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CLINICAL ARTICLE

Perinatal death audit and classification of stillbirths in two provinces in Papua New Guinea: a retrospective analysis

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Keywords

Avoidable factors; Intrapartum asphyxia; Intrapartum monitoring; Pre-eclampsia; Stillbirth; Unexplained

Synopsis

Among 59 stillbirths we identified 127 possible avoidable factors, including poor response to reduced fetal movement, delay in seeking care in labor, and poor intrapartum monitoring.

ABSTRACT

Objective: To undertake a retrospective perinatal death audit and assessment of avoidable factors associated with stillbirths among a cohort of women in two provinces in Papua New Guinea.

Methods: We used data from an ongoing cluster-randomised crossover trial in 10 sites among 4,600 women in Papua New Guinea (2017-date). The overarching aim is to improve birth outcomes.

All stillbirths from July 2017 to January 2020 were identified. The Perinatal Problem Identification Program was used to analyse each stillbirth and review associated avoidable factors.

Results: There were 59 stillbirths among 2558 births (23 per 1,000 births). 68% (40/59) were classified 'fresh' and 32% 'macerated'. Perinatal cause of death was identified for 63% (37/59); 30% (11/37) were due to intrapartum asphyxia and traumatic breech birth; and 19% (7/37) due to pre-eclampsia. 95% (56/59) of stillbirths had at least one avoidable factor identified. Patient-associated factors included lack of response to reduced fetal movements and delay in seeking care during labor. Health personnel-associated factors included poor intrapartum care, late diagnosis of breech presentation and prolonged second stage with no intervention.

Conclusion: Factors associated with stillbirths in this setting could be avoided through a package of interventions at both the community and health facility level.

1 INTRODUCTION

An estimated 2.6 million stillbirths occur each year, over 98% in low- and middle-income countries (LMICs) [1]. Stillbirth rates in LMICs are estimated to be ten times that of high-income countries (HIC) [2]; with those living in rural and remote areas experiencing the highest burden [3]. An estimated half of all stillbirths could be prevented through a package of evidence-based antenatal and intrapartum

interventions [4]. Prevention strategies include identifying and addressing the major causes for stillbirth; improving access and acceptability of maternity care; ensuring maternity health professionals are well-trained and supported; improving the quality of intrapartum monitoring and care; and implementation of a continuous quality improvement audit system [4, 5]. Undertaking audits of stillbirths is an important strategy in stillbirth prevention [6] but only when combined with further analysis and action on identified modifiable and contributing factors [7].

Where stillbirth data are collected and a classification system utilised, the most frequently reported cause of death is 'unexplained stillbirth' [5]. Unfortunately, unexplained can also be the default for 'inappropriately investigated'. It is estimated that only 20% of stillbirths should fall into the unexplained category [8]. Currently there are more than 80 stillbirth classification systems in the world [9]. Designed and developed as a facility-based audit tool in South Africa in the 1990s, the Perinatal Problem Identification Program (PPIP) system has been adopted nationally since 2012, and applied in LMICs [7] as a means to classify deaths and understand potential avoidable factors associated with perinatal death [10].

Papua New Guinea (PNG), a LMIC in the Asia-Pacific region has one of the highest maternal and perinatal mortality rates in the world. With a severe health workforce shortage, particularly in maternal and newborn health [11, 12], the majority of maternity care is provided by nurses or community health workers often with limited midwifery skills and knowledge. Maternal and perinatal mortality rates originate primarily from hospital settings, reporting between 19-37 per 1000 live births [13, 14]. While some hospitals have conducted audits to review factors contributing to stillbirths, there is currently no systematic approach to classifying, investigating or reporting stillbirths in PNG except for classifying deaths as 'fresh' or 'macerated'.

As part of trial monitoring procedures, we undertook a retrospective analysis and perinatal death audit of all stillborn babies identified in an ongoing trial. The aim of this paper is to present the analysis and assess avoidable factors associated with these stillbirths.

2 MATERIALS AND METHODS

The Women and Newborn Trial of Antenatal Interventions and Management (WANTAIM) is a cluster-randomised crossover trial among 4,600 women and their newborns in two provinces in PNG (July 2017 to date). The trial aims to measure the

effectiveness, health system implementation requirements, cost-effectiveness and acceptability of antenatal point-of-care testing and treatment for sexually transmitted infections to improve birth outcomes in high-burden, low-income settings. Conducted in East New Britain and Madang provinces, the WANTAIM trial recruits women at 10 peri-urban and rural health centres. Women aged 16 years or over, less than 26 weeks pregnant (confirmed by obstetric ultrasound scan) and attending their first antenatal clinic visit are eligible [15]. The WANTAIM protocol has previously been published [15]. Ethical approval for the trial was received from all relevant research committees in PNG, the UK and Australia [15].

Severe adverse events (SAEs) of all participants are reported using a study-specific SAE form describing the mother's general health, pregnancy risk factors and the circumstances around the event including antenatal, labor and birth events, gestational age at birth, birth weight and final outcome [15].

All stillborn babies identified in SAE reports between July 2017 and January 2020 were reviewed to test the South African PPIP system to analyze and synthesize findings from the SAE reports. The software was freely available and easy-to-use which made it an appropriate system to test in PNG.

All stillbirth SAE reports were identified by one member of the research team (LV) who entered data into the PPIP database, conducted initial analysis and coding of perinatal cause of death, maternal condition at time of perinatal death and avoidable factors, as per the PPIP codes. Once coded, the database was exported into a MS Excel spreadsheet (Microsoft Corp., Redmond, WA, USA). All SAE reports were then reviewed by a second reviewer (RS) for independent analysis and coding. Results of the reviewers were compared, with differences resolved through discussion and consensus; adjudication where necessary was undertaken by a third reviewer (CH). To further validate assigned codes, 10% of the SAE reports were randomly selected, assessed and coded independently by two obstetricians in PNG (DB, JB).

Data were summarized as frequencies and percentages by characteristics of interest (parity, number of antenatal visits, hemoglobin), classification of stillbirth ('macerated' or 'fresh'), location of birth and avoidable factors.

3 RESULTS

Between July 2017 and January 2020 there were 59 were stillbirths among 2558 total births (stillbirth rate 23 per 1,000 births).

Half of the study participants were aged under 24 years, and 54% were primiparous (Tables 1, 2). Just over one third (36%) attended antenatal clinic four or more times. All women received a rapid point-of-care test for syphilis (SD Bioline anti-TP 3.0, Alere, Germany), among whom 10 were positive (17%) and eight completed treatment (Table 1). Of 53 women tested for HIV, none were HIV-positive. Of those for whom haemoglobin (Hb) measurements were available, 61% (35/57) were anaemic, with Hb less than 10g/dL (Table 1).

Two thirds of stillborn babies were classified as 'fresh' (40/59; 68%); the remaining 19 classified as 'macerated' (Table 2). Three quarters (45/59; 76%) were born in a health center (n=22) or hospital (n=23); 13 were born at home and one was born before arrival at the health facility. Of the 40 'fresh' stillbirths, 43% (17/40) were alive during labor (fetal heart heard or fetal movements felt); 30% (12/40) had no fetal heart heard or fetal movement felt immediately prior to the onset of labor. The viability of the fetus during labor was unknown in 11 cases (11/40; 28%) (Table 2).

Around half of all stillborn babies (32/59; 54%) were preterm (less than 37 completed weeks); five (8.5%) were post-term (more than 40 completed weeks). Birth weight data was available for 78% of babies (46/59), among whom 54% (25/46) had a birth weight at or below 2.5kg (Table 2).

Of the 17 stillborn babies known to be alive during labor, six were born in a health centre and ten in a hospital (16/17; 94%); 11 (65%) were term or post term; and 11 (65%) had a birth weight over 2.5kg (Table 2). Among the 19 'macerated' stillbirths, 14 (74%) were preterm; and 11 (79%) had a birth weight below 2.5kg (Table 2).

More than half of all babies (24/45; 53%) had a birth weight in the 10th percentile of sex-adjusted estimated fetal weight for gestation (Table 2) [16].

Twenty-two (22/59; 37%) stillbirths were classified as an unexplained intrauterine death; 46% (10/22) were classified as 'fresh'. The leading cause of perinatal death was intrapartum asphyxia or a traumatic breech birth, accounting for 30% (11/37); seven (7/37; 19%) were linked to pre-eclampsia, three (3/37; 8%) were due to idiopathic preterm birth, and two (5%) were due to cord prolapse. Other causes of

death are included in Table 3. There were insufficient notes to ascertain perinatal cause for two babies.

Of the 59 stillbirths, 48% of women (28/59) had an identifiable maternal condition at the time of the birth (Table 4). Among these, 57% (16/28) had hypertension-related conditions; 11 had pre-eclampsia; three had non-proteinuric hypertension; and two had placental abruption with hypertension (Table 4). Of the 22 women with an unexplained stillbirth 55% (12/22) were anaemic, and three (3/22; 14%) had hypertension (not pre-eclampsia) (Table 5).

Nearly all stillbirths (56/59; 95%) had at least one avoidable factor associated with the outcome; 21 had three to five avoidable factors identified (Table 5). Overall, 127 avoidable factors were identified with patient-associated and health personnel-associated factors accounting for the majority. Of all avoidable factors, 73 were deemed as a possible contributory factor and 40 as probable factor for the stillbirth (Table 6).

Inappropriate response to poor fetal movements and delay in seeking care during labor were the main patient-associated possible factors (36/48; 75%). Avoidable factors associated with health personnel related primarily to intrapartum care, including unidentified fetal distress, or no fetal monitoring during labor (11/49; 22%), prolonged second stage of labor without intervention (5/49; 10%), undiagnosed breech presentation in labor (5/49; 10%), and poor or no use of the partogram (3/49; 6%).

4 DISCUSSION

This is one of the largest published series of stillbirths examined in PNG. Cases come from two different provinces and data were collected systematically on all deaths as part of the WANTAIM trial. Among the 59 stillbirths, 37% (22/59) were unexplained, of which 12 were ‘macerated’ and 10 were ‘fresh’ stillbirths. Intrapartum asphyxia and traumatic breech birth were identified as the cause of death in nearly one-fifth of cases (11/37; 30%) and pre-eclampsia in 19% (7/37). Almost half of the women (28/59; 48%) had a specific maternal condition identified at the time of the death. Most stillbirths (56/59; 95%) had at least one identifiable contributory factor identified. Patient-associated factors related to poor response to reduced fetal movements and delay in seeking care during labor. Health personnel-associated

factors related primarily to poor intrapartum care, highlighting a critical need for health care providers to be trained in routine and emergency intrapartum care.

More than half of the babies in our cohort were small-for-gestational age (SGA), indicating likely fetal growth restriction (FGR). Stillbirth is strongly associated with FGR or excessive fetal growth (above 90th centile), and approximately one-third to one-quarter of stillborn babies are identified as SGA [17]. The detection and management of FGR remains poor especially in contexts where antenatal care is limited and provided by non-specialist staff.

Many conditions prevent babies from reaching their expected growth potential or have an impact on intrauterine wellbeing that increases risk of stillbirth. Unfortunately, many women experience multi-morbidities that increase risk for themselves and their babies [18]. Maternal multi-morbidities were common in this cohort, in particular, high levels of anemia and hypertension. Anemia is not specified as a maternal condition in the PPIP system, and was therefore not classified as such in our data capture. However, an Hb of less than 11g/dL seems to increase the risk of adverse outcomes, including stillbirth (19). In our cohort, 61% of women had an Hb of less than 10g/d, a similar rate to women enrolled into the WANTAIM trial within the same time period (70%). Regardless of gestation, low Hb levels in pregnancy are associated with adverse perinatal outcomes and ideally public health interventions addressing anemia should be scaled up in the reproductive population, especially in regions where chronic anemia is common [19].

A significant burden of stillbirth is associated with hypertension in pregnancy [20] and this is evident in our findings. Hypertension, in particular pre-eclampsia, was present in more than half of the women with an identified maternal condition at the time of birth with many women not being managed appropriately [21]. Correct diagnosis and timely evidence-based management protocols can significantly reduce morbidity and mortality associated with hypertension in pregnancy [21]. Hypertension contributes to placental abruption and FGR, a contributing factor to stillbirths identified in our study population. Prevention strategies should include clear evidence-based protocols for training and ongoing management of women who present with hypertension while pregnant. In addition, the importance of women attending antenatal clinic early in pregnancy, and for health staff to ensure timely consultation, referral and escalation.

The association between syphilis and poor pregnancy outcomes, including stillbirth is well documented. Prevalence data on syphilis in PNG, specifically among antenatal

women is lacking, furthermore available data is considered high due to the high local prevalence of yaws [22]. Therefore, results for syphilis among women experiencing stillbirth (17%), in the absence of laboratory-based rapid plasma regain, needs to be interpreted with caution as some infections may be attributable to childhood infection. The high rapid test positivity for syphilis was higher among women experiencing stillbirth (17%), compared to the study cohort (13%), but was not significant (Odds ratio 1.40 (CI: 0.71, 2.79; p=0.213) (data not shown).

A key area of stillbirth prevention is quality intrapartum care. In our study 29% of women had a live fetus at the start of labor. This could have been higher as another 19% had unknown fetal status at the start of labor. Globally, it is estimated that up to 50% of stillbirths occur in the intrapartum period and almost all of these are preventable [23]. Inadequate fetal heart rate monitoring and poor recognition of and response to intrapartum complications significantly contribute to stillbirths [23]. Preventive actions to improve the quality of intrapartum care requires a systems approach and should include strengthening education and training for maternity health professionals; ensuring facilities provide Basic and Comprehensive Emergency Obstetric and Newborn Care signal functions; and strengthening emergency responses and referral pathways and processes [2, 3, 23]. Modelling in PNG has shown that provision of high-quality midwifery care also has the potential to significantly reduce the stillbirth rate [23].

An increasing number of HICs are developing and implementing packages of care or 'bundles' aimed at stillbirth prevention. The bundles of care focus on evidence-based prevention strategies, such as, improved management of reduced fetal movements; smoking cessation support; side-sleeping advice; better identification and monitoring of FGR and appropriate fetal monitoring during labor [24]. In our analysis we identified a number of modifiable factors that could be aimed at community and health-facility levels to improve outcomes. Awareness and education at the community level, about the importance of reporting reduced/absent fetal movements, and timely seeking of care during labor needs to be undertaken alongside training of health facility staff.

At the facility level there is need for staff to understand the critical importance of timely detection, management and treatment of antenatal anemia, FGR, hypertension and the importance of intrapartum monitoring.

This analysis of stillbirths used the PPIP audit system, a system designed as a facility-based audit tool, to synthesize findings from SAE reports. While we were able to classify cause of perinatal death, and assign maternal condition at time of the perinatal death in half of the stillbirths, clinical information was lacking for some of the cases. The availability of clinical notes, in particular review of partographs, would have allowed for a more thorough understanding of care and progress during labor.

5 CONCLUSION

Through the classification and investigation of stillbirths in our cohort we identified patient and health personnel-associated factors that could be avoided through a package of interventions at both the community and health facility level. Central to the package of interventions is the importance of training of primary level health staff to identify and manage key antenatal problems and provide evidence-based intrapartum care to improve birth outcomes. In addition they need to provide support and information to women attending antenatal clinic, in particular the importance of responding to and reporting reduced fetal movements, and the important message of planning a health facility birth.

Author contributions

LV, CH conceived the idea. LV undertook data entry. LV, RS, CH, DB, JB, CP reviewed and analysed data. RS wrote the first draft of the manuscript. LV, CH and RS revised the early manuscript. LA, AM are site co-ordinators and MR is the WANTAIM trial co-ordinator; all participated in the collection of data included in the SAE reports and participated in the revision of the manuscript. WP & AV lead the WANTAIM trial, including the design, data collection and data analysis and participated in the revision of the manuscript. JV provided technical input and oversight in the use of the PPIP, and participated in the revision of the manuscript. All authors approved the final version.

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Conflicts of interest

The authors have no conflicts of interest.

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TABLE 1 Background Characteristics

	Primiparous n=32 (%)	**Multiparous n=27 (%)**	**Total n=59 (%)**
Age (n=57)[a]			
< 19 year	6 (19)	0	6 (11)
20-24	17 (5)	6 (23)	23 (40)
25-29	7 (23)	6 (23)	13 (23)
30-34	0	9 (35)	9 (16)
35+	1 (3)	5 (19)	6 (11)
Gestational Age at enrolment			
<16 weeks	3 (9)	5 (19)	8 (14)
17-22	20 (63)	10 (37)	30 51)
23-26	9 (28)	12 (44)	21 (36)
Number of antenatal visits			
1	8 (25)	4 (15)	12 (20)
2-3	15 (47)	11 (40)	26 (44)
4	1 (3)	8 (30)	9 (15)
>4	8 (25)	4 (15)	12 (20)
Syphilis test			
Syphilis negative	25 (78)	24 (89)	49 (83)
Syphilis positive	7 (22)	3 (11)	10 (17)
Completed treatment	6 (86)	2 (67)	8 (80)
Hb at time of perinatal death (n=57)[a]			
>10 g/dL	13 (41)	9 (35)	22 (39)
8-10g/dL	11 (36)	8 (31)	19 (33)
7-7.9g/dL	5 (16)	6 (23)	11 (19)
<7g/dL	2 (7)	3 (12)	5 (9)

[a]1 missing from primiparous and multiparous groups

TABLE 2 Location of birth, gestational age at birth and birth weight

		Fresh stillbirths			
	Macerated stillbirths n=19 (%)	**FDIU before labor n= 12 (%)**	**Fetus alive during labor n=17 (%)**	**Fetal status unknown during labor n=11 (%)**	**Total N=59 (%)**
Primiparous	9 (47)	6 (50)	9 (53)	8 (73)	32 (54)
Multiparous	10 (54)	6 (50)	8 (47)	3 (27)	27 (46)
Location of birth					
Home	4 (21)	2 (17)[a]	1 (6)[b]	6 (55)	13 (22)
Health centre	9 (47)	5 (42)	6 (35)	2 (18)	22 (37)
Hospital	6 (32)	5 (42)	10 (59)	2 (18)	23 (39)
BBA	0	0	0	1 (9)	1 (2)
Gestational age at birth (completed weeks)					
<24	0	0	1 (6)	1 (9)	2 (3)
25-28	3 (16)	0	0	1 (9)	4 (7)
29-34	6 (32)	2 (17)	3 (18)	2 (18)	13 (22)
35-36	5 (26)	6 (50)	2 (12)	0	13 (22)
37-40	4 (21)	4 (33)	8 (47)	6 (55)	22 (37)
Post term	1 (5)	0	3 (18)	1 (9)	5 (8)
Birth weight					
	n=14	*n=10*	*n=17*	*n=5*	*n=46 (78)*
<1000g	2 (14)	0	1 (6)	1 (20)	4 (9)
1001-1500	2 (14)	1 (10)	0	0	3 (7)
1501-2000	3 (21)	1 (10)	2 (12)	0	6 (13)
2001-2500	4 (29)	4 (40)	3 (18)	1 (20)	12 (26)
2501-3000	2 (14)	2 (20)	4 (24)	3 (60)	11(24)
3001-3500	1 (7)	1 (10)	5 (29)	0	7 (15)
>3501	0	1 (10)	2 (12)	0	3 (7)
Assessment of birth weight for gestational age					
	n=13	*n=10*	*n=17*	*n=5*	*n=45(75)*
SGA	11 (85)	5 (50)	4 (24)	4 (80)	24 (53)
LGA	0	0	2 (12)	0	2 (4)
Appropriate growth	2 (15)	5 (50)	11 (65)	1 (20)	19 (42)

[a]no FMF prior to labor; [b]FMF during labor

TABLE 3 Obstetric cause of perinatal death

Perinatal cause of death	**n=59 (%)**
Unexplained macerated	12 (20)
Unexplained fresh	10 (17)
Labor-related intrapartum asphyxia	7 (12)
Pre-eclampsia	7 (12)
Traumatic breech birth	4 (7)
Idiopathic PTB	3 (5)
Fetal abnormality	3 (5)
Malaria[a]	3 (5)
Cord prolapse	2 (3)
Domestic violence	2 (3)
Abruption with hypertension	2 (3)
Other[b]	4 (7)

[a] All women were diagnosed with malaria by rapid test,. One didn't complete her home-based treatment; one was treated and gave birth 2 days after completion of treatment, one was diagnosed when she presented in labor, there was evidence of fetal distress.

[ab]Includes: unexplained due to lack of notes (2); ruptured uterus (1); non-proteinuric hypertension (1)

TABLE 4 Maternal condition at time of perinatal death

Maternal condition	**n=59 (%)**
No maternal condition identified	31 (53)
Pre-eclampsia	11 (19)
Malaria	3 (5)
Hypertension (non-proteinuric)	3 (5)
Domestic violence	2 (3)
Antepartum haemorrhage with hypertension	2 (3)
Other[a]	7 (12)

[a] non pregnancy related infection (1); accident (1); lack of notes (3); generalised body aches and pains, no fever (1); UTI (1);

TABLE 5 Unexplained stillbirths, maternal condition, avoidable factors

GA at birth (weeks)	Birth weight (g)	Maternal condition	Hb	Avoidable factors
Macerated stillbirths (n=12)				
Health facility births				
34	960	Hypertension at 21/40. No record of BP during labor to determine if pre-eclampsia	8.5	No response to poor fetal movement No response to maternal hypertension No response to poor uterine fundal growth
39	2480		10.2	No response to poor fetal movement
33	600		8.6	No response to poor fetal movement No response to poor uterine fundal growth
42	3000		8.2	No response to poor fetal movement
36	2000		9.5	No response to poor fetal movement
39	2000		8.5	Failed to return on the prescribed date No response to poor fetal movement No response to rupture of membranes Delay in seeking medical care during labor
35	3040		10.9	Nil identified
Hospital births				
34	1200		6.2	No response to poor fetal movement No response to poor uterine fundal growth
40	2630		9	No response to poor uterine fundal growth
36	2320		10.1	No response to poor fetal movement
Home births				
34	NK	Accident - fell	9.1	No response to poor fetal movement Lack of transport - Home to institution Infrequent visits to antenatal clinic
35	NK		10	No response to poor fetal movement Failed to return on the prescribed date No response to poor uterine fundal growth Delay in seeking medical care during labor
Fresh stillbirths (n=10)				
Health Facility Births				
39	3000	Urinary tract infection	7.4	Monitored, but fetal distress not detected intrapartum;
39	3000	Reviewed for pre-eclampsia antenatally, slight increase in BP at 38/40; trace	10.5	No response to maternal hypertension

		proteinuria.		
40	2950		10.5	Fetal distress not detected intrapartum; not monitored
41	3700		12.1	Fetal distress not detected intrapartum; not monitored Personnel not sufficiently trained
Hospital Births				
34	2990	Hypertension once intrapartum	10.7	Fetal distress not detected intrapartum; not monitored Personnel not sufficiently trained
36	1100	Unwell for 3 days	10.6	No response to poor fetal movement
38	3680		7.3	No response to poor fetal movement
37	2020		12.1	No response to poor fetal movement
Home births/ BBA				
40	NK		7	Lack of transport - Home to institution Delay in seeking medical care during labor
31	840		9.8	No response to poor fetal movement Delay in seeking medical care during labor Poor response to uterine fundal growth

TABLE 6 Avoidable factors of perinatal cause of death

Number of avoidable factors identified	**1**	**2**	**3**	**4**	**5**	**Total**
Number of cases with avoidable factors identified	14	21	15	4	2	**56/59**
Total number of avoidable factors	14	42	45	16	10	**127**

	Overall 127 (%)	**Possible factors 73[a] (65%)**	**Probable factors 40[a] (35%)**
Patient Associated	**48 (38)**	**42 (58)**	**6 (15)**
Poor response to reduced fetal movements	21	21	0
Delay in seeking medical attention during labor	15	9	6
Failed to return on the prescribed date	7	7	0
Other patient associated factors[b]	5	5	0
Health Personnel	**49 (39)**	**26 (36)**	**23 (58)**
Antenatal factors			
Poor response to uterine growth	6	6	0
Multiple pregnancy not identified antenataly	2	1	1
External Cephalic Version not done due to lack of staff	1	0	1

Intrapartum – monitoring			
Fetal distress not detected intrapartum; not monitored *(5 health centre; 6 hospital)*	11	5	6
Prolonged second stage no intervention *(4 health centre; 1 hospital)*	5	1	4
Breech diagnosed late in labor *(3 home births; 1 no transport from health centre to hospital)*	5	1	4
Poor progress in labor, partogram interpreted incorrectly or not used *(1 health centre; 2 hospital)*	3	1	2
Multiple pregnancy not identified in labor	1	1	0
No response to history of stillbirth *(Hospital; numerous avoidable factors)*	1	1	0
Intrapartum – delays			
Delay in referral to secondary/tertiary treatment *(1 twin pregnancy; 1 no transport)*	3	2	1
Delay in calling for expert assistance *(Health centre)*	2	1	1
Delay in decision to do caesarean section	1	0	1
Intrapartum-management			
Hypertension – no treatment or incorrect management *(5 health centre; 2 hospital)*	7	6	1
Inappropriate use of vacuum extraction	1	0	1
Administrative Problems	**16 (13)**	**5 (7)**	**11 (28)**
Personnel not sufficiently trained *(5 health centre; 4 hospital)*	9	4	5
Lack of transport *(3 home to facility; 1 health centre to hospital)*	4	1	3
Theatre delay[c]	3	-	3
Insufficient notes to assess all avoidable factors	**14 (11)**	**-**	**-**

[a] Excludes insufficient notes

[b] Inappropriate response to rupture of membranes (2); incomplete malaria treatment (1); domestic violence (1); incomplete syphilis treatment (1). [c] Includes, theatres occupied, no staff and anaesthetic delay