the administrative staff. It is very disappointing that given the level of development and sophistication of South Africa, the number of births and perinatal deaths in health institutions within the country is not known.

Free State Report

The Perinatal Data presented in this report is data collected from all the 30 Free State Provincial Hospitals, (25 District Hospitals, 4 Regional Hospitals and one Tertiary Hospital), and Community Health Centres (CHC) via the intra-net database, and is stratified per Health District (5 in the Free State). This data is "passively collected" data on a monthly basis with regular maintenance and occasional spot-checks performed. Data from the Community Health Centres was collected via the Primary Health Care (PHC) basic data set. Data from the private health facilities in the Free State has once again not been included in this report. The data presented in this report is that collected for the period 1st October 2002 to 30th September 2003.

Of the 46039 births registered in these public facilities over this period; 7663 (16.6%) were from CHC's; 26214 (57.0%) were from level one hospital; 11515 (25.0%) from level two hospitals and 647 (1.4%) from the tertiary hospital.

Perinatal Data: Free State Province; Per district; October 2002 to September 2003

	Births	C/S %	Ass Del %	PNM	NND	LBW %	Teen Preg. %	PCI
Free State	***45978***	***15.5***	***2.1***	***46.1***	***13.0***	***15.5***	***22***	***2.97***
DC 16 Xhariep	1604	1.1	0.8	35.4	12.5	10.6	31	3.34
DC 17 Motheo	13162	21.6	3.5	45.9	12.9	16.4	21	2.8
DC 18 Lejweleputswa	10535	12.3	1.0	55.1	15.1	15.5	20	3.55
DC 19 Thabo Mofutsanyane	12785	13.4	0.7	42.7	12.7	15.1	25	2.83
DC 20 Northern Free State	7892	16.4	3.8	41.7	10.9	15.6	20	2.67

Compared to the previous reported period, there has not been an increase in absolute numbers of deliveries in the Free State province. This means that not only the rate of growth of the deliveries has slowed down, but that for the first time since measured the absolute number of deliveries in the public institutions in the Free State are leveling out. In the Free State the low-birth-weight rate has decreased significantly in the latest period measured. This has occurred in all the regions, without any known change in the measurement process. This in turn has increased (worsened) all the Perinatal Care Indices (PCI) for the Free State districts this time round.

The high caesarean section rate and slightly higher PNMR in the Motheo district is reflected again and explained by the fact that two hospitals in this

district act as referral hospitals, and that the majority of patients in the Xhariep district (DC 16) needing caesarian sections are referred to Motheo district. This, in turn explains the low caesarean section rate in Xhariep (1.1%). The percentage of mothers delivering, being under the age of 20 yrs has increased to disturbingly high rates of 22% for the province, with Xhariep region being alarmingly high at 31%.

For the entire Free State province the PMNR and NNDR have increased slightly with this measurement. This may be in part explained by the increased awareness that the saving babies report has created, but also seems to be linked with the fact that the "denominators" have not increased along with the numerators this year. Region DC 18 has a much higher PNMR and NNDR in this measurement as compared to the other regions and the previously reported period. In general the PNMR is still high compared with other provinces in the country for the same period.

PPIP sites

During the period of reporting, seven additional PPIP sites have been established in the Southern Free State. The level one hospitals of the DC 16 Xhariep and DC 17 Motheo have been analyzed according to the PPIP format for the period January 2003 to November 2003. This exercise has shown very well the effect the CHC in the Botchabelo district have on the peri-natal statistics and how the hospital if seen in isolation seems to have poor indicators, yet when viewed with the entire district served, the indicators of the district, fall into acceptable ranges.

For the Motheo District level one hospitals (four and their CHC) the obstetrical cause of peri-natal deaths was ranked as follows: Intrauterine deaths (27%); Intrapartum asphyxia (23%); Spontanous preterm labour (14%); Antepartum haemorrage (11%); Hypertensive disorders (9%); No obstetric cause (6%); and fetal abnormality (5%).

The main causes of neonatal deaths included: Immaturity related (38%); Hypoxia (32%); Congenital abnormality (8%) and Infection (5%). (Unfortunately some of the statistics of the Community Health Centers in Mangaung have not yet been included in the above analysis.)

In analysing the avoidable factors that probably have lead to the deaths in this district, the blame for 19% of the deaths could be contributed to substandard care by the health team. Only 12 % were though to have been caused by administrative problems, mainly lack of facilities for caring for the premature. Only 6 percent were assessed to be patient related reasons.

For the Xhariep District level one hospitals (three) the causes of peri-natal deaths were ranked as follows: Spontaneous preterm labour (33%); Intrauterine death (21%); Intrapartum asphyxia (18%); Hypertensive disorders (6%); fetal abnormalities (6%) and delivery trauma (6%).

The main causes of neonatal deaths included: Immaturity related (54%); Hyphoxia (36%) and congenital abnormalities (9%). If analysing the avoidable factors contributing to the deaths, improvement of neonatal care facilities for the premature infant in this district would impact perinatal mortality significantly by reducing these avoidable deaths. The improved observation of patients in labour with the follow through of the correct management in the case of fetal distress and delay in labour would also reduce the main causes for perinatal loses in this district.

During this period of reporting not much improvement in the perinatal indicators in the Free State health districts have been shown, esp. if compared to those measured during the pervious period. This can mainly be ascribed to the fact that the number of deliveries has not increased, yet the number of perinatal deaths has stayed similar. The low birth weight rate has decreased much with a concomitant increase in the PCI for the reported period. The calculated perinatal mortality rate is regarded as “high” for the current South African context.

Gauteng Province

Total Provincial Data (Minimum data set – approximately 20 000 births not submitted)

Weight Category (g)	Stillborn	Neonatal death	Alive on discharge	Total
500 – 999	916	401	306	1623
1000 – 1499	565	323	1190	2078
1500 – 1999	511	189	3294	3994
2000 – 2499	389	161	9841	10391
2500 +	621	289	81959	82869
TOTAL	3002	1363	97317	100955

Provincial Indices (>1000g)

SB Rate: 21/1000 NNDR: 9.7/1000 PNMR: 30.7/1000
LBWR: 18% PCI: 1.7 SB:NND: 2.2
C/s rate: 17.7% Assisted delivery rate: 2%
Proportion teenage pregnancies: 6%
Syphilis prevalence: 4%
Maternal mortality rate: 138/100 000
Proportion of women who attended antenatal care: 94%

Perinatal Indices per District (1000g+)

District	PNMR	NNDR	LBWR	PCI	SB:NND Ratio
Central Johannesburg	24	6	18	1.3	3.0:1
Tshwane	28	12	20	2.1	1.4:1
Sedibeng	38	11	18	2.1	2.6:1
West Rand	39	11	17	2.2	1.8:1
Province	30.7	9.7	18	1.7	2.2

PPIP Sites: Kalafong, Pretoria Academic, George Mukhari, Johannesburg Hospital, Coronation, Dr Yusuf Dadoo, Leratong, Sebokeng, Heidelberg, Tambo Memorial, Far East Rand, Tembisa, Edenvale

Amalgamated PPIP site Data 2003 (>1000g)

Primary Obstetric causes of death

1. Spontaneous Preterm Labour 23,9%
2. Intrauterine Death (Unexplained) 20,3%
3. Antepartum haemorrhage 14,4%
4. Hypertensive disorders 12,7%
5. Intrapartum asphyxia 10,6%

Final causes of neonatal death

1. Hypoxia 31,5%
2. Immaturity related 28,1%

3. Infection	19,2%

Avoidable factors	**%**
Patient related	59,0
Administrative	11,1
Health worker related	22,3
Missing files	7,6

Top 5 Individual Items in the Avoidable Factors

1. Never initiated antenatal care	19%
2. Inappropriate response to poor foetal movement	14,7%
3. Booked late in pregnancy	10,6%
4. Delay in seeking medical attention during labour	5,4%
5. Infrequent visits to antenatal care	3,5%

Comments on problems related to data collection

Delay of institutions submitting data to the provincial office.
Data submitted often incomplete.

Future Plans:

1. The quality of Antenatal care will be audited and quality improvement measures implemented.
2. Transport between institutions to be improved
3. An on-site in service training programme for medical and nursing staff to be implemented
4. Quality of Intra partum care at 1st and 2nd level institutions to be improved.
5. Kangaroo Mother Care units to be increased with 4 units.
6. Neonatal resuscitation training done in all hospitals.
7. Implementation of an Obstetric Flying Squad will be investigated.
8. A Peri-partum Unit will be established at the Provincial Office.

KwaZulu Natal

Total Provincial Data

Weight Category (g)	Stillborn	Neonatal death		Alive on discharge	Total
		Early	Late		
500 – 999	245	138	15	183	581
1000 – 1499	190	174	36	478	878
1500 – 1999	168	87	18	1191	1464
2000 – 2499	157	63	8	3851	4079
2500 +	305	188	10	38995	39498
TOTAL	1065	650	87	44698	46500

Provincial Data (>1000g)

SB Rate: 2.3% NNDR: 12.9/1000 PNMR: 30.6/1000
LBWR: 15.1% PCI: 2.00 SB:NND: 1.4:1
C/S rate: 24.4% Assisted delivery rate: 1.6%
Proportion teenage pregnancies: 22%
Syphilis prevalence: 1.8%
Maternal mortality rate: Not available (146/100,000 but not all units had data on PPIP)
Proportion of women who attended antenatal care: (52.6% - not all units had data)

Perinatal Indices per PPIP site (1000g+)

	Deliveries	PNMR	NNDR	LBWR	PCI	SB:NND Ratio
Addington	6352	8	5	12.6	0.63	0.6:1
Christ the King	1627*	49	22	11.5	4.24	1.3:1
Empangeni	9696	42	15	17.6	2.40	1.7:1
Eshowe	2968	29	10	11.2	2.60	1.3:1
Ladysmith	5717	49	23	14.7	3.31	1.4:1
Mahatma Gandhi	6764	39	19	16.9	2.29	1.2:1
Mosvold	1581**	25	12	10.3	2.40	1.1:1
Mseleni	1375	21	7	14.0	1.48	2.0:1
Port Shepstone	1179***	39	15	14.6	2.65	1.5:1
Prince Mshiyeni	8114*	15	5	16.1	0.91	2.0:1
St. Apollinaris	1125*	26	8	14.1	1.83	2.0:1

* 9 months data, ** 11 months data, *** 3 months data

Amalgamated PPIP Perinatal Data (>1000g)

Primary Obstetric causes of death:

1. Spontaneous preterm labour 17.6%
2. Intra-uterine death (Unexplained) 16.2%
3. Intrapartum asphyxia 15.3%
4. Antepartum Haemorrhage 15.1%
5. Hypertensive disease 12.7%

Final causes of neonatal death:

1.	Immaturity related	34.3%
2.	Hypoxia	28.0%
3.	Infections	21.2%

Avoidable factors	**All %**	**Probable %**
Patient related	42.2%	8.3%
Administrative	15.6%	5.9%
Health worker related	37.2%	22.2%
Missing files	5.1%	0.1%

Top 5 Individual Items in the Avoidable Factors

1.	Never initiated antenatal care	139	12.2%
2.	Delay seeking attention in labour	84	7.3%
3.	Booked late in pregnancy	76	6.6%
4.	Inappropriate response to poor fetal movements	69	5.9%
5.	No response to maternal hypertension	66	5.8%

Discussion

Data presented in this report covers the period 01 April – 30 September 2003. Data from the clinics are not included. Health Informatics Unit provided data collected from all Hospitals for the period April – October 2003. In the meantime, MCWH sub directorate conducted a survey and requested specific data elements for period 01 April – 30 September 2003 from all hospitals providing maternity care. Forty-eight (48) institutions responded. Some data elements presented by the institutions did not tally with those on data captured by Health Informatics for the same period. For instance according to Health Informatics report, there were 52689 women who delivered during April – September 2003 whereas according to the MCWH survey a total of 67554 women delivered in 48 hospitals at the same period.

There are concerns regarding reliability of these statistics especially in view of the variations in data collected from the same facilities. Until such time that the data have been verified and found to be accurate, it is difficult to work out indicators.

The following table (Table 1) presents data obtained directly from the 48 facilities that submitted their data as requested by MCWH.

It is not clear why the number of deliveries (67554) over a period of 6 months as indicated in the MCHW data should be more than number of deliveries (62030) over a period of 7 months as shown in the Health Informatics report. There were fewer early neonatal deaths in the Health Informatics report than in MCWH data.

Table 1. Deliveries collected by MCWH

MCWH Maternity Survey (48 Hospitals: Period: April – September 2003	
Total deliveries	67554
Total C/section	16734
Live births	65175
Fresh stillbirths	979
Macerated stillbirths	1400
ENND	970
Total Deaths	3349
LBW<2kg	5258
Maternal deaths (Notified)	109
No of 1st antenatal visits at <20 weeks gestation	14280
No of 1st antenatal visits at >34 weeks gestation	25921
No of unbooked women	2237

PPIP Sentinel sites in KZN 2000-2003

Implementation of PPIP is slow and inconsistent in KZN. Of the 6 sites that started implementing PPIP in 2000, only 3 have continued to use PPIP. In 2001, Ladysmith hospital commenced PPIP and was followed by Eshowe and Mahatma Ghandi Hospitals in 2002. The rest of the institutions have been using PPIP on and off and as a result have not been able to present complete year data. However, this year shows the greatest number of hospital returns to date, with eleven sites submitting data.

Comments on problems related to data collection

Some of the hospitals are not collecting data because the rapid medical and nursing staff turnover. Computer users in some cases are not familiar enough with file management to send data to central collection point. Data arrived in three cases after the Provincial Meeting, and was amalgamated later. In Pietermaritzburg, someone is required to take on the responsibility of ensuring collecting and entering of data. Paediatric data had been collected, but not obstetric. Somehow also there is a need for someone to do the same for King Edward VIII, & RK Khan. The Addington data and the Prince Mshiyeni data both suffer from not having one individual "obstetrician" overseeing the coding which has resulted in some degree of unreliability.

The above data are not for a complete year as some units only started collecting in the last few months. This doesn't invalidate the data but no

comparisons can be made with last year, as units submitting are not the same – Itshelejuba and Grey's dropped out while Port Shepstone, St Apollinaris, Mosvold, Prince Mshiyeni and Christ the King have come in.

The Provincial data seems to be affected adversely by being accepted uncritically by Informatics, from sources within the hospitals and clinics or at District Level, without any recognition that glaring discrepancies are being passed on. The tools used to collect the data need to be reviewed to identify points where errors are occurring. The data collection process should be expanded to include all clinics. The Monthly report (Minimum Dataset) seems to be poorly understood by those providing the figures, and there is room for consideration to be given to redesigning the data collection form. MC&WH and Health Informatics will need to work together to achieve accurate MDS data for all institutions in the Province.

Table 2: Implementation of PPIP in KZN 2000-2003

Area	Year 2000	Year 2001	Year 2002	Year 2003
Metro	Addington Hospital King Edward VIII Hospital (KEH)	Addington Hospital KEH	Addington Hospital KEH Mahatma Ghandi Hospital (MGH) Greys	Addington Hospital - MGH - Prince Mshiyeni Hospital
City & Town	Lower Umfolozi District War Memorial (LUDWM)	LUDWM Madadeni Hosp Ladysmith	LUDWM - Ladysmith Eshowe	LUDWM - Ladysmith Eshowe Port Shepstone
Rural	Mseleni Bethesda Manguzi Hospital Mosvold Hospital	- - - -	Mseleni - - - Itshelejuba	Mseleni - - Mosvold Hospital - Christ the King Hospital St Appolinaris Hospital
Total	7	5	9	12

Limpopo Province

Introduction

Limpopo Province has a surface area of 123 000 Km², which is the 10% of South Africa's land area. It's population of just above 5,5 million, constitutes 12,8% of South Africa's population. It is mainly a rural province. Women of reproductive age are estimated above 1,4 million.

The province is divided into six districts, which are further divided into sub district. There are 35 level I hospitals (Sub district Hospitals), 7 level II hospitals (District Hospitals) and one level III hospital, the Polokwane-Mankweng Complex. Each district has at least one level II hospital. Private institutions are not included. Each sub district has numerous local clinics where nearly 1/3 of total deliveries occur. The estimate home delivery is 19%.

Limpopo Province has been understaffed, mostly doctors in general and Obstetricians and Paediatricians in particular. This situation has worsened since 2002.

PPIP usage

Provincial MCWH coordinates PPIP. District coordinators meet on a monthly basis where all aspects of PPIP are discussed. PPIP sites were expanded to cover almost all hospitals, although just a few hospitals are using computers, manual data is collected and sent to district coordinators whom then enter data into computer program. The lack of personnel, in general, and PPIP trained, in particular, leads to inconsistency in reporting on time and sources and poor quality of data collection and analysis. Exodus of doctors including those trained in PPIP causes instability. Most of those doctors were using their personal computers, as poor accessibility to computers at institutions remains a general problem. Commitment still cited as a problem.

PPIP sites and data collection

38 hospitals out of 43 are currently PPIP users. Only 7 use computers. One has upgraded to PPIP version 2. Data collected are institutional only. The data used in this provincial report was collected from 24 PPIP sites, as the data for the remaining 14 was inconsistent and unreliable.

Four hospitals are level II, 17 hospitals are level I, and one level III institution, being the Polokwane-Mankweng Complex, although only

Mankweng submitted reliable data. Data from two Midwife Obstetric Unit was included. Five hospitals are classified as City and Towns: Mesina, Louis Trichardt, Ellisras and Thabazimbi (level I hospitals) and Warmbaths (level II). The rest are rural hospitals.

Data analysis

Total deliveries data according to weight categories:

Weight Categories	Stillborn	Neonatal Death	Alive on discharge	Total
500-999g	222	171	252	645
1000-1499g	352	326	584	1262
1500-1999g	347	198	1839	2384
2000-2499g	295	108	7259	7662
2500+g	755	460	84240	85455
Total	1971	1263	94174	97408

Other indicators for all deliveries including <1000g:

C/S Rate: 13.4%
Assisted deliveries rate: 3.3%
LBWR: 12.3%
PCI: 2.30
SB/NND ratio: 1.6:1
BBA: 2.4%
Attended antenatal care: 89.5%
Teenage Pregnancies: 22.3%

Provincial Perinatal Care Indices according to weight categories per 1000 births:

Weight category	PNMR	NNDR	ENNDR	FD Ratio	FD Rate
All	32.5	13.2	12.6	20.7	20.2
All > 1000g	28.8	11.5	10.9	18.4	18.1
500 - 999g	600	404.3	390.1	524.8	344.2
1000 - 1499g	520.6	358.2	335.2	386.8	278.9
1500 - 1999g	224.4	97.2	92.3	170.3	145.6
2000 - 2499g	51.8	14.7	13.8	40	38.5
2500g+	14	5.4	5.2	8.9	8.8

Primary obstetric causes of perinatal deaths

Description	% Of total
Intrauterine death (Unexplained)	30.2
Intrapartum asphyxia	22.8
Spontaneous preterm labour	18.2
Hypertensive disorders	6.6
Antepartum haemorrhage	6.5
Fetal abnormality	4.8
Infections	3.9
Trauma	2.4
Maternal disease	1.2
Intrauterine growth retardation	0.3

Final causes of neonatal deaths

Description	% Of total
Immaturity related	39.1
Hypoxia	37
Congenital abnormalities	8.4
Infection	7.7
Unknown cause of death	3.7
Trauma	0.8

Avoidable Factors

Avoidable factors in stillborn (>1000g)

Description	% Of total
Patient associated	43.4
Inappropriate response to poor fetal movements	15
Never initiated antenatal care	6.9
Delay in seeking medical attention during labour	6.2
Booked late in pregnancy	5.6

Administrative problems	9.1
No syphilis screening performed at hospital / clinic	2.7
Result of syphilis screening not returned to hospital/clinic	1
Lack of transport - Home to institution	0.7
Lack of transport - Institution to institution	0.6
No dedicated high risk ANC at referral hospital	0.5
Personnel not sufficiently trained to manage the patient	0.5
Medical personnel associated	20
No response to maternal hypertension	3.1
Fetal distress not detected intrapartum; fetus monitored	2.3
Delay in referring patient for secondary/tertiary treatment	1.8
Fetal distress not detected intrapartum; fetus not monitored	1.5

Avoidable factors in neonatal deaths (>1000g)	% Of total
Patient associated	28.4
Delay in seeking medical attention during labour	9.8
Never initiated antenatal care	7
Booked late in pregnancy	3.7
Inappropriate response to rupture of membranes	2.8
Administrative problems	21
Inadequate facilities/equipment in neonatal unit/nursery	8.9
Inadequate resuscitation equipment	2.2
No syphilis screening performed at hospital / clinic	1.5
Lack of transport - Home to institution	1.3
Result of syphilis screening not returned to hospital/clinic	1.1
Medical personnel associated	30.3
Fetal distress not detected intrapartum; fetus monitored	3.8
Neonatal resuscitation inadequate	2.4
Poor progress in labour, but partogram not used correctly	2.3
Fetal distress not detected intrapartum; fetus not monitored	2.2
Medical personnel underestimated fetal size	1.9
Delay in medical personnel calling for expert assistance	1.9

Future Plans

PPIP usage

1. Strengthening current PPIP sites to ensure sustainability
2. PPIP awareness campaigns
3. In-service current users and newly recruited personnel on PPIP usage
4. Improve accessibility to computers in all PPIP sites
5. Create a stable electronic PPIP data flow to a provincial coordinator
6. Upgrade all sites to PPIP version 2 to allow a more comprehensive analysis

Improving perinatal mortality

1. Promote early booking, initiating antenatal care on confirmation of pregnancy.
2. Implement syphilis serology rapid test at all levels of antenatal care
3. Use of standard management protocols in general and the use of partogram in particular in all institutions performing deliveries.
4. In-service training on neonatal care and resuscitation of newborn.
5. To implement the use of CPAP at all level two hospitals.
6. To develop and implement Referral Criteria Protocols and referral routes. Availability of transport must be addressed.
7. To implement monthly quality check of antenatal and labour records
8. Implement Kangaroo Mother Care at all levels.
9. To hold regular Perinatal Review Meetings in every institution performing deliveries.

Appendix: Total deliveries and period reported per PPIP site

Unit	Period reported	Total deliveries
Blouberg (MOU)	Jan 02-Jul 03	1116
Botlokwa	Jan 02-Dec 03	2305
Donald Fraser	Jan 02-Dec 03	4015
Elim	Jan 02-Dec 03	5859
Ellisras	Jan 02-Jul 03	1406
Groothooek	Jan 02-Dec 03	5961
Helena Franz	Jan 02-Dec 03	3628
Jane Furse	Jan 02-Jul 03	5024
Kgapane	Jan 02-Jul 03	3251
Letaba (Level II)	Jan 02-Jul 03	3549
Louis Trichardt	Jan 02-Dec 03	1771
Malamulele	Jan 02-Dec 03	5902
Mankweng (Level III)	Jan 02-Dec 03	7502
Mapulaneng (Level II)	Jan 02-Dec 03	6359
Mecklenburg	Jan 02-Jul 03	2494
Messina	Jan 02-Dec 03	1991
Sekororo	Jan 02-Jul 03	2216
Seshego	Jan 02-Dec 03	7274
Siloam	Jan 02-Dec 03	4407
Thabazimbi	Jan 02-Jun 03	1061
Tshilidzini (Level II)	Jan 02-Dec 03	9348
Tshilidzini Clin (MOU)	Jan 02-Dec 03	3639
Van Velden	Jan 02-Jun 03	1759
WF Knobel	Jan 02-Dec 03	3413
Warmbaths (Level II)	Jan 02-Jul 03	2158
Total		97408

Mpumalanga Province

Introduction

Mpumalanga Province has a population of approximately 3.2 million and is mostly rural with all the problems associated with a rural environment. In 2001, we presented 3 PPIP sites; in 2002, 10 sites and in 2003, 20 sites. The Province consists of 3 districts: Nkangala, Gert Sibande and Ehlanzeni

THE PPIP SITES FOR THE PROVINCE PER DISTRICT ARE:

NKANGALA DISTRICT:
Towns\Cities:
Hospitals: Witbank, Middelburg, Bernice Samuel (Delmas), Impungwe
Clinics: Phola, Siphosensimbi
Rural:
Hospital: Philadelphia
CHCs: Belfast, Waterval Boven

GERT SIBANDE DISTRICT:
Towns:
Hospitals: Bethal, Standerton, Piet Retief
CHC: Siyatemba
Rural:
Hospital**:** Embhuleni

EHLANZENI DISTRICT:
Towns:
Hospitals: Barberton, Rob Ferreira
Rural:
Hospitals: Matibidi, Lydenburg, Sabie, Themba

TOTAL PROVINCIAL DATA: 1 January 2003 – 31 December 2003

Total data from PPIP sites

Weight category	Stillborn	Neonatal death	Alive on discharge	TOTAL
500 – 999g	86	90	83	259
1000 – 1499g	124	86	256	466
1500 – 1999g	131	35	675	841
2000 – 2499g	119	26	2 277	2 422
> 2500g	218	94	22 317	22 629
TOTAL	**678**	**331**	**25 608**	**26 617**

PERINATAL CARE INDICES

	NKANGALA	GERT SIBANDE	EHLANZENI	PROVINCE
Total deliveries	10 673	5 137	10 807	26 617
PNMR	32/1000	54.6/1000	37.1/1000	41.2/1000
PMR>1000g	23.4/1000	45.5/1000	34/1000	34.3/1000
NNDR	9.8/1000	19.4/1000	13/1000	14/1000
NNDR>1000g	5.5/1000	15.4/1000	10.8/1000	10.5/1000
LBWR	9.9%	15.4%	12.0%	15.3%
N of c/sections	1 283 (12.0%)	551 (10.7%)	1 649 (15.3%)	3 483 (13.1%)
PCI	1.30	3.10	2.60	2.30
BBA	609	231	263	1 103

TOP 5 PRIMARY OBSTETICAL CAUSES OF DEATH >1000g

CAUSES	NR	%
1. Intrauterine death (Unexplained)	211	25.4
2. Spontaneous preterm labour	143	17.2
3. Hypertensive disorders	126	15.1
4. Intrapartum Asphyxia	118	14.2
5. Antepartum Haemorrhage	102	12.3

TOP FINAL CAUSES OF NEONATAL DEATHS >1000g	NR	%
1. Immaturity related	94	37.9
2. Hypoxia	90	36.2
3. Infection	20	8.0
4. Congenital abnormalities	20	8.0

AVOIDABLE FACTORS	NR	%
Patient-related	300	36.1
Administration-related	298	35.9
Health worker-related	83	11.4
No information\Could not be assessed	53	7.4

INDIVIDUAL AVOIDABLE FACTORS	NR	%
Patient related		
1. Never initiated antenatal care	66	22.7
2. Inappropriate response to poor fetal movements	63	21.7
3. Delay in seeking medical attention during labour	49	16.8
4. Book late in pregnancy	42	14.4
5. Infrequent visits to antenatal clinic	22	7.6
Health worker related		
1. No response to maternal hypertension	41	13.9
2. Delay in referring patient for secondary/tertiary treatment	32	10.9
3. Fetal distress not detected intrapartum: fetus monitored	28	9.5
4. Fetal distress not detected intrapartum: fetus not monitored	26	8.8
5. Delay in medical personnel calling for expert assistance	14	4.8
Administrative problems		
1. Lack of transport home to institution	19	23.2
2. Inadequate facilities/equipment in neonatal unit	16	19.5
3. No accessible neonatal ICU bed with ventilator	10	12.2
Insufficient notes to comment on		
1. File missing	23	43.4
2. Insufficient notes	21	39.6

Major problems identified

- Health workers leaving facilities for greener pastures.
- Rapid staff rotation.
- Some maternity wards do not have basic equipment e.g. HB meteres, BP machines and incubators.
- Staff shortage: doctors and nurses.
- Lack of continued professional development activities.
- Hypertensive conditions not referred in time.
- Use of Herbal medicine.
- Health education/counselling not reaching all patients.
- Unbooked and late booking of patients.
- Inadequate infrastructure.
- KMC not implemented in some institutions.
- Use of different ANC cards in the province.
- Incorrect or no use of partogram.

Solutions to these problems

- Motivation to appoint more staff in institutions.
- Appointment of coordinators at provincial office.
- Maternity staff to be kept on a permanent basis – not to be rotated frequently.
- To organize update and refresher courses for professionals.
- High-risk conditions o be detected in time and referred appropriately.
- Community awareness of the importance of early booking for ANC.
- Implementation of KMC in all institutions.
- Province to address the infrastructure deficiencies.
- Standard ANC card for the province or national.
- Ongoing training of midwives on the use of the partogram.

Future plans for the Province

1. To extend KMC to 4 new hospitals in the province.
2. To ensure that all hospitals implement PPIP and conduct Perinatal Mortality meetings.
3. In-service training of midwives on Maternity Care Guidelines especially on the use of the labour graph.
4. To update midwives working in labour wards on neonatal resuscitation.
5. Improvement of transport services between facilities.
6. To conduct provincial PPIP workshops.

North West Province

Total Provincial Data

Weight Category (g)	Stillborn	Neonatal death Early	Late	Alive on discharge	Total
500 – 999	396	296		82	478
1000 – 1499	264	175		496	760
1500 – 1999	228	105		1140	1368
2000 – 2499	216	73		3493	3709
2500 +	810	120		49931	50741
TOTAL	1914	769	128	55142	57056

Provincial Data (>1000g)

SB Rate: 26.9 % NNDR: 15/ 1000 PNMR: 41.1 / 1000
LBWR: 11.8% PCI: 3.5 SB:NND: 1.8:1
C/s rate: 9.6% (5445) Assisted delivery rate: 2.7% (1535)
Proportion teenage pregnancies: Not done
Syphilis prevalence: 20768 negative, 1361 positive, 7522 unknown status (Prevalence of those tested 6.2%)
Maternal mortality ratio: 231/100 000
Proportion of women who attended antenatal care: Not done

Perinatal Indices per site (1000g+)

Hospital	PNMR	NNDR	LBWR	PCI	SB:NND Ratio
Gelukspan	46.8	11	22.9	2.3	1.82:1
Klerksdorp	53	28	17.7	3.3	0.96:1
Mafikeng	53.9	20.7	19.7	3.5	1.69:1
Rustenburg	46.8	12	16.2	4.0	1.98:1
Thusong	39	12.8	17.0	2.9	1.67:1
Zeerust	31	19	20.5	1.8	0.57:1

Primary Obstetric causes of death

District Hospitals:

1. Spontaneous preterm labour: 38.0%
2. Intrapartum asphyxia: 30.0%
3. Intrauterine deaths (Unexplained) 18.0%
4. Infection 8.7%
5. APH, HT disorders 5.3%

Provincial Hospitals

1. Spontaneous preterm labour 35.0%
2. HT disorders: 21.5%
3. Intra artum asphyxia 20.3%
4. APH 15.5%
5. Intrauteine deaths (Unexplained) 7.7%

Final causes of neonatal death

District Hospitals

1. Immaturity 50.0%
2. IUD (misclassified) 22.0%
3. Hypoxia: 14.3%
4. Infection: 13.7%

Provincial Hospitals

1. Immaturity: 41.3%
2. Hypoxia: 34.1%
3. Infection: 24.6%

Avoidable factors	All %
Patient related	25%
Administrative	38%
Health worker related	30%
Missing files	7%

Top 5 Individual Items in the Avoidable Factors

1. Patient factors
    - Unbooked
    - Late booking
    - Delay in seeking help
2. Administrative factors
    - Transport related (from facility to facility)
    - Syphilis testing: No results mostly at clinics
    - Inadequate resuscitation equipments
3. Medical personnel
    - Intrapartum monitoring: partogram not used appropriately
    - Inadequate skilled personnel to care for neonates at risk

Comments on problems related to data collection

1. No proper coordination of PPIP in the Province e.g. supporting other facilities to start with PPIP, consolidating report from PPIP sites into a Provincial report. Program manager works alone for the whole program and that is too much for one person
2. Decline in performance of some of the PPIP sites perhaps is due to lack of support e.g. Potchefstroom, no data was submitted for the Provincial Saving Babies Summit up to date.
3. Sending data to Provincial Program Manager is still problematic
4. PPIP Sites mostly driven by Doctors and is a problem to start afresh when they leave the government
5. Midwives willing to run with PPIP but difficult due to staff shortage and lack of support from district and hospital management

6. No computers to use for PPIP (The ones available at facilities are used for DHIS and information officers are reluctant to assist with PPIP data capturing)

Future Plans:

1. Planning a workshop for Midwives on PPIP (though the Doctor who was willing to assist with workshop was appointed as a Clinical Manager and is always busy due to workload)
2. Meet with senior management to inform them on importance of PPIP and recommend for a Provincial PPIP coordinator.

Northern Cape Province

The Northern Cape has approximately 800,000 inhabitants with an estimated 20, 000 births per year. The PPIP sites include Kimberley, Kuruman, Uppington, De Aar, Springbok, Jan Kempdorp and Calvinia. Kimberley is the only level II hospital and it receives the bulk of the referrals from the entire province. The total number of deliveries for this period was 11 130. The Kimberley data include the information from the Kimberly Hospital Complex and its Community Health Centre, Galeshewe Day Hospital.

Total Provincial Data

Weight Category (g)	Stillborn	Neonatal death		Alive on discharge	Total
		Early	Late		
500 – 999					221 (2.0%)
1000 – 1499					255 (2.3%)
1500 – 1999					566 (5.1%)
2000 – 2499					1496 (13.4%)
2500 +					8592 (77.2%)
TOTAL	295	21	159	10,655	11,130

Provincial Data (>1000g:01/02 vs 02/03)

	2002	2003
Stillbirth Rate	20	19
Neonatal death Rate	10.5	11
Perinatal Mortality Rate	32	30
Low Birth Weight Rate	22%	22.8%
Perinatal care Index	1.45	1.30
Stillbirth:Neonatal Death Ratio	2.2 : 1	1.6 : 1
Caesarean Section Rate	19.6%	19,6%
Assisted delivery Rate		2.1%
Teenage pregnancies		17%
Syphilis prevalence		4.7% (In perinatal deaths)
Maternal Mortality Ratio		171
Booking Rate	90%	96.4% (43.2% unknown)

Perinatal Indices per site (1000g+)

	PNMR	NNDR	LBWR	PCI	SB:NND Ratio
Northern Cape	30	11	22.8%	1.30	1.6 : 1
Kimberley	29	9	24.6%	1.20	2.4 : 1
Kuruman	19	9	13.6%	1.38	1.5 : 1
Uppington	48	20	25.9%	1.75	1.2 : 1
De Aar	17	10	24.0%	0.70	0.6 : 1
Springbok	27	13	19.1%	1.44	1.0 : 1
Jan Kempdorp	31	11	14.7%	1.31	1.6 : 1
Calvinia	10	0	31.5%	0.33	3.0 : 0

Provincial PPIP Data (>1000g)

Primary Obstetric causes of death

1. Intrauterine death (Unexplained) 23.5%
2. Spontaneous preterm labour 20.1%
3. Antepartum haemorrhage 18.3%
4. Intrapartum asphyxia 11.8%
5. Hypertensive disorders 8.4%

Final causes of neonatal death

1. Immaturity related 40.7%
2. Hypoxia 20.3%
3. Infection 15.4%

Avoidable factors	**All %**	**Probable %**
Patient related	45.3%	13.0%
Administrative	13.2%	2.8%
Health worker related	20.1%	5.9%
Missing files	21,5%	0.0%

Top 5 Individual Items in the Avoidable Factors

1. Files missing 12.7%
2. Inappropriate response to fetal movements 10.8%
3. Never initiated antenatal care 9.9%
4. Booked late in pregnancy 9.7%
5. Delay in seeking medical attention during labour 8.0%

Comments on problems related to data collection

There are several problems related to data collection and they include, communication difficulties, timeous collection and forwarding of data, staff having difficulty with finding time to do the work, and understanding of the avoidable factors. These problems are enhanced by the lack of a fully trained, computer literate co-ordinator at the Provincial MCWH office.

Future Plans:

1. Strengthen antenatal care and encourage early booking.
2. Strengthen the use of the maternity care guidelines and proper partogram usage.
3. Improve neonatal resuscitation.
4. Broaden the use of Kangaroo mother care.
5. Develop and implement a rigorous management protocol for PMTCT.
6. Improve the referral policy and its proper usage.

West Cape Province

The Perinatal Problem Identification Programme (PPIP) is now being used in most of the Metro Region and in the Boland Overberg Region of the Province. The overall Provincial data will be presented as obtained from the Provincial health informatics department. The more detailed data will be from the PPIP sites. PPIP data from the regions where it is being used is not available from the following delivery centres:
Metro Region: False Bay Hospital, Wesfleur Hospital, Bishop Lavis MOU, Elsies River MOU and Macassar MOU.
Boland Overberg Region: Hermanus Hospital and Montagu Hospital.

Summary Statistics

PPIP sites

PNMR: 33 / 1000
PNMR (>999g): 19 / 1000
LBW Rate: 19.8%

NNMR: 11 / 1000
NNMR (>999g): 6 / 1000
PCI: 0.95

Primary Obstetric Cause of Death: Antepartum haemorrhage (24.2%), Unexplained IUD (16.2%), Spontaneous preterm labour (11.0), Intrapartum hypoxia (10.7%) and Infection (8.7%).

Final Neonatal Cause of Death: Infection (25.9%), Hypoxia (24.8%), Immaturity related (20.7%), Congenital abnormalities (15.0%).

Avoidable Factors: The commonest were related to poor attendance at antenatal clinic and delays in getting to a health facility when there was a problem.

Comments

1. The perinatal and neonatal mortality rates are relatively low
2. There are several possible reasons for this:
   - The dedication and quality of care given by the staff, particularly the midwives.
   - Ongoing education and support of staff in most areas.
   - The use of patient management protocols.
   - The support provided at district, regional and provincial level by the personnel in the sub-directorate: Maternal, Child and Women's Health

- The support given by senior staff of the referral centers to the peripheral units.

3. The main primary obstetric causes of death where interventions could reduce the mortality are:
   - Intrapartum hypoxia
   - Intrauterine growth restriction
   - Unexplained intrauterine death
4. The main final neonatal causes of death where improvement could be achieved are:
   - Hypoxia
   - Immaturity
5. Interventions to deal with the problems in 4 and 5 will be aimed at the medical staff related avoidable factors.
6. The commonest avoidable factors are related to the patient not attending the antenatal clinic adequately

1. Provincial Birth Statistics: West Cape Province, January - December, 2002

Region	Total births	Live births	Still births	Early NND	PNMR	ENNDR	LBW	LBW rate	PCI	SB:NND
Boland - Overberg	8644	8435	209	67	31.9	7.9	1268	14.7	2.2	3.1
Cape Town Metropolitan	46186	45161	1025	295	28.6	6.5	8162	17.7	1.7	3.5
Southern Cape - Karoo	8731	8511	220	96	36.2	11.3	1488	17.0	2.1	2.3
West Coast - Winelands	9432	9221	211	58	28.5	6.3	1443	15.3	1.9	3.6
Total: West Cape Province	**72993**	**71328**	**1665**	**516**	**29.9**	**7.2**	**12361**	**16.9**	**1.8**	**3.2**

2.1.1 Birth weight and outcome

	Tertiary Hospitals			Secondary Hospitals			District Hospitals			MOUs		
	PND	Alive	Total	PND	Alive	Total	PND	Alive	Total	PND	Alive	Total
500 - 999g	307	265	572	249	175	424	50	10	60	100	24	124
1000 - 1499g	115	488	603	105	341	446	25	47	72	52	86	138
1500 - 1999g	65	1453	1518	76	727	803	16	196	212	35	267	302
2000 - 2499g	64	584	648	72	1951	2023	10	586	596	27	1381	1408
2500g +	69	6178	6247	117	14562	14679	18	2913	2931	48	15994	16042
Total	**620**	**8968**	**9588**	**619**	**17756**	**18375**	**119**	**3752**	**3871**	**262**	**17752**	**18014**

2.1.2 Hospital data

	Tertiary	Secondary	District	MOUs	All Units	Rate (%)
Caearean section	3135	5909	646	0	9690	19.4
BBA	25	183	396	1255	1859	3.7
Unbooked	699	633	259	2034	3625	7.3

	2.1.3. Perinatal Mortality Rates (per 1000 births)					2.1.4. Neonatal Death Rates (per 1000 births)				
	Tertiary	Secondary	District	MOUs	All Units	Tertiary	Secondary	District	MOUs	All units
All	65	34	31	14	33	24	10	13	5	11
All 1000g +	35	21	18	9	19	12	5	6	3	6
500 - 999g	621	587	833	806	641	229	229	483	306	251
1000 - 1499g	191	235	347	377	236	65	49	111	159	72
1500 - 1999g	43	95	75	116	68	16	20	33	26	20
2000 - 2400g	99	36	17	19	37	25	8	5	7	10
2500g +	11	8	6	3	6	4	2	1	1	6

	Tertiary	Secondary	District	MOUs	All Units
LBW rate	34.3	20	24.3	10.9	19.8
SB / NND ratio	1.8 : 1	2.5 : 1	1.4 : 1	1.7 : 1	2.0 : 1
PCI	1.02	1.03	0.75	0.82	0.95

Not all the BBA figures are included – absent data at some tertiary and secondary units.

The overall perinatal mortality rate for the Province – birth weight 500g and more – is 30 / 1000, and the neonatal mortality rate 7 / 1000. These are relatively good figures and compare favourably with the rest of South Africa, where these are approximately the rates for infants with birth weights of 1000g and more. The SB : NND ratio is also high, suggesting that neonatal care is of a good standard. The number of low birth weight infants born in the rural regions was submitted for live births only. This number is therefore less than it should be and the low birth weight rates are too low, and the PCI too high. Both the perinatal and neonatal mortality rates are highest in the tertiary hospitals and lowest in the MOUs, with the secondary and district hospitals having rates which approximate to the mean for the service. This suggests that there is a good referral system, and that generally patients are being managed at the appropriate level of care. This trend is also demonstrated in the low birth weight rates. The mortality rates are reasonably good and are better than most other areas of South Africa.

2.1.5. Primary Obstetric Cause of Death

	Tertiary		Secondary		District		MOUs		Total	
	n	%	n	%	n	%	n	%	n	%
Antepartum haemorrhage	**109**	**34.6**	**87**	**23.5**	**10**	**14.5**	15	9.3	**221**	**24.2**
Unexplained IUD	24	7.6	**80**	**21.6**	**13**	**18.8**	**31**	**19.3**	**148**	**16.2**
Spontaneous preterm labour	25	7.9	29	7.8	**15**	**21.7**	**32**	**19.9**	**101**	**11.0**
Intrapartum hypoxia	11	3.5	**51**	**13.8**	9	13	**27**	**16.8**	98	10.7
Infection	19	6	33	8.9	7	10.1	21	13	80	8.7
Intrauterine growth restriction	27	8.6	29	7.8	2	2.9	17	10.6	75	8.2
Fetal abnormality	**45**	**14.3**	18	4.9	4	5.8	4	2.5	71	7.8
Hypertension	**36**	**11.4**	24	6.5			4	2.5	66	7.2

There is a difference in the causes of death between the tertiary hospitals and the others. Antepartum haemorrhage (abruptio placentae), fetal abnormalities and hypertension are the top 3 primary obstetric causes in the tertiary hospitals. This suggests that there are appropriate referral systems in place. Antepartum haemorrhage remains a problem at all the hospitals, but unexplained IUDs, spontaneous preterm labour and intrapartum hypoxia become much more common as causes of death. It would be reasonable to expect that there could be a reduction in deaths from the last 2 of these, with appropriate interventions.

2.1.6. Neonatal Causes of Death

	Tertiary		Secondary		District		MOUs		Total	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Infection	**42**	**39.3**	14	17.5	4	19	9	15.5	69	25.9
Hypoxia	14	13.1	**29**	**36.6**	**5**	**23.8**	**18**	**31**	66	24.8
Immaturity related	13	12.1	**17**	**21.3**	**6**	**28.6**	**19**	**32.8**	55	20.7
Congenital abnormality	**23**	**21.5**	12	15	3	14.3			40	15

Infection (mainly pneumonia and septicaemia) and congenital abnormalities are the two commonest neonatal causes of death at the tertiary hospitals. It is likely that many of the deaths due to infection are occurring in the smaller infants. In all other levels of care the main causes of neonatal death are hypoxia and immaturity related. It is in these areas where an improvement in the monitoring and care of the patient could result in a lowering of the mortality rate.

2.1.7. Avoidable Factors

	Tertiary		Secondary		District		MOUs		Total	
	n	%	n	%	n	%	n	%	n	%
Patient Associated										
Booking / antenatal attendance	53	47.7	66	30.8	13	28.9	41	39.0	173	36.4
Delay in coming in labour	3	2.7	15	7.0	2	4.4	14	13.3	34	7.2
Delay in responding to fetal movements	7	6.3	19	8.9	2	4.4	9	8.6	37	7.8
Other	6	5.4	8	3.7	6	13.3	6	5.7	26	5.5
Medical Personnel Associated										
Problems in antenatal care	19	17.1	31	14.5	11	24.4	6	5.7	67	14.1
Problems in labour	5	4.5	27	12.6	3	6.7	7	6.7	42	8.8
Delays in referral	6	5.4	14	6.5	1	2.2		0.0	21	4.4
Inadequate care of the newborn	2	1.8	6	2.8			2	1.9	10	2.1
Other	4	3.6	3	1.4			2	1.9	9	1.9
Administrative Problems										
Transport	5	4.5	12	5.6	3	6.7	9	8.6	29	6.1
Personnel numbers / training			2	0.9	1	2.2		0.0	3	0.6
Blood results										
Facilities inadequate			2	0.9			4	3.8	6	1.3
Other	1	0.9	2	0.9	1	2.2		0.0	4	0.8
Inadequate notes			7	3.3	1	2.2	5	4.8	13	2.7

2.1.8. Individual Avoidable Factors

	Tertiary		Secondary		District		MOUs		Total	
	n	%	n	%	n	%	n	%	n	%
Never initiated antenatal care	21	3.4	35	5.7	1	0.8	31	11.8	97	6.0
Booked late in pregnancy	20	3.2	17	2.7	2	1.7	7	2.7	46	2.8
Inappropriate response to FM	7	1.1	19	3.1	2	1.7	9	3.4	37	2.3
Delay in coming in labour			15				14	5.3	34	2.1
Infrequent antenatal visits	12	1.9	14	2.3	1	0.8			29	1.8
Lack of transort - instit to instit			10				6	2.3	20	1.2
Fet distress not detected in lab			11						17	1.0
Delay in referral to level 2 or 3	6	1.0		0.0		0.0				
Insufficient notes							4	1.5		

The problem of poor attendance for antenatal care is considered to be the most important avoidable factor in the perinatal deaths at the PPIP sites. There is certainly room for improvement in the care given to patients at antenatal clinic and in labour, and there are transport problems that need to be dealt with. There are a few patients where the note keeping was substandard. Table 2.1.8, where individual avoidable factors are recorded, shows the predominance of patient related factors.

Comments

1. Rapid turnover of medical staff, particularly community service doctors, is a problem.
2. Poor note keeping by sessional staff, who also do not attend perinatal audit meetings, is a problem in some areas.
3. Poor contact in some areas with the district services which provide the antenatal care. The staff of these services often do not attend perinatal audit meetings.
4. High rate of unknown syphilis serology in some areas.
5. There is a higher incidence of perinatal hypoxia where the caesarean section rate is relatively low.
6. Relatively poor antenatal care for antenatal patients who live on farms.
7. A "quota" booking system in some places
8. The main cause of neonatal death in infants with a birth weight of 1000g or more in all units other than the tertiary hospitals is perinatal hypoxia.
9. Inter-institutional transport of both mothers and infants is a problem in most areas.
10. Patients or the institutions are being billed for doing placental histology.

Recommendations

1. Establish a pregnancy diagnosis service with immediate booking should the patient be pregnant
2. Resolve the problem of the "quota" system for booking. (This has already been started)
3. Wherever possible, have an early ultrasound examination, in particular to establish gestational age.
4. Better investigation of the unexplained intrauterine deaths. The costs of billing for pathological investigations must be assessed.
5. Improve the monitoring of fetal growth to try to reduce deaths from intrauterine growth restriction.
6. Improve the monitoring of the condition of the fetus during labour. In particular, there is a need to recognise and act on problems when they occur.
7. Improve the quality of neonatal resuscitation, particularly the skills component.
8. Improve the quality of care provided for the small and sick infant.
9. Address the problem of inter-institutional transport of both mothers and newborn infants.
10. Encourage the staff at all delivery centres to use PPIP for the monitoring of perinatal mortality

Appendix 1

Methods, definitions and common abbreviations used in the Survey

Methods

All provincial Maternal, Child and Women's Health units were requested to submit to the national Maternal, Child and Women's Health unit data relating to perinatal care in their provinces. This minimum perinatal data set was agreed to at the first Perinatal Care Survey Workshop in 2000. Data included the number of deliveries and deaths per weight category, as well as information relating to the number of caesarean sections, the number of babies born before arrival, and the number of maternal deaths. The basic form is shown in figure 1.1. Collecting the data was effected either by the provincial MCWH units collecting the minimum data from the institutions directly or by requesting the information from the provincial Health Information Systems units. The provincial data is shown under the respective provinces reports.

The MRC unit contacted all people currently using PPIP and requested them to electronically send their PPIP data to the unit. The MRC unit electronically collated the data using PPIPWIN v2 (Simply Software®). The PPIP sentinel sites were grouped into three categories, those from metropolitan areas (as defined by the new 'mega-cities'), city and town areas, and rural areas. This categorisation was chosen as it grouped the hospitals into naturally comparable units and covered most of the institutional deliveries occurring in those areas and was thought to be more representative of population based data than any other combination. Furthermore, the metropolitan grouping represents a fully functioning tiered health care system, with all patients in the area having relatively easy access to tertiary care if needed. The city and town grouping represents areas where patients usually have easy access to primary and secondary level institutions, but there is some difficulty in accessing tertiary institutions. Finally the rural grouping represents primary care, with the patients having to be referred for secondary and tertiary care. This categorisation was not always easy. It was decided not to combine the data by levels of care across the country because of the very different referral patterns. Data for each province is given separately.

PPIP was developed in the 1990s by the MRC unit and been extensively field tested since 1996. PPIP is a simple, user friendly computer-based programme that, once simple perinatal data is entered, calculates various perinatal care indices, describes the medical conditions that led to the perinatal death and describes the avoidable factors, missed opportunities and substandard care that led to the deaths. The data from various sites can be collated, thus perinatal care indices, patterns of disease and avoidable factors can be analysed for various groupings of sites, e.g. provincial, or primary, secondary and tertiary levels of care, or metropolitan, city

and town, and rural areas. Once this information is available, the priority problems are clearly identified and solutions can be sought. PPIP follows the 'ICA solution' audit system, first described in 1995[1]. 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. Thus it takes enthusiasts to run it, and at present cannot be introduced at all sites where births occur.

Data for the chapters on the specific disease categories was taken from 1st October 1999 to 30th September 2003 in the amalgamated database. Data for the provincial reports in for the year 2003 unless specifically stated otherwise.

Definitions

The definition of the perinatal care indicators and their significance is described below:

1. **Neonatal death rate (NNDR)** $\frac{\text{Total number of neonatal deaths} \times 1000}{\text{Total number of live births}}$

A viable live born baby from birth to 28 days is called a neonate. Neonatal deaths are subdivided into early (first 7 days of life) and late (8 – 28 days) where early neonatal death (ENND) is an indicator of intrapartum care and partly the quality of neonatal facilities.

2. **Stillbirth rate (SBR)** $\frac{\text{Total number of stillbirths} \times 1000}{\text{Total number of births}}$

A viable baby born dead is called a stillbirth. The stillbirth rate is an indicator of the quality of obstetric care in general. Stillbirths can be further subdivided into fresh stillbirths and macerated stillbirths where fresh stillbirths would usually reflect the quality of intrapartum care and macerated stillbirths the quality of antenatal care.

3. **Perinatal mortality rate (PNMR)** $\frac{\text{Total number of perinatal deaths} \times 1000}{\text{Total number of births}}$

Figure 1.1. Example of the minimal perinatal data collection tool.

MONTHLY SUMMARY STATISTICS

Name of institution: Level of care:

Health district: Rural/peri-urban/urban

Health region:

Month: Year:

Weight Category (g)	Stillborn		Neonatal death		Alive on discharge	Total
	Fresh	Macerated	Early	Late		
500 –999						
1000 – 1499						
1500 – 1999						
2000 – 2499						
2500 +						
TOTAL						

Total Number of births: _____

Women less than 20 years: _____

Women more than 34 years: _____

Syphilis status: **Negative** _____

Positive _____

Unknown _____

Route of delivery:

Normal vaginal birth: _____

Assisted birth – Vacuum: _____

Forceps: _____

Caesarean section _____

Born before arrival: _____

Number attended antenatal care: _____

Maternal deaths: _____

Compiled by: _____ Signature: _____

Date: _____ Tel/fax: _____

The perinatal period starts at the beginning of fetal viability (28 weeks gestation or 1000 g in South Africa) and ends at the end of the 7th day after delivery. A perinatal death is one that occurs during this time period and is the sum of stillbirths plus early neonatal deaths. South Africa still uses the older World Health Organisation (WHO) definition of PNMR. The most recent WHO definition of PNMR is the number of stillbirths and neonatal deaths occurring from 24 weeks gestation or 500g to 28 days neonatal life.

The PNMR is the most sensitive indicator of obstetric care. For developed countries the PNMR for babies of 1000 g or more is usually less than 6/1000 births whereas for developing countries PNMR ranges from 30 – 200/1000 births. It is important to note that developed countries calculate their PNMR from 24 weeks gestation or 500 g. For South Africa, the PNMR is estimated to be 40/1000 births with a wide range, and this is for babies of 28 weeks gestation or more or 1000 g or more. The maternal mortality ratio for South Africa was estimated at 150/100 000 in 1998 (DHS, 1998). For every maternal death there are at least 27 perinatal deaths.

4. **Low birth weight rate (LBWR)** $\frac{\text{Total number of births} < 2500\text{ g}}{} \times 100$

Low birth weight rate is an indicator of the socio-economic status and health of the community in general. If deliveries are categorized by weight, this will give an indication of low birth weight as a cause of perinatal mortality as well as an indication at what weight babies survive. The LBWR for births in developed countries is around 7%, whereas in developing countries it is much higher, around 15%.

For all the indicators mentioned above, 1000g is used as a cut off and babies weighing 999g or less are regarded as late abortions. Birth weight is used instead of gestational period as in a significant number of women gestational age is not known. Birth weight of 1000 g equates to about 28 weeks gestation. There is considerable debate as to whether the PNMR (and other calculations) should be calculated from 500g, with the Western Cape asking for the inclusion of all babies from 500g whereas the rest of the country uses 1000g or more[2]. In a great many hospitals in the country, small stillbirths are not weighed and are regarded as abortions. Furthermore, in a large number of hospitals, patients considered to be having an abortion do not deliver in the labour ward, but in a female ward or gynaecology ward. A number of babies weighing between 500g and 1000g are born in these sites and are not recorded as births. Hence the debate goes around the accuracy of the data and the need for completeness. Another aspect to the debate relates to the common policy in neonatal units of not providing ventilation for neonates born under 1000g at state institutions.

Clearly the move should be towards recording all births of 500g or more, however, until the data is shown to be accurately collected, the PNMR should be reported per 500g and above (where available) and from 1000g and above. Comparisons in PNMR should be made using 1000g and above.

5. **Stillborn:neonatal death (SB:NND) ratio.**

If the data on perinatal deaths is collected by separating stillbirths and neonatal deaths, the SB:NND ratio can be calculated and is another indicator of the perinatal environment. A developed country usually has a SB:NND ratio of around one. In developing countries where there is almost no care the ratio is also around one with as many stillbirths as neonatal deaths. As care improves, i.e. more births take place in institutions and labour, delivery and immediate care of the neonate is supervised, the NNDR declines and the SB:NND ratio increases. Finally as antenatal care improves, the number of stillbirths decline and the ratio decreases again to one.

6. **Perinatal Care Index (PCI)** $\frac{\text{Overall PNMR}}{\text{Percentage low birth weight babies}}$

This was first described by Theron *et al*.[3] in 1985. It can be used to compare the standard of care of various areas. It takes into account the environmental factors so that the comparison can be more valid. The LBWR of an area is an indication of the socio-economic status of that area. It is not dependent on the care received in the clinic or hospital, but more dependent on environmental factors. Most deaths occur in babies weighing less than 2500 g. If the LBWR is high, it is to be expected that the PNMR will be high. If the PNMR is low in this set of circumstances, then good care is present. However, in areas with a low LBWR that have a high PNMR, then the care must be poor. A low PCI indicates good care whereas a high PCI indicates poor care. A low PCI indicates good care because the PNMR is relatively low in relation to the LBWR. A high PCI indicates poor care because the PNMR is relatively high in relation to the LBWR. It is only appropriate to use this index to compare hospitals with similar circumstances or the same hospital over a period of time.

7. **Caesarean section (C/S) rate** $\frac{\text{Number of C/Ss} \times 100}{}$

8. **Assisted delivery rate** $\frac{\text{Number of assisted births} \times 100}{\text{Total number of births}}$

9. **Booked status rate:** $\frac{\text{Number of booked women (who have given birth)} \times 100}{\text{Total number of births}}$

This is a proportion of women booked for antenatal care and reflects the utilisation of health facilities. A pregnant woman is regarded as booked if she has had a single visit to a general practitioner or the clinic prior to labour or developing a complication. In modern obstetrics, with the availability of on-site testing, a patient can be fully risk classified at the first visit and the antenatal care planned. The term ‘booked’ is unfortunate. It is derived from a pregnant woman booking a bed for the birth of her baby. That has come to mean someone who attended antenatal care. The term still gives rise to confusion, especially among pregnant women. It would be better to use the term ‘attended antenatal care’. This would emphasise the right action.

10. **Maternal mortality ratio (MMR):** $\frac{\text{Total number of maternal deaths} \times 100\,000}{\text{Total number of live births}}$

The MMR is not discussed in this report, but it is useful to record the number of maternal deaths on the same form as perinatal deaths.

The classification system used in PPIP to describe the causes of perinatal death was first used in Aberdeen by Sir Dugald Baird and his colleagues from the 1940s and is clearly defined in *Perinatal Problems: The second report of the 1958 British Perinatal Mortality Survey*[4]. 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*[6] in 1986 to bring it into line with modern obstetrics and this forms one of the systems used in CESDI. The Aberdeen classification was adapted again by Pattinson *et al*[6] in 1989 for use in developing countries and again in 1995[1] to include the concept of avoidable factors, missed opportunities and substandard care.

Commonly used abbreviations

Abbreviation	Meaning
Admin.	Admission
AP+HT	Abruptio placentae and hypertension
APH	Antepartum haemorrhage
Cong. Abn.	Congenital abnormality
CPAP	Continuous positive airway pressure
ENND	Early neonatal death
FSB	Fresh stillbirth
HT	Hypertension
Idio. IUGR	Idiopathic intrauterine growth restriction
IPA	Intrapartum asphyxia
IPA+T	Intrapartum asphyxia and birth trauma
IUGR	Intrauteine growth restriction
LBWR	Low birth weight rate
LNND	Late neonatal death
Mac. SB	Macerated stillbirth
Mat. Dis.	Pre-existing maternal disease
MRC unit	MRC Maternal and infant health care strategies research unit
nCPAP	Nasal continuous airway pressure
NND	Neonatal death
NNDR	Neonatal death rate
PCI	Perinatal care index
PNMR	Perinatal mortality rate
PPIP	Perinatal Problem Identification Programme
SB	Stillbirth
SBR	Stillbirth rate
Tot.	Total
Unex. IUD	Unexplained stillbirth
Unk.	Unknown

References

1. Pattinson RC, Makin JD, Shaw A, Delport SD. The value of incorporating avoidable factors into perinatal deaths. S Afr Med J 1995; 85: 145-147.
2. Woods D, Khan M, Louw H. A comparison of the perinatal mortality rates for infants weighing 500g or more at birth and those weighing 1000 g or more. S Afr Med J 2001; 91: 323-324.
3. Theron GB, Pattinson RC, Engelbrecht BHJ. Kaaplandse plattelandse perinatale sterftes Januarie-Desember 1985. S Afr Med J 1988; 73: 211-213.
4. Baird D, Thompson AM. The survey perinatal deaths re-classified by special clinico-pathological assessment. In Perinatal Problems: the Second Report of the 1958 British Perinatal Mortality Survey (Butler NR, Alberman ED eds), Churchill Livingstone, Edinburgh, 1969, 200-210.
5. 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.
6. 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.

Appendix 2
PPIP Sites (Past and Present)

This is a list of institutions and their CHCs, which have used or are using the PPIP programme:

Institution	Institution
Addington	Louis Trichardt
Barberton	Lydenburg
Belfast CHC	Madadeni
Bernice Samuel	Mafikeng
Bethal	Mahatma Gandhi
Bethesda	Malamulele
Blouberg	Mamelodi
Botchabela	Manguzi
Botlokwa	Mankweng
Bredasdorp	Maphutha L Malatji
Caledon	Mapulaneng
Calvinia	Mary Terese
Carolina	Matibidi
Cecilia Makiwane	Matikwana
Central Karoo	Matlala
Ceres	Mecklenburg
Ceza	Messina
Chris Hani Baragwanath	Middelburg
Christ the King	Mokopane
Church of Scotland	Montagu
CN Phatudi	Moroka
Coronation	Mosvold
De Aar	Mowbray Maternity
Donald Fraser	Mseleni
Dora Nginza	Nkhensani
Dr N Mandela National	PE Provincial
Dr Yusuf Dadoo	Penisular Maternity & Neonatal Services
Duiwelskloof	Philadelphia
East Griqualand and Usher Memorial	Phola Clinic
Eben Donges	Piet Retief

Institution

Edendale
Edenvale
Elim
Ellisras
Embhuleni
Empangeni (Lower Umfolozi District War Memorial)
Ermelo
Eshowe
Far East Rand
FH Odendaal
Frere
Frontier
Galeshewe Day Hospital (CHC)
Ga-Rankuwa (George Mukhari)
Gelukspan
George
George Masebe
Germiston
GJ Crookes
Glen Grey
Goldfields
Gordonia
Grabouw
Greys
Groote Schuur
Groothoek
HC Boshoff
Heidelberg
Helena Franz
Hermanus
Hlabisa
Hottentots Holland
Impungwe
Itshelejuba
Jan Kempdorp
Jane Furse

Institution

Polokwane
Port Alfred
Port Shepstone
Potchefstroom
Pretoria Academic
Prince Mshiyeni
Rob Ferreira
Robertson
Rustenburg Provincial
Sabie
Sebokeng
Sekororo
Seshego
Settlers
Shongwe
Siloam
Siphosensimbi Clinic
Siyathemba Clinic
Somerset
South Rand
Springbok
St Apollinoris
St Elizabeths
St Marys
St Patricks
St Ritas
Standerton
Stanger
Swellendam
Tambo Memorial
Tembisa
Thabazimbi
Themba
Thusong
Tintswalo
Tonga

Institution	Institution
Johannesburg	Tshilidzini
Jubilee	Tygerberg
Kalafong Academic	Uitenhage
Karl Bremer	Uppington
Kgapane	Van Velden
Kimberley	Virginia
King Edward VIII	Voortrekker
Klerksdorp	Warmbaths
Kuruman	Waterval Boven CHC
Ladysmith	Wesfleur
Lehurutshe	WF Knobel
Leratong	Witbank
Letaba	Witpoort
Livingstone	Zeerust

International PPIP sites who have registered with us

Lamb Hospital (Bangladesh)
Oshakati State Hospital (Namibia)
Mulago Hospital (Uganda)