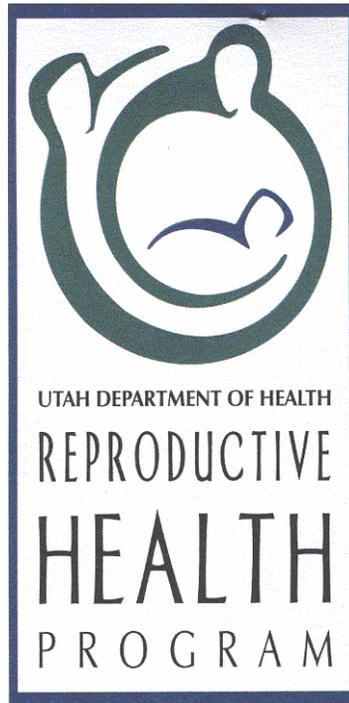


Infant Death in Utah

A State Review of Non-Anomalous Infant Deaths
Due To Perinatal Conditions
1995 - 1998



Utah Department of Health
Division of Community and Family Health Services
Maternal and Child Health Bureau

2003

Acknowledgements

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INTRODUCTION

The U.S. infant mortality rate decreased to the lowest rate ever recorded in 1999, ending a century that saw a 90% decrease in infant deaths.¹ Rates have decreased over time due to many factors: use of surfactants, improved sanitation practices, regional transport for high risk deliveries, improvements in case management, and increases in early enrollment in prenatal care. However, U.S. infant mortality rates continue to lag behind many industrialized nations. Low birth weight and prematurity rates have increased dramatically from 1984 to 1999.² Racial and ethnic disparities in infant mortality persist with the mortality rate of black infants more than twice that of white infants.³ Deaths in infants indicate a community's health and well-being as well as the extent to which its health and human services and other resources meet the needs of the women and infants in that community.⁴ Several factors such as maternal age, marital status, socio-economic status, alcohol and tobacco use and maternal education continue to be associated with poor birth outcomes.

Recognizing the importance of identifying and responding to issues raised by infant deaths, the Utah Department of Health began a Perinatal Mortality Review Program (PMRP) in 1995. The objectives of this program are to provide timely and pertinent statewide data on perinatal health, to develop an efficient and practical review process and to make recommendations for improving pregnancy outcomes.

OBJECTIVE

The purpose of this report is to describe maternal and infant characteristics of a select group of infants who died and compare these characteristics to the general population to assess Utah's perinatal health. This report describes the findings of the Utah PMRP from 1995 through 1998 for all non-anomalous infants who died of perinatal conditions.

METHODS

Linked birth and death certificates for all infants who died under one year of age were identified by vital records and sent to the PMRP coordinator once a month. Deaths from perinatal conditions were identified by selecting all records containing International Classification of Disease, 9th Revision (ICD-9) codes 760-779.9 and excluding those infants who died of SIDS or those where a lethal anomaly was identified. The PMRP Coordinator gained access to the medical records from the facility where the death occurred. Utah Code, Chapter 25 section 26-25-1 grants authority to provide data to the Department of Health for the purpose of reducing morbidity and mortality. Data were abstracted from infant and maternal medical records using field-tested tools provided by the National Fetal-Infant Mortality Review (NFIMR) Program and entered into an Epi Info database. Cases were summarized, de-identified and reviewed by the Perinatal Mortality Review Committee (PMRC). This committee was comprised of experts in perinatal health care who explored contributing factors that may have led to the death and then discussed strategies and made recommendations to prevent future deaths.

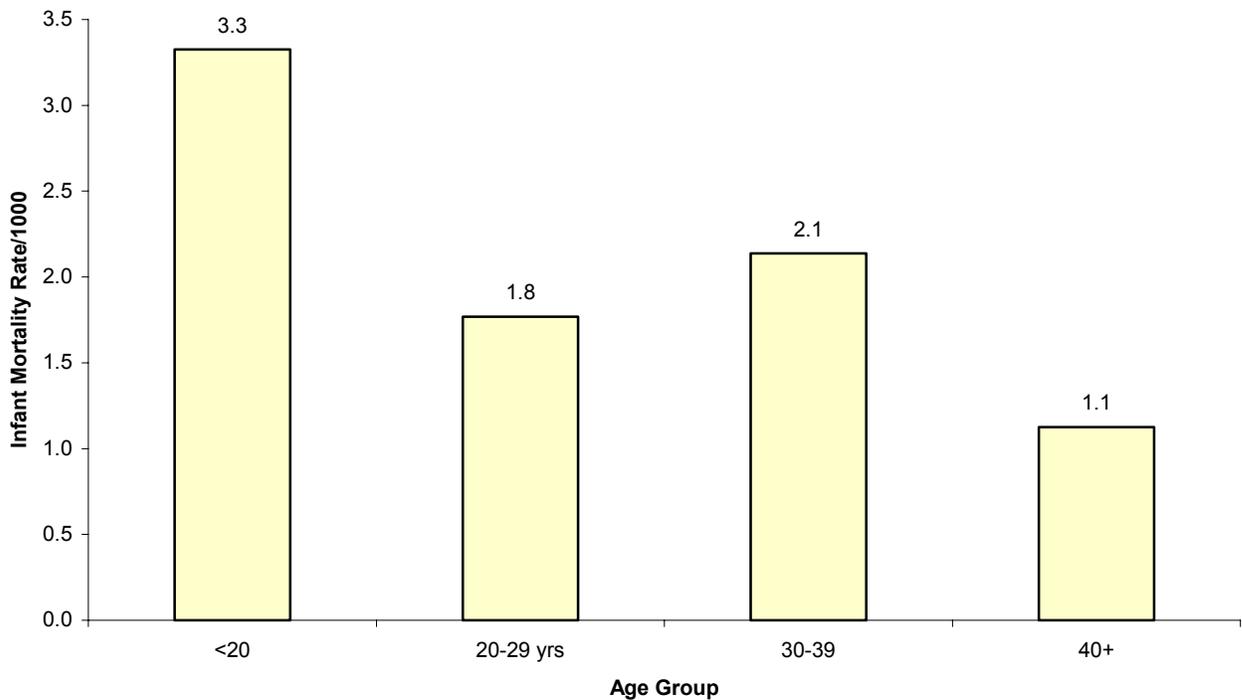
Infant mortality rates (infant deaths/1000 live births) were examined across various categories of potential risk and analysis was conducted using statistical analysis software (SAS version 8.0). Data were obtained from the PMRP database, Hospital discharge database, Vital Records birth and death certificates and from Utah's Indicator-Based Information System for Public Health (IBIS-PH). The chi square test of independence was used to examine the statistical significance of bivariate association between each independent variable and infant mortality. This statistical procedure is frequently used in health care research for similar queries.⁵

RESULTS

In the years 1995 through 1998, 962 infant deaths occurred in Utah and of those deaths, 370 cases met the review criteria. Table 1 shows maternal characteristics for the 342 mothers and Table 2 shows characteristics for the 370 infants. In some of the cells the numbers may not equal the total number examined due to missing data. The overall infant mortality rate for this group was 2.0/1000.

Maternal ages ranged from 14 to 40 years with higher mortality rates noted in the under 20 year old group (3.3/1000) and 30 to 39 year old group (2.1/1000). Both groups show a significant relationship between age and infant mortality ($p < 0.01$) when compared to 20-29 year olds (1.8/1000) as displayed in Figure 1.

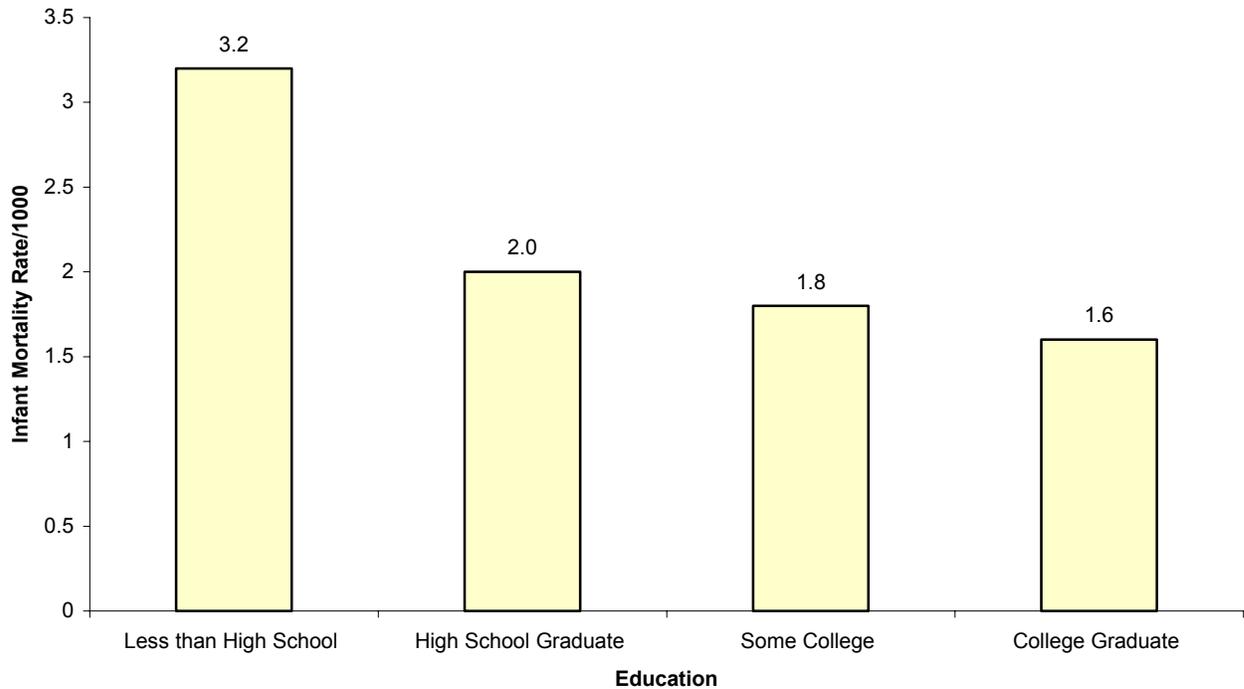
Figure 1. Infant Mortality Rate by Maternal Age



Seventy-six percent of mothers of infants in the study group were married. Unmarried women had a statistically significant higher rate of infant mortality (2.9/1000) than married women (1.8/1000) ($p < 0.05$).

Infant mortality rate by level of education (Figure 2) for the study group was higher for mothers with less than a high school education (3.2/1000 live births) than for those who had graduated high school (2.0/1000 live births) ($p < 0.01$).

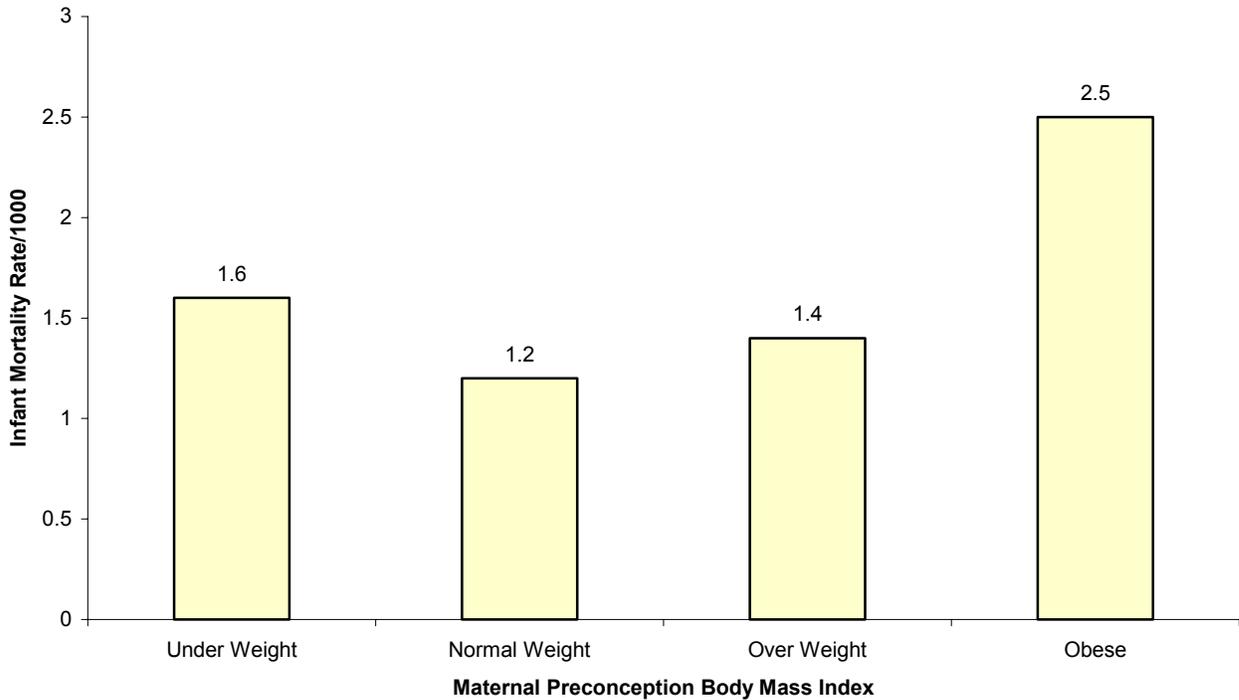
Figure 2. Infant Mortality Rate by Education



For 127 mothers, the pregnancy in which the death occurred was a first pregnancy while 206 of the women were having their second, third, or fourth pregnancy. The infant mortality rate was slightly increased in nulliparous women (2.0/1000 live births) in comparison to women having their second, third or fourth deliveries (1.9/1000 live births), but was not statistically significant.

The pre-conception weight of the women ranged from 88 pounds to 290 pounds. A Body Mass Index of 29.1 or greater was associated with a significantly increased risk of infant mortality (2.5/1000), ($p < 0.01$). (Figure 3).

Figure 3. Infant Mortality Rate by Maternal Preconception Body Mass Index



Lack of prenatal care was a significant indicator for infant mortality in Utah (7.1 deaths/1000) compared to women who had one or more prenatal visits (1.4 deaths/1000) ($p < 0.01$).

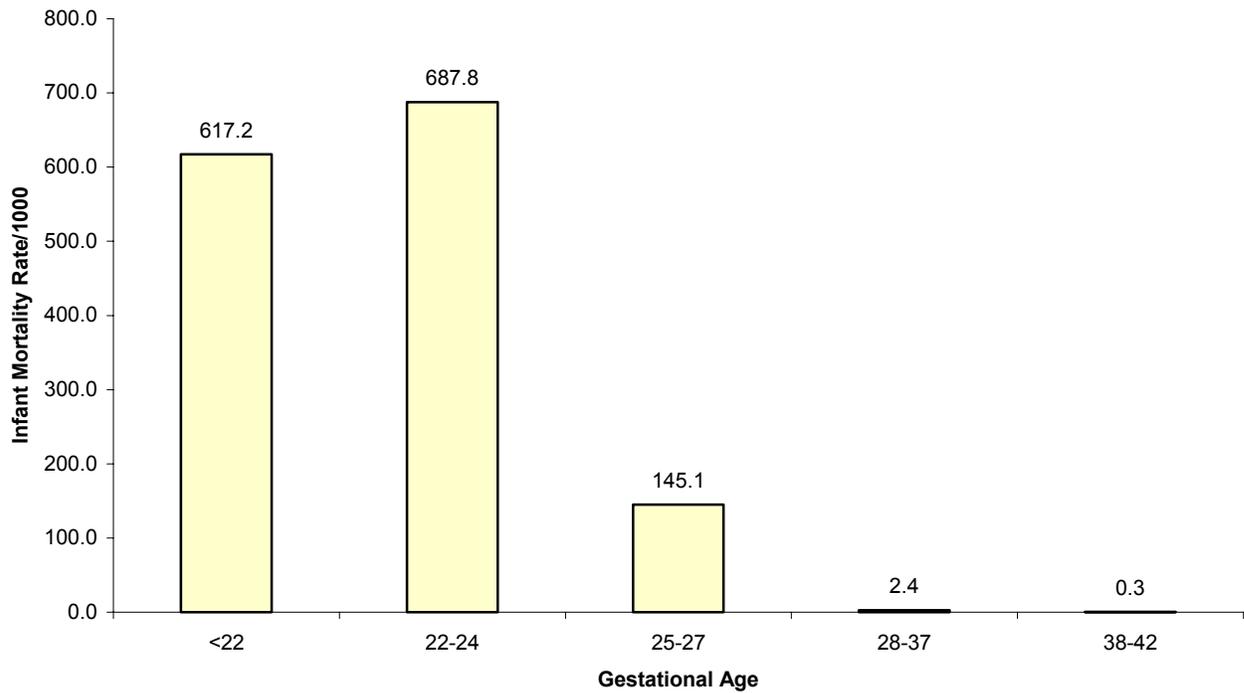
In the study group, 14% of the women utilized tobacco during their pregnancy. This proportion was greater than women in the general population at 9%. Use of alcohol during the pregnancy was higher (3%) in comparison to the general population of mothers (1.4%). The difference in infant mortality between alcohol and tobacco users and non-users was statistically significant.

More than half of the women in the study population (57%) delivered their infants vaginally. In comparing spontaneous vaginal versus assisted vaginal delivery, there was a higher infant mortality rate for infants delivering with vacuum or forceps ($p < 0.01$). While 40% of the women in the study population had a cesarean section, it also was associated with a statistically higher mortality rate ($p < 0.01$) compared to spontaneous vaginal delivery. The most common indication for surgery in the 134 cesarean sections was for fetal problems such as distress or breech presentation.

Most of the infant deaths reviewed in this study were associated with pregnancy complications. Placental abruption complicated 19% of pregnancies in the study population compared to a placental abruption rate of 1.7% of all maternal inpatient hospital discharges for labor and delivery. Uterine rupture occurred in 1.5% of infant deaths in the study population compared to 0.06% in the general population.

Preterm delivery at or below 24 weeks occurred in 231 of the 370 deaths. As gestational age increased, infant mortality decreased (Figure 4).

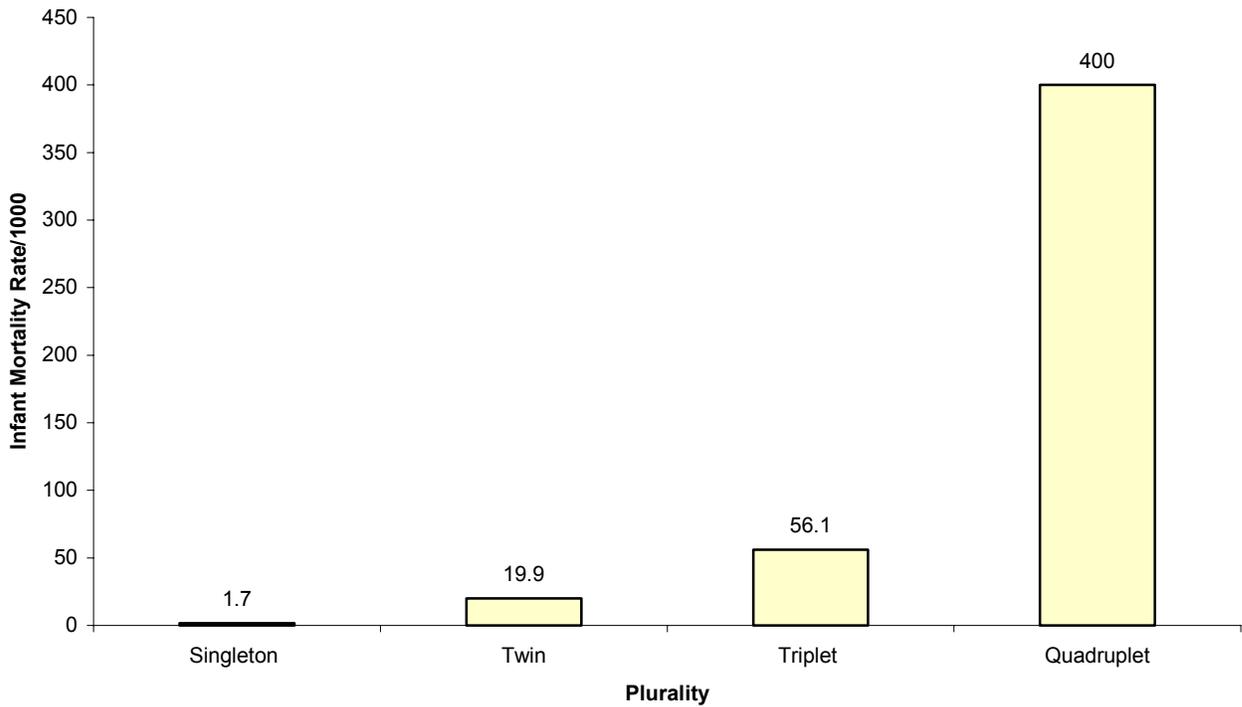
Figure 4. Infant Mortality Rate by Gestational Age



The gender distribution of the infant group was 217 males and 153 females with a statistically significant higher mortality rate for males ($p > 0.01$).

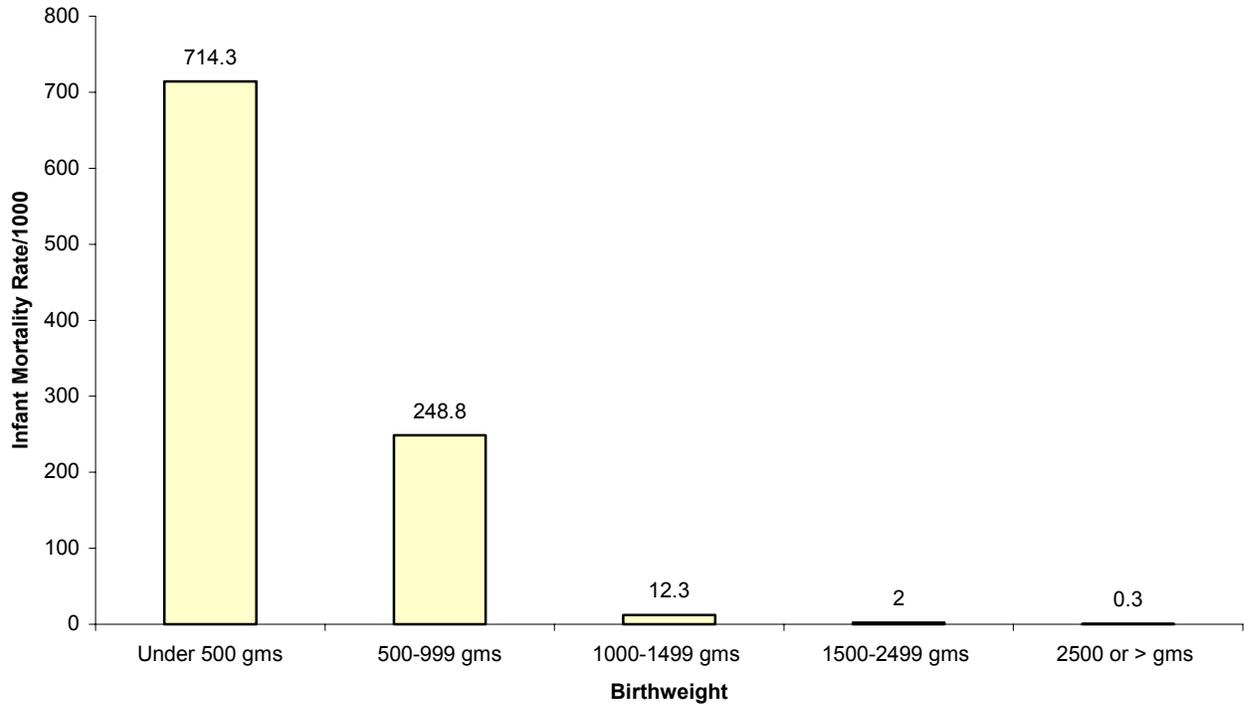
The infant mortality rate for multiple gestations in the study population was significantly higher than that of singletons. ($p < 0.01$) This rate increased incrementally from 1.7/1000 for singletons to 19.9/1000 for twins to 56.1/1000 for triplets to 400/1000 for quadruplets. There were 79 twin, 11 triplet and 4 quadruplet deaths reviewed (Figure 5).

Figure 5. Infant Mortality Rate for Plurality



The association between low birth weight (< 2500 grams) and infant mortality was statistically significant ($p < 0.01$). As birth weight increased, infant mortality rates decreased markedly from 714.3/1000 for infants < 500 grams to 0.3/1000 for infants 2500 grams or more. The majority of the infants in the study group (88%) were low birth weight. Of the low birth weight infants, 94% were categorized as very low birth weight (less than 1500 grams) (Figure 6).

Figure 6. Infant Mortality Rate by Birthweight



Of the 370 infant deaths in the study group, 56% died during the first 24 hours of life, 31% died between day 1 and day 28 and only 13% of the infants lived past the first 28 days into the postneonatal period.

The leading causes of infant deaths were prematurity, maternal causes such as placental problems and birth asphyxia, perinatal infections and respiratory disorders (Table 3). The PMRC examined issues associated with infant deaths and placed them into five categories including pregnancy related socio-demographic issues, maternal health factors, medical care provider issues, health care facilities issues and health systems issues (Table 4).

The PMRC also evaluated the ability to prevent the deaths for each of the 342 pregnancies. The committee opinion was in no chance that the outcome could have been altered in 290 of the cases. In 35 cases reviewed, the committee determined there was some chance the outcome could have been altered. In 8 cases there was a good chance, and in 9 cases there was a strong chance that the outcome could have been altered. During each case review, any recommendations for management of similar cases were recorded. These recommendations are listed in Table 5.

CONCLUSIONS

Several studies have evaluated maternal age and infant mortality rates.⁶ In the U.S., infants are more likely to be born premature to mothers less than 20 years of age. Our data showed a significant increase in mortality to infants of women less than 20 years with prematurity being the leading cause.

Pregravid body weight was a significant indicator for infant mortality in our study. As BMI increased from the overweight (26.1-29.0) to the obese category (29.1) the infant mortality rate doubled. Our data are consistent with studies evaluating the relationship of mother's pregravid body weight to pregnancy outcome.⁷

In the general population in Utah during the study period of 1995 to 1998, 99.5% of women had prenatal care and 84% of women who gave birth entered prenatal care during the first trimester. Prenatal care is essential for healthy outcomes of both mother and baby. Several studies have demonstrated that close monitoring of pregnancies can reduce morbidity and mortality rates.⁸ In our study population, only 81% of women entered prenatal care during the first trimester. Having no prenatal care was associated with a five times greater infant mortality rate.

Placental abruption complicates only 1-2% of all pregnancies but is associated with a very high mortality rate.^{9,10} In the general population of Utah, 1.7% of all pregnancies were complicated by placental abruption in the four-year time period studied, a rate consistent with the research findings. However, in our study population, placental abruption occurred in 19% of the pregnancies. Ananth and Wilcox state that the relative risk for abruption was highest in the lowest 1% of weight at each gestational age.⁹ The distribution of very low birth weight babies in our population may be related to placenta abruption.

The finding that preterm delivery occurred in 89% of the infant deaths in this population confirms that this problem remains an international epidemic in developed countries.² Risk factors for preterm birth include previous preterm delivery, multiple gestation, smoking, unplanned pregnancy, infection and poor nutrition. Continued surveillance of these factors is an essential component to having an impact on the reduction of the prematurity rate. The very low birth weight infants that result from these births are extremely difficult to manage and are some of the sickest babies in the NICU.¹¹⁻¹³ Our study confirms that as birth weight increased, mortality rates decreased.

The number of twin, triplet and other higher order multiple births has increased in the United States at a rapid pace.¹⁴ Preterm delivery, low birth weight, structural malformations and twin-to-twin transfusion syndrome can cause infant mortality in multiple gestations. In our study population, we noticed a significant correlation between death and the number of fetuses. The infant mortality rate for quadruplet pregnancy was 71 times higher than in singleton pregnancies. The PMRC strongly recommends that assisted reproductive technology be provided by accredited clinics and that American Society for Reproductive Medicine guidelines be strictly followed.

DISCUSSION

The PMRC continues to review infant mortality on an ongoing basis in an effort to prevent future infant deaths in the state of Utah. This discussion describes some of the actions that have or will take place based on the recommendations generated from the PMRC.

These results highlight many provider education opportunities. A frequently made recommendation is the need to screen and refer women for substance abuse. The Reproductive Health Program has published a newsletter report utilizing data obtained from the Pregnancy Risk Assessment Monitoring System (PRAMS) dataset that describes the prevalence of preventive counseling during prenatal care visits. Less than 50 percent of women surveyed reported that the topic of smoking, alcohol or street drug use was discussed with them during their prenatal care. This report will be disseminated to prenatal care providers throughout the state. Collaboration between the Utah Department of Health and the Utah Chapter of the American College of Obstetricians and Gynecologists (ACOG) will help to guide educational efforts to encourage prenatal care providers to include this important part of risk assessment for their pregnant patients.

Early and continuous prenatal care is widely accepted to decrease the risk of adverse pregnancy outcomes. Late entry and lack of prenatal care have been noted to greatly increase the risk of infant mortality in this study population. The Reproductive Health Program recently conducted focus groups among women who received inadequate prenatal care to determine contributing factors. This information has been extremely valuable in developing new social marketing messages to increase public awareness of the importance of early and continuous prenatal care. The Baby Your Baby media campaign has developed new television and radio spots using these messages, which are currently being aired throughout the state.

Another critical area for prenatal care provider education includes the importance for providers to screen and treat women for genito-urinary tract infections. The Reproductive Health Program will review ACOG's practice guidelines and currently published literature to develop a fact sheet on this topic. This fact sheet will be widely distributed by mail and Internet to prenatal providers throughout the state.

Continuing education of prenatal care providers and hospital nursing staff in recognizing and responding promptly to signs of fetal distress was identified as a priority need from these reviews. All too frequently, review of fetal monitor strips by expert obstetric committee members indicated that staffs were slow to respond to ominous fetal heart rate tracing patterns. The Reproductive Health Program will collaborate with the large tertiary care hospitals outreach education staff in the state to help develop a process for continuing education in this area.

Although the incidence of neonatal death due to early onset group beta strep is relatively rare, the committee has noted numerous cases where these deaths have occurred in which the protocols recommended by the Centers for Disease Control (CDC) and Prevention were not followed. With publication of revised guidelines from the CDC in August of 2002, the Reproductive Health Program recognizes the need to undertake publicity of these guidelines among prenatal care providers and delivery hospitals throughout the state. The RHP will collaborate with the CDC to explore creative ways in which to accomplish this goal.

Another area of concern that has been highlighted by these reviews is related to the frequency of re-certification in neonatal resuscitation skills for physicians and nurses throughout the state. Cases reviewed indicate that there may be a need for assurance of regular certification in these skills. The Reproductive Health Program will develop and disseminate a survey to determine policies for ongoing certification of perinatal health care providers. The results of this survey will be utilized to guide an intervention to address this critical issue.

Lastly, the need for women to notify their prenatal care providers immediately when danger signs of pregnancy are noted was commonly identified during these reviews. Time after time medical records noted that women reported experiencing cramping or vaginal fluid leakage for several days prior to calling their providers. Women need to be made aware of the danger signs of pregnancy and then empowered to recognize and act upon them when they occur.

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Table 1. Infant Mortality Rates, p-Values and Odds Ratios by Maternal Characteristics, Utah, 1995-1998.

Maternal Characteristics	Number of Women	Number of Births, Utah, 95 - 98	Death Rate/ 1,000 Births	p value	Odds Ratio
	342	169,747	2.0		
Maternal Age					
<20	59	17,737	3.3	<0.01	1.9
20 - 29	187	105,761	1.8	ref	1.0
30 - 39	93	43,513	2.1	<0.01	2.6
40+	3	2665	1.1	NS	1.4
Marital Status					
Married	262	141,821	1.8		
Unmarried	80	27,856	2.9	<0.01	0.6
Maternal Education					
Less than High School	78	24,007	3.2	<0.01	1.6
High School Graduate	112	55,048	2.0	ref	1.0
Some College	94	52,155	1.8	NS	0.9
College Graduate	58	36,924	1.6	NS	0.8
Race of Mother					
White	319	160,103	2.0		
Other Than White	22	8827	2.5	NS	1.3
Hispanic Ethnicity					
Hispanic	34	16,219	2.1		
Non-Hispanic	306	153,258	2.0	NS	1.1
Residence					
Rural	65	36,902	1.8		
Urban	248	132,845	1.9	NS	0.9
Parity					
Nulliparous	127	62,949	2.0		
Multiparous	206	106,158	1.9	NS	1.0
Body Mass Index					
<19.8	53	32,908	1.6	NS	1.3
19.8 - 26.0	116	93,380	1.2	ref	1.0
26.1 - 29.0	23	16,867	1.4	NS	1.1
29.1+	56	22,262	2.5	<0.01	2.0
Prenatal Care					
Any Prenatal Care	238	166,767	1.4		
No Prenatal Care	5	707	7.1	<0.01	0.2
Trimester Prenatal Care Began					
1st trimester	193	139,769	1.4	ref	1.0
2nd or 3rd trimester	45	26,998	1.7	NS	1.2
No prenatal care	5	707	7.1	<0.01	5.16
Adequacy of Prenatal Care					
Inadequate	47	54,983	1.7		
Adequate	192	112,083	0.9	<0.01	0.5
Tobacco Use					
Yes	46	15,364	3.0		
No	291	153,799	1.9	<0.01	1.6
Alcohol Use					
Yes	10	2,336	4.3		
No	326	166,781	2.0	<0.05	2.2
Delivery Method					
Vaginal	194	142,496	1.4	ref	1.0
Cesarean Section	134	27,137	4.9	<0.01	3.64
Assisted Vaginal	11	64	171.9	<0.01	152.2
Placental Abruptio					
Yes	65	2,841	23.4		
No	277	166,906	1.7	<0.01	14.1
Uterine Rupture					
Yes	5	102	51.5		
No	337	169,645	2.0	<0.01	25.9
ref = referent group					
NS = Not significant					

Table 2. Infant Mortality Rates, p-Values and Odds Ratios by Infant Characteristics, Utah, 1995-1998.

Infant Characteristics	Number of Deaths	Number of Births, Utah, 95 - 98	Death Rate/ 1,000 Births	p value	Odds Ratio
	370	169,747	2.0		
Gestational Age					
< 22 weeks	79	128	617.2	<0.01	6246.4
22 - 24 weeks	152	221	687.8	<0.01	8534.7
25 - 27 weeks	56	386	145.1	<0.01	657.5
28 - 37 weeks	46	18,935	2.4	<0.01	9.4
38 - 42 weeks	37	143,387	0.3	ref	1.0
Gender of Infant					
Female	153	82,717	1.8		
Male	217	87,024	2.5	<0.01	0.7
Plurality of Birth					
Singleton	276	165,556	1.7	ref	1.0
Twins	79	3,977	19.9	<0.01	12.1
Triplets	11	196	56.1	<0.01	35.6
Quadruplets	4	10	400.0	<0.01	399.2
Birth Weight					
Under 500g	135	189	714.3		9213.5
500 - 999g	159	639	248.8	<0.01	1220.8
1000 - 1499g	11	895	12.3	<0.01	45.9
1500 - 2499g	19	9,433	2.0	<0.01	7.4
+ 2500g	43	158,516	0.3	ref	1.0
Small For Gestational Age					
Small	68	20,680	3.3		
Not Small	302	147,346	2.0	<0.01	1.6
ref = referent group					

Table 3. Infant Death Causes by Category, Utah, 1995-1998.

Cause of Death Category	ICD-9 Code	Number of Infants	% of Total Study Group
Prematurity	765	99	26.8%
Maternal Causes	760-763	75	20.3%
Other Respiratory Disorders	519 & 770	50	13.5%
Perinatal Infections	771	36	9.7%
Digestive Disorders	777	22	6.0%
Respiratory Distress Syndrome	769	19	5.1 %
Hypoxia/Asphyxia	768	18	4.9%
Birth Trauma	767	13	3.5%
Ill Defined Perinatal Conditions	779	13	3.5%
Pulmonary Hypoplasia	748	12	3.2%
All Other Causes	Residual	7	1.9%
Other Infectious or Parasitic Diseases	001-139	6	1.6%

Table 4. Issues Associated With Infant Deaths, Utah, 1995-1998.

Issues	Frequency
Pregnancy Related Socio-Demographic Issues	
unmarried	80
delay of failure to seek care	70
poverty	67
teen pregnancy	47
smoking	26
substance use	26
limited understanding, lack of knowledge	14
unintended pregnancy	13
lack of patient follow through in care plan	12
language barrier	12
mental illness	7
Maternal Health Issues	
obesity	56
low prepregnancy weight	37
urinary tract infection	23
infertility	22
hypertension	7
sexually transmitted disease	4
Medical Care Provider Issues	
delay or lack of diagnosis or treatment	23
mismanagement	17
poor communication with other providers	9
lack of risk assessment	9
incomplete records	9
misdiagnosis	8
failure to seek consultation	8
use of ineffective treatment	5
poor continuity of care	2
inaccessibility/shortage	2
Health Care Facility Issues	
inadequately trained personnel	7
unavailable facilities	4
communication/coordination problems	3
delayed transportation to tertiary care facility	1
Health Systems issues	
uninsured	27
lack of coordination of services	3
services unavailable	2

Table 5. PMRC Recommendations

Committee Recommendations	# of Cases recommendation was made
Providers need to consider genital tract and urine cultures and administration of appropriate antibiotics in women with signs and symptoms of preterm labor	19
Mothers need to notify prenatal care provider when danger signs of pregnancy are noted.	14
Prompt recognition and response by providers to signs of fetal distress	13
Need for providers to consult perinatologist and neonatologist in a timely manner in high risk cases	9
Strict and timely adherence to the CDC recommended protocol for the prevention of neonatal early onset group beta strep	9
Increase public awareness of the importance of early prenatal care	8
Transport of high risk moms and infants to tertiary care issues; candidates need to be appropriately screened, transport needs to be accomplished in a timely manner, and transport team needs to be adequately equipped	7
Increased provider use of appropriate antepartum maternal and fetal assessment (including genetic testing)	6
Every facility delivering newborns needs to assure that staff are current in newborn resuscitation skills	5
Hospitals need sufficient facilities and staff to comply with the ACOG standard of 30 minutes between decision and incision for emergency cesarean sections	4
Public education regarding the importance of and procedure for fetal movement counts	4
Accurate vital records reporting by providers; infants born with apgars of 0/0 should not be reported as live births	3
Newborn nursery staff need to adhere to AAP recommendations for infant stabilization	2
Need for translators for non-English speaking women	2
Availability of family planning to Women in need	2
Adherence to ACOG standards for the use and administration of Pitocin to augment labor	1
Better monitoring of weight gain and nutrition referral for women who have high pre-pregnant weights	1
Providers need to perform versions as inpatient procedures so that protocols that call for fetal assessment prior to and following version can be appropriately carried out	1