

Investigative Report of A Late Fetal Death Cluster in Bay County, Florida 2008

Florida Department of Health

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Sohyun Park^{1,2}, PhD, MS

William Sappenfield², MD, MPH

Dan Thompson², MPH

Tracy Claveau³, RN, BAN

R. Jason Newsom⁴, MD, MPH

¹ Epidemic Intelligence Service Officer, Centers for Disease Control and Prevention

² Division of Family Health Services, Florida Department of Health

³ Bay, Franklin, Gulf Healthy Start Coalition

⁴ Bay County Department of Health

EXECUTIVE SUMMARY

Background: In March 2008, the local Healthy Start Coalition reported an unusual cluster of 6 late fetal deaths (≥ 28 weeks gestation) in Bay County, and requested assistance from the Florida Department of Health.

Investigation Questions: Investigation of the late fetal death cluster included validating the cluster, characterizing risk factors, identifying potential causes, and assessing the need for public health action.

Methods: We analyzed vital records for known risk factors, interviewed mothers for symptoms and exposures, and conducted in-depth case reviews. Data sources included hospital obstetrics labor and delivery logs, fetal death and birth certificates, prenatal care records, hospital charts, and environmental resources. A case was defined as a fetal death of ≥ 28 weeks gestation and birthweight $\geq 2,500$ grams occurring in February 2008 to a Bay County resident. For statistical analyses, we used Poisson probability distribution to determine if the number of fetal deaths was greater than expected, chi-square to measure the significance of differences between proportions, and logistic regression to determine the association between risk factors and late fetal deaths.

Results: The occurrence of 6 confirmed late fetal deaths in Bay County in February 2008 was significantly more than would be expected ($P = 0.0008$) on the basis of Bay County fetal mortality data for 1995–2007. All deaths occurred before hospital admission and onset of labor. Mean and range of maternal age, gestational age, and birthweight were 27.8 years (21–36 years), 37.5 weeks (35–39 weeks) and, 3,367 grams (2,630–4,432 grams), respectively. The likelihood of a death in a fetus weighing $\geq 2,500$ grams in Bay County in February 2008 was 29.9 (95% confidence interval, 12.9–69.5) times the risk of such deaths in Florida during January 2006–March 2008, after adjusting for maternal age, race, education, smoking, prepregnancy body mass index, prenatal care, diabetes, and hypertension. Some of the women with fetal deaths were found to be at higher risk with one or more known risk factors, but these risk factors did not explain the increase in the fetal mortality rate in Bay County in February, 2008. Moreover, these risk factors were not sufficient by themselves to cause fetal demise. No commonality or cause of death regarding socio-demographics, medical risk factors or diagnoses, fetal growth, health providers, or environmental exposures explained the occurrence.

Conclusions: Bay County experienced a significant increase in late fetal deaths in February 2008; however, no common cause or commonality was identified after a comprehensive investigation.

Public Health Implications: Recommendations include (1) hospitals, the county health department, and the local Healthy Start Coalition should closely monitor fetal deaths for potential continuation, and (2) physicians and hospitals should use ACOG Committee Opinion recommendations in conducting a clinical work up of late fetal deaths. Moreover, women in Bay County who pursue healthy behaviors before and during pregnancy, seek preconception and prenatal health care early, and follow medical advice may reduce their risk of late fetal deaths. No public health actions are recommended at this time.

BACKGROUND

In late March of 2008, the local Healthy Start Coalition and Fetal, Infant Mortality Review contacted the Infant, Maternal and Reproductive Unit, Florida Department of Health, about an unusual cluster of six late fetal deaths (≥ 28 weeks of gestation) in February 2008 among Bay County residents. Bay County Health Department and the local Healthy Start Coalition requested assistance from the Florida Department of Health. Due to the unusual nature of the situation, discussions were held in March and April with the Bay County Health Department; Bay, Franklin and Gulf Healthy Start Coalition; and the Division of Family Health Services in the Florida Department of Health. Staff from other departmental entities were consulted including the Office of Health Statistics and Assessment, Division of Environmental Health and Division of Disease Control. We also contacted the Centers for Disease Control and Prevention (Division of Reproductive Health and Division of Birth Defects and Division of Birth Defects and Developmental Disabilities), the National Institute of Child Health and Development (Pregnancy and Perinatology Branch), and the University of Florida in Jacksonville (Maternal Fetal Medicine Division). Based on these discussions and advice, a systematic investigation was launched.

Fetal death is defined by the National Center for Health Statistics as fetal deaths occurring at 20 or more weeks of gestation.^{1,2} Late fetal death is defined as a fetal loss by the 28th completed week of pregnancy or later. Leading causes of late fetal death include placental insufficiency or fetal malnutrition, and placental abruption.^{3,4} Frequently, the causes of late fetal death remain unexplained even after clinical and pathological evaluation. Unexplained fetal deaths are generally described as not having apparent etiology such as a major congenital anomaly, infection, or abruption.⁵ Common risk factors for fetal deaths are black race, extreme maternal age, maternal obesity, abnormalities of blood clotting, hypertension, diabetes, infection, infertility, multiple gestations, and exposures such as medications and toxins.^{3,5-7} The Healthy People 2010 Objective for fetal mortality, of 20 or more completed weeks of gestational age, is not more than 4.1 fetal deaths per 1,000 live births plus fetal deaths. The fetal mortality (≥ 20 weeks of gestation) rate was 7.3 per 1,000 live births plus fetal deaths in Florida in 2006, and was 5.3 per 1,000 live births plus fetal deaths in Bay County in 2006 (Three-year rate of 6.2 for 2004–2006).

INVESTIGATION OBJECTIVES

The following investigation objectives were established by investigators based on expert and local consultations:

1. To validate the occurrence of the late fetal death cluster
2. To explore the risk factors contributing to the cluster
3. To identify potential causes and commonality that explain the cluster
4. To assess the need for public health action

INVESTIGATION METHODS AND RESULTS

1st Investigation Question: Was there a statistically significant increase or cluster of late fetal deaths among Bay County residents in February, 2008?

Methods

A case was defined as an intrauterine fetal death of ≥ 28 weeks of gestation and birthweight $\geq 2,500$ grams occurring in February of 2008 to a Bay County resident regardless of hospital of delivery. We reviewed the obstetric delivery logs for both hospitals in Bay County to determine if any late fetal deaths were not reported by fetal death certificates. These two hospitals accommodate 98% deliveries to Bay County residents. To determine whether the number of late fetal deaths in February of 2008 were possibly due to chance, we used a Poisson probability distribution test to estimate the probabilities of obtaining the reported numbers of fetal deaths for a given 28 day period in the years from 1995 through 2007. This type of statistical testing was used because fetal deaths in Bay County followed a Poisson distribution.

Results

On the basis of our case definition, six late fetal deaths were identified. Review of obstetric delivery logs did not identify any additional fetal deaths or late fetal deaths meeting Florida reporting requirements. **Table 1** demonstrates the number of all fetal deaths in 169 28-day time-periods from 1995 to 2007 for Bay County residents. The highest number of fetal deaths in any period was four, and this occurred in four (2.4%) of the 169 time periods. The probability of six or more late fetal deaths occurring to Bay County residents in any 28 day period or for the 28 days of February, 2008 was $P = 0.0008$. In other words, the occurrence of six late fetal deaths in Bay County in February 2008 was highly statistically significant and unlikely to be due to chance or some random occurrence.

Table 1. Fetal death counts and Poisson probabilities for 28 day periods according to fetal death certificates, Bay County residents, Florida, 1995 to 2007

Bay County Fetal Deaths per 28 day period	Poisson Probability	Cumulative Poisson Probability	Cumulative Probability	Number of 28 Day Periods		Fetal Deaths
				Expected	Actual	
0	0.3509	0.3509	1.0000	59	51	0
1	0.3675	0.7184	0.6491	62	76	76
2	0.1924	0.9108	0.2816	33	29	58
3	0.0672	0.9780	0.0892	11	9	27
4	0.0176	0.9956	0.0220	3	4	16
5	0.0037	0.9992	0.0044	1	0	0
6	0.0006	0.9999	0.0008	0	0	0
7	0.0001	1.0000	0.0001	0	0	0
Total	1.000			169	169	177

2nd Investigation Question: How high was the rate of late fetal deaths among Bay County residents in February, 2008? To what extent did known risk factors identified on vital records contribute to this high rate of late fetal death or late fetal death cluster?

Methods

Chi-square analysis and t-test were used to test for statistically significant difference between the six late fetal deaths (≥ 28 weeks of gestation) in February 2008 and the 33 other fetal deaths in Bay County for January 2006 through March 2008. *P* value < 0.05 was considered statistically significant.

Logistic regression analysis was used with the cohort of statewide births plus fetal deaths for January 2006 through March 2008. The outcome of the investigation was late fetal deaths (≥ 28 weeks of gestation and birthweight $\geq 2,500$ grams). The risk factor of interest was Bay County residents in February 2008. Births and fetal deaths that met this criterion were considered positive for this risk factor. The comparison group for the risk factor is Florida County residents from January 2006 through March 2008 excluding Bay County resident from February 2008.

Results

Table 2 illustrates the maternal and infant characteristics for late fetal deaths occurring in February 2008 to Bay County residents using information from the fetal death certificates. The mother's mean age was 28 years and the women were of diverse racial and ethnic backgrounds. On average, the women were obese with a BMI of 33. All women had prenatal care with between 9 to 15 visits. The earliest fetal death was at 35 weeks, well beyond the cut off of 28 completed weeks of gestation, with a mean gestational age of 37.5 weeks.

The six late fetal deaths that occurred in Bay County in February 2008 were compared to 33 fetal deaths that occurred in Bay County in the years 2006 and 2007 and in the months of January and March of 2008 in terms of maternal characteristics (black race, smoking, education, and body mass index), gestational age, prenatal care, and birthweight. Contrary to the usual pattern for fetal deaths where more than half of fetal deaths were less than 28 completed weeks, all six fetal deaths in February were birthweight $\geq 2,500$ grams and gestation ≥ 28 weeks. Only the percentage of low birthweight ($< 2,500$ grams) and the percentage of later gestation were statistically significantly different ($P < 0.05$) using Chi-square test. This difference was also reflected in the comparison of the mean birthweight and mean gestational age ($P < 0.01$).

After adjusting for known risk factors collected on vital records--underweight body mass index, obesity, Black race, smoking, low education, no prenatal care, maternal age, chronic diabetes, chronic hypertension, and prior terminations--the adjusted odds ratios for late fetal death among Bay County residents in February, 2008 births compared to Florida for January 2006 to March 2008 was highly statistically significant. The adjusted odds ratio was 29.9 (95% confidence interval, 12.9–69.5). In other words, the risk among Bay County residents was almost 30 times the risk for the other births and fetal deaths among Florida residents accounting for all of the listed risk factors (**Table 3**). The unadjusted odds ratio or the odds ratio when the risk factors were not accounted for was 26.9. This means that these known risk factors did not explain any of the increase fetal mortality risk in Bay County in February, 2008. In fact, the risk was slightly higher when the risk factors were considered. Some of the women with fetal deaths were found to be at higher risk with one or more known risk factors, but these risk factors did not explain the increase in the fetal mortality rate in Bay County in February, 2008. Moreover, these risk factors were not sufficient by themselves to cause fetal demise.

Table 2. Maternal and infant characteristics for the six late fetal deaths (≥ 28 weeks of gestation) occurring in February 2008 according to fetal death certificates, Bay County residents, Florida

Characteristics	Mean or Number	Range
Maternal age (years)	28 years	21–36 years
Maternal race	2 Blacks	
Maternal ethnicity	1 Hispanic	
Prepregnancy body mass index (kg/m^2)	34.3	20.5–50.4
Gestational weight gain (lbs)	27.3 lbs.	9–45 lbs.
Total prenatal care visits	12.5 visits	10–14 visits
Gestational age (weeks)	36.9 weeks	36–39 weeks
Birthweight (grams)	3,227 grams	2,637–3,884 grams

Table 3. Florida births plus fetal deaths January 2006 through March 2008, adjusted odds ratios for fetal death $\geq 2,500$ grams by risk factor

Risk Factor	Fetal Death		
	$\geq 2,500$ grams	95% Confidence interval	
	Adjusted Odds Ratio	Lower	Upper
Maternal BMI $< 18.5 \text{ kg}/\text{m}^2$	0.51	0.29	0.88
Maternal BMI $\geq 35 \text{ kg}/\text{m}^2$	1.70	1.34	2.15
Maternal race Black	1.41	1.16	1.70
Maternal smoking	1.75	1.35	2.28
Maternal education $<$ High School	1.16	0.94	1.43
No prenatal care	2.40	1.55	3.71
Maternal age > 35 years	1.11	0.86	1.43
Maternal age < 18 years	0.59	0.32	1.09
Chronic diabetes	9.45	6.90	12.93
Chronic hypertension	2.44	1.65	3.61
Prior terminations	1.16	0.96	1.40
Bay County resident in February 2008	29.94	12.90	69.49

3rd Investigation Question: Were there common risk factors, medical conditions, health services or reported causes that explained the cluster of late fetal deaths?

Methods

We developed a medical records abstraction form to collect information from prenatal records, hospital charts, and available pathology and autopsy reports (see Appendix A for the abstraction form). Access was provided to all prenatal and hospital records for all six late fetal deaths. All records were abstracted by nurses, physicians, and epidemiologists familiar with prenatal and delivery records and then verified by another abstractor. The investigation focused on risk factors, medical conditions, health services and reported causes that might explain the fetal deaths individually and collectively.

We used the US National Reference for Fetal Growth using their birthweight at the time of delivery to evaluate fetal growths.⁸ The National Reference for Fetal Growth provides 5th, 10th, 50th, 90th, and 95th percentiles of birthweight for gestational age. Birthweights from six fetal deaths were plotted to the fetal growth percentile curves across gestational age groups.

Results

All six late fetal deaths occurred prior to the onset of labor or hospital admission for delivery. All women received prenatal care with first trimester entry and up until the time of fetal demise. No woman was seen as an outpatient or in the emergency room in the 72 hours prior to the recognition of fetal demise for pregnancy-related issues that could have contributed to the fetal death. All women were managed clinically by obstetricians throughout their pregnancies. These fetal deaths occurred in both delivery hospitals in Bay County, and were cared for by multiple obstetrical providers prenatally and during their hospital stay. No commonality of care was identified that could have contributed to these events.

Table 4 illustrates clinical information and risk factors for late fetal deaths occurring in February 2008, Bay County, Florida. The placentas of all six fetal deaths were sent to pathology for examination; only two fetal deaths were submitted for autopsy. Clinical causes reported in hospital and pathology records included unusual coiled cords (2 fetal deaths), visible placental infarcts but not a substantial portion of the placenta (2), dark clot (1), epidermal separation (1), fibrosis plaque (1), loose nuchal cord (1), and two vessel cords (1). Identified medical conditions included oligohydramnios (1 fetal death), lupus anticoagulant antigen (1), and A1298C mutation (1). Identified risk factors included diabetes (2 fetal deaths), chronic hypertension (2), previous preterm (1), and asthma (1).

There was discrepancy between fetal death certificates and medical charts. Chronic hypertension and asthma were not recorded on the fetal death certificate, but were recorded on medical charts. After abstracting information from medical charts, there were slight changes on mean BMI of 33.1 kg/m² (range 20.5–50.4), mean gestational weight gain of 29 lbs (range 9–47), mean total prenatal care visits of 12 (range 9–15), mean gestational age of 37.5 weeks (range 35.6–39.6), and mean birthweight of 3,367 grams (range 2,630–4,432).

After consulting with state and national experts, these clinical causes, medical conditions, and risk factors were not sufficient at an individual level to explain one late fetal death. In addition, no common conditions or risk factors were present in a majority of these deaths to explain having a cluster. Only one mother had an extensive clinical work up related to having a fetal death similar to that recommended in the 2007 ACOG Clinical Opinion.⁹ No placental, cord, or fetal tissues were frozen for examination at a later date.

When fetal growths were evaluated, five cases had fetal growth within 10th and 90th percentile, and one case had ≥ 95th percentile of the US National Reference for Fetal Growth using their birthweight at the time of delivery (**Figure 1**). No growth restriction was observed in six late fetal deaths based on birthweight at the time of delivery.

Table 4. Clinical information and risk factors for six late fetal deaths, Bay County, Florida, February 2008*

Causes	Conditions	Risk Factors
Infarcts (2 fetal deaths)	Oligohydramnios	Obese (3 fetal deaths)
Unusual Coiled Cord (2)	Lupus Anticoag Antigen	Chronic hypertension (2)
Dark Clot	A1298C Mutation	Diabetes (2)
Epidermal Separation		Black race (2)
Fibrosis Plaque		Previous preterm birth
Hemorrhagic Cyst		Infertility problem
Loose Nuchal Cord		Advanced maternal age
2 Vessel Cord		Asthma
		Smoking during pregnancy

*One fetal death may have more than one causes, conditions, and risk factors.

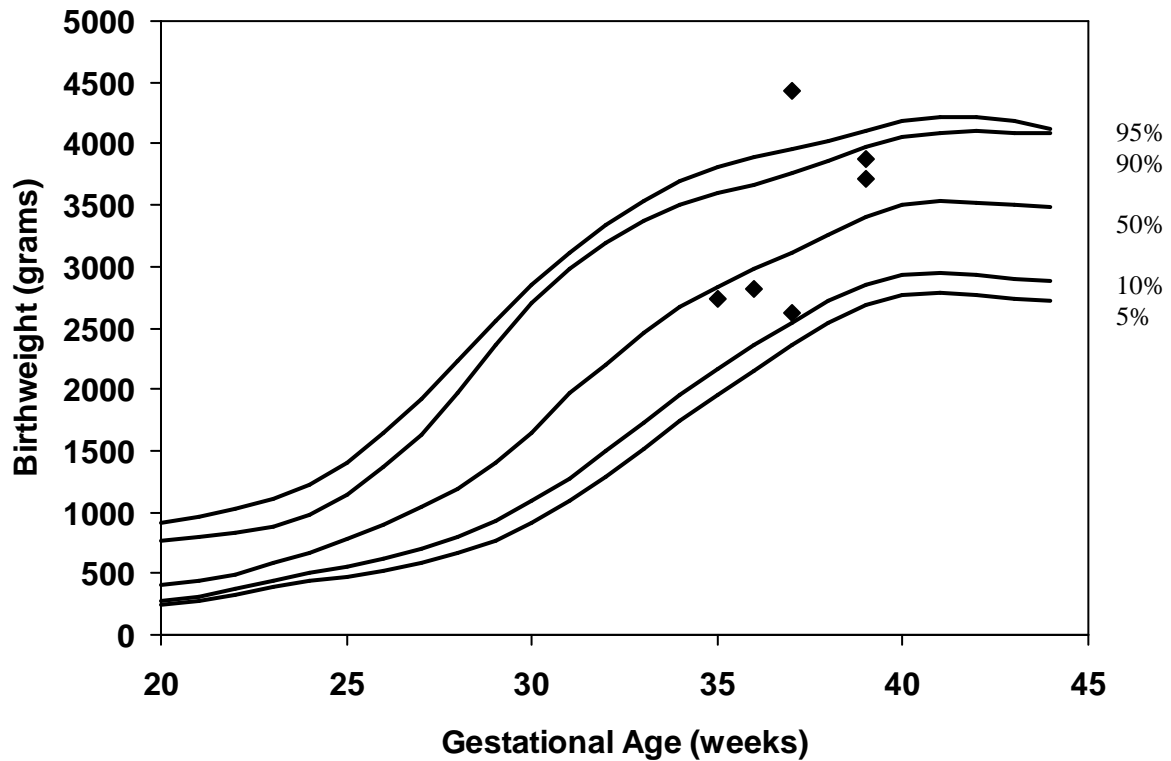


Figure 1. Six late fetal deaths by birthweight and gestational age, Bay County Residents, February, 2008.

Solid lines represent US National Reference for Fetal Growth for 5th, 10th, 50th, 90th, and 95th percentile. Diamonds represent six late fetal deaths in February 2008 in Bay County. Five cases had fetal growth within 10th and 90th percentile and one case had \geq 95th percentile of the US National Reference for Fetal Growth using their birthweight at the time of delivery.

4th Investigation Question: Were there environmental or infectious disease exposures in the community that may explain the cluster of late fetal deaths?

Methods

We reviewed reports for various environmental exposures for Bay County for this time period including notifiable infectious diseases, Florida Poison Information Center calls, water quality testing, environmental spills, and toxic waste sites. This information was obtained from the Divisions of Environmental Health and Disease Control at the Florida Department of Health. We also geocoded the geographic residence of mothers with late fetal deaths in February 2008 to compare the occurrence topology and potential commonality in the community.

Results

After systematically reviewing environmental data sources, no commonality explained the occurrence. **Figure 2** demonstrates a summary report of information on all substance exposure calls from Bay County to the Florida Poison Control Center. There was no increase in substance exposure calls from Bay County on February 2008. No infectious disease outbreaks or environmental spills in Bay County were reported from January to February 2008.

On February 22, 2008, Bay County issued precautionary boil water notice due to the extremely heavy rainfall in February. During the routine drinking water test, Bay County water system did not meet a drinking water quality standard. Turbidity (cloudiness) measurements of water in February exceeded the normal turbidity level. Turbidity has no health effects, but it can interfere with disinfection and provide a medium for microbial growth. Only one neighborhood tested positive for coliforms demonstrating inadequate disinfection for that specific area. The coliforms are a broad class of bacteria which live in the digestive tracts of humans and many animals. The presence of coliform bacteria in drinking water suggests that the treatment system is not working properly. Although many types of coliform bacteria are harmless, some can cause health problems which include diarrhea, cramps, nausea, and vomiting.¹⁰ New water quality regulations enacted after this event require water testing for more than just coliforms. In terms of this event, half of fetal deaths occurred during the days prior to the problem with water turbidity. No other abnormal water tests for public or private water supplies for Bay County were identified.

Figure 3 illustrates the reported maternal residence of the six late fetal deaths to Bay County residents in February 2008. No apparent pattern by geographic locations of maternal residence was identified; fetal deaths were from most populated areas of Bay County.

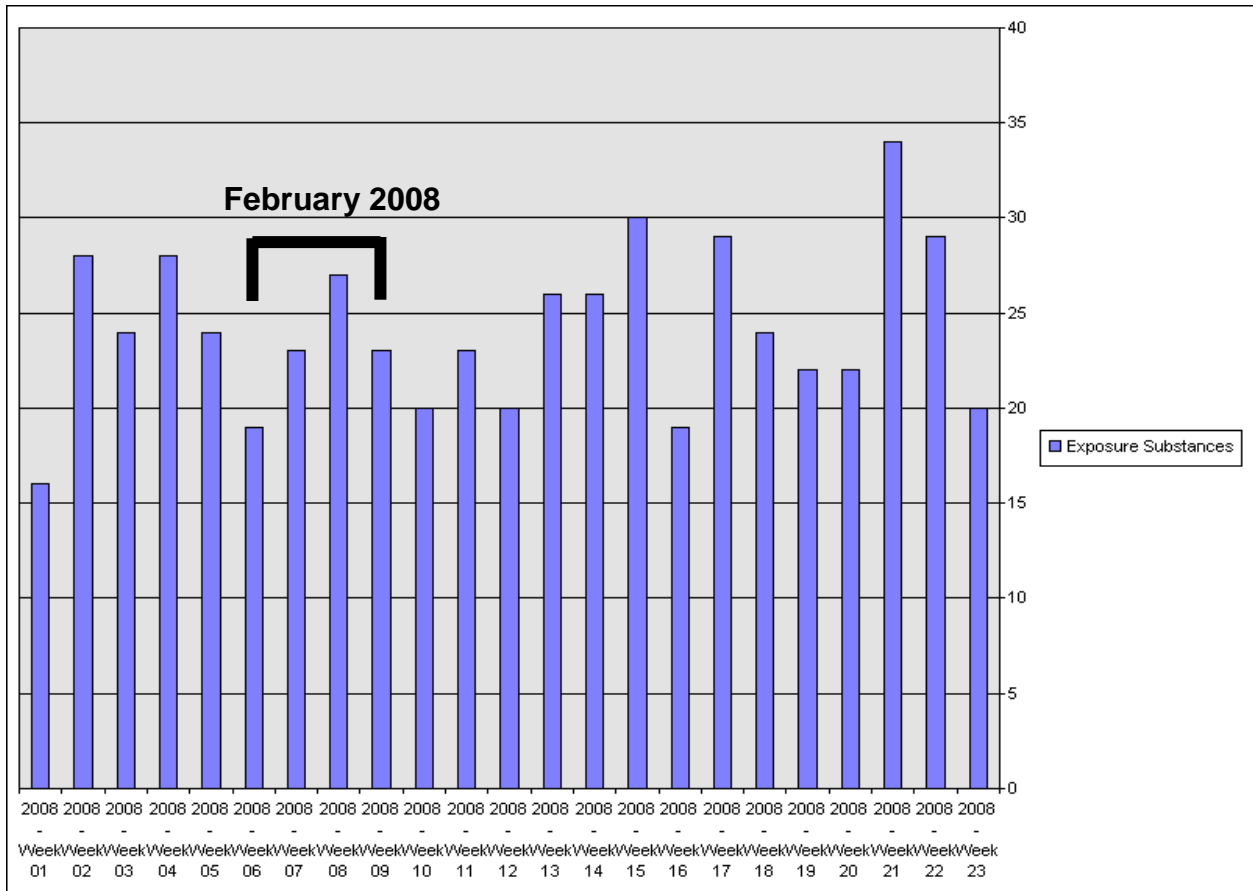


Figure 2. Exposure calls to the Florida Poison Control Center, Bay County residents, 2008. A summary report of information on all substance exposure calls from Bay County to the Florida Poison Control Center, January–April 2008.

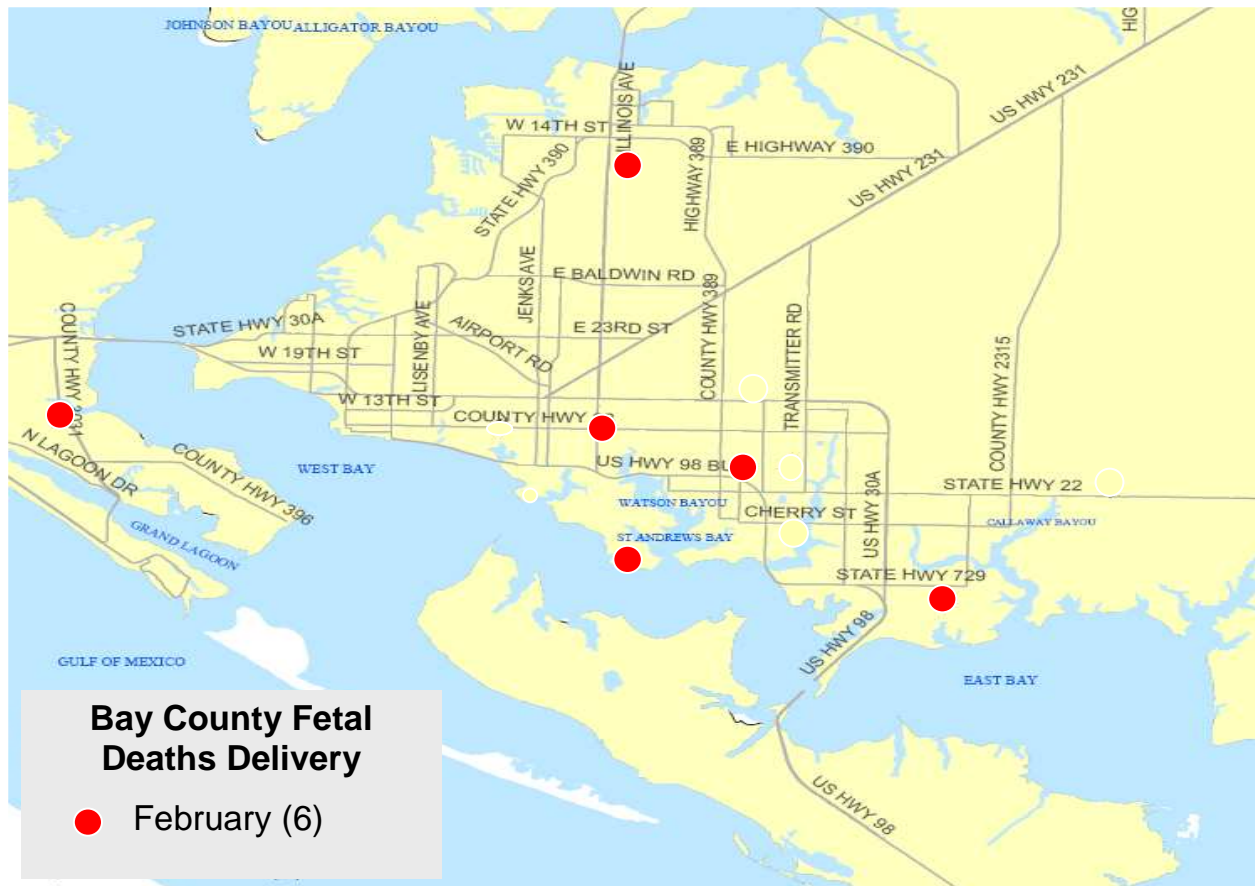


Figure 3. Six late fetal deaths by geographic location of maternal residence, Bay County, Florida, February, 2008. Red dots represent six late fetal deaths in February 2008 in Bay County. There was not a clear pattern in fetal deaths by geographic location.

5th Investigation Question: Were there other health issues or exposures missed by vital and medical records that may explain the cluster of late fetal deaths?

Methods

For our last investigative step, we developed a maternal interview form to collect additional information on prior illness and health conditions, occupation, pets, residence history, injury, dietary and environmental exposures, and natural father from the mothers that were not available from the fetal death certificates and prenatal and hospital charts. Again, the focus was on finding individual causes of fetal deaths or commonalities (see Appendix B).

Results

Of the six late fetal deaths in February 2008, four had maternal interviews conducted by phone or in-person. One mother could not be located based on available contact information from vital, prenatal, and hospital records; one mother did not respond after multiple attempts to contact her and set up a time to meet or call. Upon examining maternal interview responses, a maximum of two mothers had any common health issues, symptoms, or exposures such as dogs, secondhand smoking, working a job late into pregnancy, and household exposure to pesticides during pregnancy. Besides for pesticide exposure, none of the exposures were sufficient to explain the late fetal death. Moreover, the pesticide exposures were considered to be minimal based on the interview and not a major risk. None of the four women interviewed developed symptoms of gastrointestinal infection after the date of the February water turbidity episode. No commonality was identified among more than two mothers, and none are considered sufficient to account for fetal demise.

SUMMARY OF INVESTIGATION FINDINGS

- The hospitals, local Healthy Start Coalition, and county health department were quick to recognize and notify the Florida Department of Health of a probable problem with late fetal deaths in Bay County. Staff of the local Healthy Start Coalition and the local Fetal and Infant Mortality Review were prompt in noting, responding, and communicating with responsible parties. The risk of late fetal death cluster was almost 30 times the risk of late fetal deaths in Florida, even adjusting for known risk factors.
- The occurrence of six late fetal deaths in Bay County in February 2008 was highly statistically significant and unlikely to be due to chance.

- Known risk factors (underweight body mass index, obesity, Black race, smoking, low education, no prenatal care, maternal age, chronic diabetes, chronic hypertension, and prior terminations) did not explain any of the increase in the fetal mortality rate in Bay County in February, 2008. Some of the women with fetal deaths were found to be at higher risk with one or more known risk factors, but these risk factors did not explain the increase in the fetal mortality rate in Bay County in February, 2008. Moreover, these risk factors were not sufficient by themselves to cause fetal demise.
- All six late fetal deaths occurred prior to the onset of labor or hospital admission for delivery. No commonality of care was identified that could have contributed to these events.
- The placentas of all six fetal deaths were sent to pathology for examination; only two fetal deaths were submitted for autopsy. No common conditions or risk factors were present in a majority of these deaths to explain having a cluster.
- No placental, cord, or fetal tissues were frozen for examination at a later date.
- No fetal growth restriction was observed using their birthweight at the time of delivery.
- After reviewing environmental data sources (notifiable infectious diseases, Florida Poison Information Center calls, water quality testing, environmental spills, and toxic waste sites), no commonality explained the larger than expected number of late fetal deaths.
- Four had maternal interviews conducted by phone or in-person, and a maximum of two mothers had any common health issues, symptoms, or exposures such as dogs, secondhand smoking, working a job late into pregnancy, and household exposure to pesticides during pregnancy. No commonality was identified among more than two mothers, and none are considered sufficient to account for fetal demise.

INVESTIGATION LIMITATIONS

- The lack of autopsy information limited the medical information potentially available to explain the cluster. Only two fetal autopsies were able to be documented.
- The lack of complete clinical and laboratory evaluations of the mother with late fetal deaths limited the investigation of these potential causes and risk factors.
- No placental cultures or testing for infectious diseases were available for any of the six late fetal deaths. Blood and placenta cultures could have been helpful in ruling out fetal Listeriosis or other fetal infections. No placental, cord, or fetal tissue were frozen for testing at a later time. However, mothers did not report any symptoms or demonstrate any symptoms related to infectious diseases during pregnancy. No Listeriosis cases have been recently reported for Bay County in 2008.

- Two maternal interviews were not able to be conducted and may have prevented the identification of common symptoms and exposures.
- This investigation was done retrospectively using prenatal care records and hospital charts and may have not collected all of the potentially useful information to the investigation.
- There were a small number of investigation cases, which limits statistical power to detect statistical significance and conduct a larger more informative case-control study.
- At this point, there is limited scientific understanding of the causes of late fetal deaths and methods for detecting the causes.

CONCLUSIONS

Bay County experienced a significant increase in late fetal deaths in February 2008. Known risk factors, such as underweight body mass index, obesity, Black race, smoking, low education, no prenatal care, maternal age, chronic diabetes, chronic hypertension, and prior terminations, did not explain any of the increase in the fetal mortality rate in Bay County in February, 2008. Some of the women with fetal deaths were found to be at higher risk with one or more known risk factors, but these risk factors did not explain the increase in the fetal mortality rate in Bay County in February 2008. Moreover, these risk factors were not sufficient by themselves to cause fetal demise. No common cause or commonality was identified that explains the occurrence after a comprehensive systematic investigation. In fact, no definitive explanation or causes for individual cases were identified. At this point, no public health actions are recommended.

RECOMMENDATIONS

Health Care Providers

1. Continue active ongoing surveillance of late fetal deaths (≥ 28 weeks of gestation). Community hospitals and County Health Department need to closely monitor fetal deaths to determine whether the increased numbers of late fetal deaths are continuing.
2. Obstetricians and pathologists broaden their clinical work up of these late fetal deaths to identify potential causes. Broader assessments might help explain the occurrences of these late fetal deaths as well as provide specific benefits to the mothers and family. Experts from the Centers for Disease Control and Prevention, the National Institute of Child Health Development and the University of Florida, concur with the following recommendations. However, we may not be

able to explain future late fetal deaths even with following these recommendations. In past research studies, a substantial portion of these late fetal deaths cannot be explained because of the limits of current scientific knowledge.

- Clinical work ups should follow the Committee Opinion on "Evaluation of Stillbirths and Neonatal Deaths" of the American College of Obstetricians and Gynecologists issued in October 2007.⁹ This opinion recommends a number of tests that could be potentially beneficial. Some tests need to be performed prior to delivery or soon after delivery.
 - The pathologists should follow the College of American Pathologists Practice Guidelines from May 1997 if they are not already doing so.¹¹ Procedures from a recent national research study were provided for culturing and storing placental, cord and fetal materials for future studies as infections may play a role in this cluster and the extension of this cluster.
3. Provide preconception and interconception counseling for all women of childbearing age.

Women of Childbearing Age

1. To assist in the prevention of late fetal death, women of childbearing age should:
 - Seek preconception counseling for pre-identified chronic disease(s) and family planning
 - Choose healthy lifestyle behaviors before, during and after pregnancy
 - Seek early trimester prenatal care
 - Follow medical advice

Communities

1. Develop and implement community programs aimed at improving and promoting preconception health and improved pregnancy outcomes
2. Promote healthy lifestyle behaviors

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Isaac Delke

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Appendix A. Fetal Death Case Abstraction Form—Bay County, 2008

ABSTRACTORS

Abtractor initials and date _____ / ____ / ____ (mm/dd/yy)

Reviewer initials and date _____ / ____ / ____ (mm/dd/yy)

Resolver initials and date _____ / ____ / ____ (mm/dd/yy)

CASE IDENTIFICATION

Fetal Death Certificate:

Date of fetal delivery _____ / ____ / ____ (mm/dd/yy)

Certificate number _____

Mother's name (last/first) _____

Mother's residence (street address, City, Zip code, County)

Mother Date of Birth _____ / ____ / ____ (mm/dd/yy)

Hospital Medical Record

Hospital Name _____

Date of fetal delivery _____ / ____ / ____ (mm/dd/yy)

Hospital records number _____

Social Security Number _____

Mother's name (last/first) _____

Mother's residence (street address, city, zip code, county)

Mother's Date of Birth _____ / ____ / ____ (mm/dd/yy)

Prenatal Care Record

Provider Name _____

Record Number _____

Mother's Name (last/first) _____

Mother's Date of Birth _____ / ____ / ____ (mm/dd/yy)

MATERNAL CHARACTERISTICS

Mother's date of birth ____ / ____ / ____ (mm/dd/yy)
Married currently ____ not stated ____ no ____ yes
Race ____ black ____ white ____ other-specify: _____
Ethnicity ____ Hispanic ____ not stated ____ other-specify: _____
Highest educational level _____

PRENATAL CARE INFORMATION

Prenatal care received ____ no ____ yes
Prenatal care records available ____ no ____ yes ____ partial
Available for last month ____ no ____ yes ____ partial
Prenatal care provider _____
Date of first prenatal visit: ____ / ____ / ____ (mm/dd/yy)
Date of last prenatal visit ____ / ____ / ____ (mm/dd/yy)
Number of prenatal visits _____ prenatal visits

DELIVERY INFORMATION

Delivery outside of hospital ____ no ____ yes ____ other-specify: _____
Delivery hospital name _____
Delivery attendant name _____
Prenatal care practice ____ no ____ yes ____ other-specify: _____
Weight of fetus ____ lbs ____ ounces ____ grams
Gender of fetus ____ male ____ female ____ unknown ____ not stated
Date of last menstrual period ____ / ____ / ____ (mm/dd/yy)
Date of hospital admission ____ / ____ / ____ (mm/dd/yy)
Date of fetal death diagnosis ____ / ____ / ____ (mm/dd/yy) How confirmed?: _____
Date of delivery ____ / ____ / ____ (mm/dd/yy)
Date of estimated delivery ____ / ____ / ____ (mm/dd/yy)
OB gestational age estimate ____ completed weeks
Gest confirmed by ultrasound ____ no ____ yes at which gestational ages: _____

Amniocentesis no yes results: _____

Timing of fetal death before labor during labor during delivery unknown

Plurality singleton twin other—specify: _____

Delivery method

Vaginal / Spontaneous no yes

Vaginal / Forceps no yes

Vaginal / Vacuum no yes

Dilation / Curettage no yes

Cesarean, emergent no yes

Cesarean, planned no yes

Other no yes specify: _____

Resuscitation attempted no yes describe: _____

Hospital discharge:

Date of hospital discharge ____ / ____ / ____ (mm/dd/yy)

Other findings on hospital discharge:

OBSTETRICAL HISTORY

Maternal death / demise no yes describe: _____

Height feet inches

Pre-pregnancy weight lbs kg not stated

Weight at delivery lbs kg not stated

Weight gain during pregnancy lbs kg

History of previous C-section not stated no yes

Previous preterm birth not stated no yes

Previous fetal loss not stated no yes at which gestational age: ____ wks

Infertility problem not stated no yes

Infertility treatments not stated no yes specify _____

Last pregnancy outcome

Date of pregnancy ended ____ / ____ / ____ (mm/dd/yy) ____ not stated

Outcome ____ live born ____ stillborn ____ spontAb ____ elective termination ____ not stated

Health during the month prior to stillbirth diagnosis

Fever ____ not stated ____ no ____ yes-degree: _____

Infection ____ not stated ____ no ____ yes-describe: _____

Hypertension ____ not stated ____ no ____ yes-describe: _____

Nausea ____ not stated ____ no ____ yes-describe: _____

Diarrhea ____ not stated ____ no ____ yes-describe: _____

Vaginal bleeding ____ not stated ____ no ____ yes-spotting light heavy n/s

Recent trauma ____ not stated ____ no ____ yes-date: ____ / ____ / ____ (mm/dd/yy)

Describe _____

Decreased fetal movements ____ not stated ____ no ____ yes-how long: _____

Health at the time of admission

Fever ____ not stated ____ no ____ yes-degree: _____

Infection ____ not stated ____ no ____ yes-describe: _____

Hypertension ____ not stated ____ no ____ yes-describe: _____

Nausea ____ not stated ____ no ____ yes-describe: _____

Diarrhea ____ not stated ____ no ____ yes-describe: _____

Vaginal bleeding ____ not stated ____ no ____ yes-spotting light heavy n/s

Decreased fetal movements ____ not stated ____ no ____ yes-how long: _____

Fetal heart tones ____ not stated ____ no ____ yes-how determined: _____

Fetus already dead ____ not stated ____ no ____ yes-how long: _____

Labor / contractions ____ not stated ____ no ____ yes-how long: _____

Describe history of preceding events prior to fetal death

PRIOR MEDICAL HISTORY

Asthma ___ not stated ___ no ___ yes

Antiphospholipid Syndrome ___ not stated ___ no ___ yes

Bleeding disorder ___ not stated ___ no ___ yes specify: _____

Cardiovascular disease ___ not stated ___ no ___ yes specify: _____

Cholestasis of pregnancy ___ not stated ___ no ___ yes

Diabetes

 Type 1 ___ not stated ___ no ___ yes

 Type 2 ___ not stated ___ no ___ yes

 Gestational ___ not stated ___ no ___ yes

 Type not stated ___ no ___ yes

Genetic / metabolic disorder ___ not stated ___ no ___ yes specify: _____

Hypertension

 Chronic ___ not stated ___ no ___ yes

 Preeclampsia / eclampsia ___ not stated ___ no ___ yes

 Type not stated ___ no ___ yes

Renal disease ___ not stated ___ no ___ yes specify: _____

System lupus erythematosus ___ not stated ___ no ___ yes

Thyroid disorder ___ not stated ___ no ___ yes specify: _____

Thrombophilia ___ not stated ___ no ___ yes specify: _____

Obesity ___ not stated ___ no ___ yes

Other medical conditions: _____

History of domestic violence ___ not stated ___ no ___ yes specify: _____

Other findings on prior medical history:

CURRENT PREGNANCY / OBSTETRICAL COMPLICATIONS

Abruption

Complete ___ no ___ yes

Partial ___ no ___ yes

Type not stated ___ no ___ yes

Anemia ___ not stated ___ no ___ yes

Anhydramnios ___ not stated ___ no ___ yes

Chorioamnionitis ___ not stated ___ no ___ yes how long: _____

Gestational diabetes ___ not stated ___ no ___ yes

Incompetent cervix ___ not stated ___ no ___ yes

 Cerclage placed ___ not stated ___ no ___ yes when: _____

Infections

 Chlamydia ___ not stated ___ no ___ yes when: _____

 Coxsackie A & B ___ not stated ___ no ___ yes when: _____

 Cytomegalovirus ___ not stated ___ no ___ yes when: _____

 E. Coli ___ not stated ___ no ___ yes when: _____

 Gonorrhea ___ not stated ___ no ___ yes when: _____

 HIV ___ not stated ___ no ___ yes when: _____

 Leptospirosis ___ not stated ___ no ___ yes when: _____

 Lyme disease ___ not stated ___ no ___ yes when: _____

 Listeria ___ not stated ___ no ___ yes when: _____

 Parvovirus (Fifth's) ___ not stated ___ no ___ yes when: _____

 Strep Group B ___ not stated ___ no ___ yes when: _____

 Syphilis ___ not stated ___ no ___ yes when: _____

 Toxoplasmosis ___ not stated ___ no ___ yes when: _____

 Other ___ not stated ___ no ___ yes specify: _____

Meconium ___ not stated ___ no ___ yes thick: ___ yes ___ no

Oligohydrannios ___ not stated ___ no ___ yes

Preeclampsia / eclampsia ___ not stated ___ no ___ yes

Prolonged rupture (> 12 hrs) ___ not stated ___ no ___ yes duration: _____

Preterm labor ___ not stated ___ no ___ yes weeks gestation: _____

Polyhydramnios ___ not stated ___ no ___ yes

Placenta previa ___ not stated ___ no ___ yes

RH disease (isoimmunization) ___ not stated ___ no ___ yes

Uterine rupture ___ not stated ___ no ___ yes

Cord problems

Nuchal cord ___ not stated ___ no ___ yes tight? ___ yes ___ no ___ not stated

Prolapsed cord ___ not stated ___ no ___ yes

Cord torsion ___ not stated ___ no ___ yes

Cord entanglement ___ not stated ___ no ___ yes

Vasa Previa ___ not stated ___ no ___ yes

CURRENT PREGNANCY / OBSTETRICAL COMPLICATIONS

Fetal growth restriction ___ not stated ___ no ___ yes

If sonograms are available from prenatal records, describe weight of fetus and weeks gestation.

___ lbs ___ ozs ___ grams at _____ weeks of gestation

___ lbs ___ ozs ___ grams at _____ weeks of gestation

___ lbs ___ ozs ___ grams at _____ weeks of gestation

___ lbs ___ ozs ___ grams at _____ weeks of gestation

Other findings on current pregnancy:

ENVIRONMENTAL EXPOSURES DURING PREGNANCY

Cat exposure (during preg) ___ not stated ___ no ___ yes specify _____

Dietary supplements ___ not stated ___ no ___ yes specify _____

Home remedies ___ not stated ___ no ___ yes specify _____

Over-the-counter medications ___ not stated ___ no ___ yes specify _____

Pain medication ___ not stated ___ no ___ yes specify _____

Pesticides ___ not stated ___ no ___ yes specify _____

Prescription medications ___ not stated ___ no ___ yes specify _____

Radiation ___ not stated ___ no ___ yes

Substance use

 Alcohol ___ not stated ___ no ___ yes specify _____

 Tobacco ___ not stated ___ no ___ yes specify _____

 Illicit drugs ___ not stated ___ no ___ yes specify _____

Tick bite (during pregnancy) ___ not stated ___ no ___ yes specify _____

MATERNAL LABORATORY FINDINGS

Anticardiolipin Antibody ___not stated ___no ___normal ___abnormal—value: _____

Creatinine ___not stated ___no ___normal ___abnormal—value: _____

Cytomegalovirus IgG ___not stated ___no ___normal ___abnormal—value: _____

Cytomegalovirus IgM ___not stated ___no ___normal ___abnormal—value: _____

Factor V Leiden ___not stated ___no ___normal ___abnormal—value: _____

HgbA1c (diabetes test) ___not stated ___no ___normal ___abnormal—value: _____

Kleihauer-Betke ___not stated ___no ___normal ___abnormal—value: _____

Lupus Anticoagulant Antibody ___not stated ___no ___normal ___abnormal—value: _____

Parvovirus IgG ___not stated ___no ___normal ___abnormal—value: _____

Parvovirus IgM ___not stated ___no ___normal ___abnormal—value: _____

Platelet counts ___not stated ___no ___normal ___abnormal—value: _____

Protein C activity ___not stated ___no ___normal ___abnormal—value: _____

RPR (Syphilis test) ___not stated ___no ___normal ___abnormal—value: _____

Thyroid Stimulating Hormone ___not stated ___no ___normal ___abnormal—value: _____

Maternal Drug Screen ___not stated ___no ___yes

 Date ___ / ___ / ___ (mm/dd/yy)

 Source ___ urine ___ blood ___ not stated ___ other—specify: _____

Amphetamines ___not stated ___no ___normal ___abnormal—value: _____

Cocaine ___not stated ___no ___normal ___abnormal—value: _____

Opiates ___not stated ___no ___normal ___abnormal—value: _____

THC/marijuana ___not stated ___no ___normal ___abnormal—value: _____

Other: _____ ___not stated ___no ___normal ___abnormal—value: _____

MTHFR gene mutation ___not stated ___no ___yes specify: _____

Other abnormal results (including cultures)

POSTMORTEM EVALUATION

Placenta sent to pathology ___not stated ___no ___yes

Pathology report available ___no ___yes ___partial

PLACENTA EVALUATION

Placenta weight _____ grams

Measurements ___ x ___ x ___ cm specify: ___ trimmed ___ untrimmed ___ not stated

Description

Circumvallate ___not stated ___no ___yes

Bilobed ___not stated ___no ___yes

Accessory lobe ___not stated ___no ___yes

Not stated ___not stated ___no ___yes

Hemorrhage/abruption ___not stated ___no ___yes

Location ___ retroplacental ___ marginal ___ other ___ not stated

Percentage ___ % of placenta

Measurement ___ x ___ x ___ cm

Infarcts ___not stated ___no ___yes

Percentage ___ % of placenta

Coverage ___ focal/small ___ diffuse ___ not stated

Chorioamnionitis: ___ no ___ yes specify: ___ mild ___ mod ___ severe ___not stated

Villitis: ___ no ___ yes specify: ___ focal/mild ___ diffuse/marked ___ not stated

Multiple placenta ___ single ___ twin ___ triple ___ other—specify: ___

 Type ___ DiCDiA ___ MoCMoA ___ MoCDiA ___ not stated

 Anastomoses: ___not stated ___no ___ yes type: _____

Bacterial cultures ___not stated ___no ___ yes findings: _____

Viral cultures ___not stated ___no ___ yes findings: _____

Other placental findings (including microscopic findings)

UMBILICAL CORD EVALUATION

Length (in delivery room) ___ cm ___ in ___ Not recorded in delivery note

Length (in pathology) ___ cm ___ in ___ Not recorded

Number of vessels ___

Insertion distance (nearest margin) ___ cm ___ in ___ not stated

Cord location ___ central ___ eccentric ___ marginal ___ not stated

Velamentous ___not stated ___no ___ yes

Knots ___not stated ___no ___ yes specify: ___true ___false ___not stated

Corditis/funisitis ___not stated ___no ___ yes

Constriction ___not stated ___no ___ yes

Rupture ___not stated ___no ___ yes

Thrombosis ___not stated ___no ___ yes

Wharton’s Jelly anomaly ___not stated ___no ___ yes

Coiling

 Excessive/Marked ___not stated ___no ___ yes

 Absent (straight cord) ___not stated ___no ___ yes

 Coiling index _____ coils/cm ___ not stated

Other cord findings (including microscopic findings)

FETAL EXAM

Gross Fetal Exam ___not stated ___no ___ yes

Fetal autopsy offered ___not stated ___no ___ yes

Fetal autopsy done ___not stated ___no ___ yes

Macerated ___not stated ___no ___ yes

 Degree macerated ___ mild ___mod ___ severe ___ not stated

Foot length ___ cm ___ in ___ not stated

Crown-rump length ___ cm ___ in ___ not stated

Estimated Gest Age ___ completed weeks ___ not stated

Additional studies

 Radiographs ___not stated ___no ___ yes findings: _____

 Photographs ___not stated ___no ___ yes findings: _____

 Bacterial cultures ___not stated ___no ___ yes findings: _____

 Viral cultures ___not stated ___no ___ yes findings: _____

 Karyotyping ___not stated ___no ___ yes findings: _____

Structural defects ___not stated ___no ___ yes

 Multiple defects ___not stated ___no ___ yes

Description: _____

Other fetal findings (including autopsy and microscopic findings)

Appendix B. Maternal Home Interview Form

INTERVIEWERS

Name (last / first) _____

Interview date _____ / _____ / _____ (mm/dd/yy)

CASE IDENTIFICATION (*Get this information from Fetal Death Certificate*)

Fetal Death Certificate number _____

Date of fetal delivery _____ / _____ / _____ (mm/dd/yy)

INFORMATION ON MOTHER

I am going to ask some questions about you and your recent pregnancy.

DEMOGRAPHICS

What is your name? (last/first) _____

When is your birthday? _____ / _____ / _____ (mm/dd/yy)

What is your race? ___white ___black ___other (specify: _____)

What is your ethnicity? ___Hispanic ___Non-Hispanic ___other (specify: _____)

What is your highest education level you completed?

___8th or less ___High school but no diploma ___High school diploma or GED ___College but no degree

___College degree ___Associate ___Bachelor's ___Master's ___Doctorate

Where did you live at the time of conception? (street address, city, zip code, county)

Did you move during pregnancy? ___ no ___ yes

If yes, how many times did you move during pregnancy? _____

What was the address of your previous residence? (street address, city, zip code, county)

Did you live in this current home at the time of delivery? ___no ___yes

If no, what was your home address at the time of delivery? (street address, city, zip code, county)

MEDICAL CONDITIONS

Do you have had any of following health conditions?

- Asthma ___ no ___yes
- Diabetes (chronic, not gestational) ___ no ___yes
- Hypertension (chronic) / high blood pressure ___ no ___yes
- Kidney disease ___ no ___yes
- System lupus erythematosus ___ no ___yes
- Thyroid disorders ___ no ___yes

Have you had a previous spontaneous abortion, stillbirth or fetal deaths? ___ no ___yes (specify how many:___)

Do you have family history of genetic diseases or disorders? ___ no ___yes (specify:_____)

Do you have family history of birth defects? ___ no ___yes (specify:_____)

INFECTIONS DURING PREGNANCY

Were you exposed to a cat or animals during your pregnancy? ___ no ___ yes (specify: _____)

Did you have a tick bite during pregnancy? ___ no ___ yes (when:_____)

Did you have sexually transmitted infections during your pregnancy? ___no ___ yes (specify type:_____)

During the last month of your pregnancy,

Did you have fever? ___no ___ yes (describe:_____)

Did you have any infections? ___no ___ yes (describe:_____)

Did you have severe nausea? no yes (describe:_____)

Did you have vomiting? no yes (describe:_____)

Did you have dehydration? no yes (describe:_____)

Did you have severe headache or neck stiffness? no yes (describe:_____)

Did you eat frozen chicken, pork, or beef burrito or grilled chicken strips from “Gourmet Boutique”, “Jan’s”, or “Archer Farms” during pregnancy? no yes (When did you eat? _____)

Do you still have the package? no yes (Produced date ___/___/___ Expiration date ___/___/___)

DIETARY EXPOSURE DURING PREGNANCY

During your pregnancy,

Did you eat unpasteurized dairy products (milk, cheese)? no yes (specify:_____)

Do you eat any homemade dairy products (butter, cheese, etc)? no yes (specify:_____)

Do you touch your mouth while handling raw meat or seafood? no yes (specify:_____)

Did you wash hands and utensils after handling raw meat or seafood? no yes

Did you eat undercooked or raw foods (fish, meat, seafood)? no yes (specify:_____)

Did you eat other non-processed or unusual foods? no yes (specify:_____)

Did you take dietary supplements (multivitamins/minerals, single vitamins/minerals)? no yes

If yes, lists names of supplements _____

How often did you take per day? once twice three times

Did you take Total Body Formula dietary supplement on January and/or February 2008? no yes

Did you take some other dietary supplement on January and/or February 2008? no yes

Did you take herbal supplements? no yes (specify:_____)

How often did you take per day? once twice three times

Did you take home remedies? no yes (specify:_____)

Other than prenatal vitamins, did you take any over-the-counter or prescribed medicine during pregnancy, even for a short period of time? no yes (specify: _____)

ENVIRONMENTAL EXPOSURE DURING PREGNANCY

Did you smoke cigarettes or use tobacco products during pregnancy? no quit smoking before pregnant quit smoking during pregnancy yes (frequency: _____)

Did you drink alcohol during pregnancy? no yes (frequency: _____)

Did you use any illicit drugs (marijuana/THC or hashish, cocaine, Amphetamines, Opiates) during pregnancy? no yes (specify: _____)

Did you work during you pregnancy? no yes (specify: _____)

Were you exposed to hazardous chemicals, pesticides, fumes, or radiation? no yes
(Examples: paints, chlorine, dry cleaning fluids, anesthetic gases, acetone, formaldehyde, etc.)

If yes, what were those hazardous materials? _____

When were you exposed? _____

Did you take any fertility drugs or receive any medical procedures from a doctor, nurse, or other health care worker to help you get pregnant? (This may include infertility treatments such as fertility-enhancing drugs or assisted reproductive technology.) no yes

Do you have complete plumbing facilities (including hot and cold running water, a flush toilet, and a bathtub or shower) in your home? no yes

Do you get the “drinking” water you use in your home from a city or county water supply or from a private well? City or county water supply Private well

Do you get the water you use in your home from a city or county water supply or from a private well? City or county water supply Private well

Did you travel during pregnancy? no yes (When and where? _____)

INJURY DURING PREGNANCY

During the last month of your pregnancy, were you injured in any way? ___no ___ yes (describe: _____
_____)

Did you have a car accident? ___ no ___ yes (if yes, were you hurt? ___ no ___ yes)

During your most recent pregnancy, did your husband or partner push, hit, slap, kick, choke, or physically hurt you
in any other way? ___ no ___ yes (describe:_____)

OTHERS

Did you live alone during pregnancy? ___ yes ___ no (with whom?_____)

What are hobbies of anyone in your home? _____

ADDITIONAL COMMENTS ON BABY’S MOTHER

INFORMATION ON BIOLOGICAL OR NATURAL FATHER

Now, I am going to ask questions about the biological or natural father’s of your baby.

DEMOGRAPHICS

When is the baby’s father’s birthday? ___ / ___ / ___ (mm/dd/yy) or How old is the baby’s father? _____years

What is the baby’s father’s race? ___white ___black ___other (specify: _____)

What the baby’s father’s ethnicity? ___Hispanic ___Non-Hispanic ___other (specify:_____)

What is the highest education level the baby’s father’s completed?

- ___8th or less ___High school but no diploma ___High school diploma or GED ___College but no degree
- ___College degree ___Associate ___Bachelor’s ___Master’s ___Doctorate

MEDICAL HISTORY

Does the baby’s father have family history or genetic/metabolic disorders? ___ no ___yes
(specify:_____)

ENVIRONMENTAL EXPOSURE

What drugs or medications did the baby’s father use before you became pregnant?
___ none ___ yes (specify: _____)

Before you became pregnant, did the baby's father work where hazardous chemicals, fumes, or radiation were regularly present? ___no ___unsure ___yes (what were those hazardous materials? _____)
_____)

Did the father of your baby live with you during your pregnancy? ___no ___ yes (specify: _____)

If no, skip the remaining questions.

Did the baby's father have a job during your pregnancy? ___ no ___ yes (specify each job he had:_____)

Did the father of your baby live or work with animals during your pregnancy? ___no ___ yes (specify: _____)

Did the father of your baby have frequent contact with a cat or animals during your pregnancy? ___ no ___ yes (specify: _____)

Did the baby's father have hobby during your pregnancy? ___no ___ yes (specify: _____)

Did you use the following substances during your pregnancy?

Smoking during pregnancy ___ no ___ yes (_____ packs per day)

Drink alcohol during pregnancy ___ no ___ yes (_____ drinks per day)

Illicit drugs ___ no ___ yes (specify:_____)

Did the baby's father travel while you were pregnant? ___ no ___ yes (when and where? _____)
_____)

ADDITIONAL COMMENTS ON BABY'S FATHER
