A DECLINE IN INFANT MORTALITY AMONG AMERICAN INDIANS AND ALASKAN NATIVES RESIDING IN WASHINGTON STATE, JULY 1988 THROUGH JUNE 1996

by

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DEDICATION

To everyone who believes we do not choose the circumstances that we are born into but are grateful for our good luck and understand the need to bring inequalities to an end.

ABSTRACT

Summaries from Washington State's First Steps Program reveal a dramatic decline in the American Indian and Alaska Native infant mortality rate. From July 1988 to June 1996, the American Indians and Alaska Natives residing in Washington State experienced a 75.5% reduction in infant deaths. The improvements in infant mortality for this population can be attributed directly to reductions in both neonatal and postneonatal deaths. A significant reduction in Washington's American Indian and Alaskan Native infant mortality was observed for infants weighing 600-1350 grams after the 1990 FDA approval of surfactants. Sudden infant death syndrome deaths dropped significantly after the 1994 Human Resources and Services Administration implemented a prevention program to educate mothers to place infants on their "Back to Sleep." Only American Indian and Alaskan Native mothers using Medicaid funding for prenatal care services after Washington State's 1989 expansion of Medicaid eligibility to 185% of the federal poverty level experienced significant reductions in infant mortality.

INTRODUCTION

Infant mortality is an important indicator of health status for a population. At the turn of the century, during the industrial revolution, high rates of infant mortality in urban centers resulted from an unsanitary environment of crowded tenement houses and polluted urban neighborhoods.[1] The social movement to reform working conditions and make the urban environment salubrious and clean became synonymous with preventing infant mortality. Henceforth, infant mortality has been internationally recognized by the World Health Organization as an indicator of public health and hygiene. Unfortunately, the United States currently ranks poorly among other industrialized nations in infant mortality. Though the infant mortality rate (IMR) for all races in the US dropped to a record low in 1994, 8.0 deaths/1000 live births, the US ranked 22nd out of 30 industrialized countries.[2,3] The low US IMR ranking is attributed to the disparity of IMR among races in the US population. Minorities, except for Asians and sub-populations of Hispanics, have experienced infant mortality rates two to three times higher than the US all race IMR.[4] Clearly, further improvements can be made toward infant survival in the world's richest nation.

Two identifiable risks associated with infant mortality are low birthweight and preterm births (gestational age less than 38 weeks). Risk factors for low birthweight and preterm births, such as smoking during pregnancy, young maternal age, and alcohol or drug use, contribute to a small portion of overall low birthweight infants.[2,5] Preterm birth is a "multifactorial" problem, with lists of medical causes and social risks similar to those for low birthweight. Yet, aside from treating women presenting with symptoms and signs of preterm labor, medical intervention has little to do with the underlying causes of preterm births.[6] Recognized prevention strategies for morbidity and mortality for preterm and low birthweight births include cessation of cigarette smoking, prevention of unintended pregnancies, and improved prenatal care. Other risk factors, such as prenatal care, single mothers, and number of prior children, are debatable risks for infant mortality, as they cannot be generalized for all populations. All risks for infant mortality are part of a complex problem for determining infant survival past the child's first year of life.

Historically, American Indians have suffered a disproportionate burden of illness.[7] They are considered an underserved population in terms of health care because of poverty and limited access to health care providers. The United States Indian Health Service (IHS) estimated in fiscal year 1996 that the IHS per capita health care expenditure was $1,578, compared to the U.S. civilian per capita expenditure of $3,920.[8] In addition, since the 1970s, American Indians in IHS service areas have experienced infant mortality rates 25% higher than the general US population.[9] National documentation of infant mortality in American Indians did not begin until 1955, when the IHS was established. Infant mortality dropped precipitously during the period from 1955 to 1973 and declined less dramatically during the period from 1973 to 1983.[9] Small improvements in American Indian infant mortality were observed throughout the 1980s. One study on the Warm Springs Reservation in Oregon attributed the significant decrease in infant mortality from 1940 through 1990 to a reduction in infectious diseases.[10] By studying improvements in infant mortality in the American Indian population, interventions can be better targeted to reduce the problems unique to the American Indian population.

In 1988, Washington State's American Indian and Alaskan Native (AI/AN) women had a higher prevalence of both known and controversial risks for infant mortality. The rate of low birthweight infants was higher (6.1%) for the AI/AN population than the Whites (4.0%). The proportion of AI/AN women smoking (36.8%) was higher than White women (24.9%). The proportion of AI/AN mothers in their teenage years giving birth (8.3%) was higher than Whites (2.9%). The proportion of AI/AN women in poverty receiving cash assistance (41.5%) was higher than Whites (13.9%). The proportion of AI/AN women receiving early prenatal care was lower (56%) than White women (78%). The proportion of AI/AN women not receiving any prenatal care was higher (4.0%) than White women (0.6%). The proportion of AI/AN women relying on Medicaid funded prenatal care was higher (56.2%) than White women (21.0%). The proportion of AI/AN women that were married (40.7%) was lower than White women (80.3%).[A] The disparity in AI/AN risk factors for infant mortality compared to Washington's White population is reflected in the infant mortality rates. The White population's infant mortality rate in 1988 for Washington State was 7.6 deaths per 1000 live births, compared to AI/AN 22.9 deaths per 1000 live births.

In the early 1920s, several advocacy groups, such as the Children's Bureau and American Association for the Study and Prevention of Infant Mortality, recognized the importance of both the mother's well being during pregnancy, as well as providing economic support to care for infants. Several studies by the Children's Bureau found that a mother entering the work force in order to supplement the household income reduced her ability to properly care for her newborn.[1] The emergence of public funding to assist low income mothers and infants began with the Sheppard-Towner Act of 1921. By

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[A] (Source: internal summaries from Washington's First Steps Database)

1935, Title V of the Social Security Act was implemented to provide assistance specifically for promoting the health of women and children.[11]

Though the US has enjoyed overall improvements in women's health and a reduction in infant mortality, the National Health Objectives for Year 2000 appear unlikely to be reached (Appendix A). In 1992, a report by the National Commission to Prevent Infant Mortality (NCPIM) painted a grim picture for improvements in infant mortality.[4] The NCPIM reported that the US spends more money *per capita* and a larger proportion of America's Gross National Product on health care than any other nation, but the US does not guarantee access to basic health services. The report provided several reasons for the slowed improvement in infant mortality, especially for minority groups of "African American" and "Native American" ethnicity. Four major problems cited were increases in high-risk pregnancies and the proportion of low birthweight infants, fewer women receiving prenatal care early, and the emergence of epidemics of preventable childhood diseases. For the State of Washington, these problems were well recognized and have been the target of several state funded programs since August 1989.

Several studies in the 1980s, specific to Washington State, brought attention to the crisis situation of access to obstetric care.[12] Problems particular to low income women seeking maternity care were: a) the exodus of physicians from the practice of obstetrics (due to increases in malpractice insurance), b) decreasing number of physicians accepting Medicaid clients as patients, c) difficulties with Medicaid (low reimbursement and slow processing time), and d) an increase in the severity and the complexity of social problems experienced by pregnant women.[13,14,15] These findings by the Access to Maternity Care

Committee in 1988, established the legislative efforts to improve maternity care in Washington State.

In July 1989, Washington State was one of 24 states to expand Medicaid coverage to individuals earning up to 185% of the Federal Poverty Level (FPL).[A] Washington State legislators took maternal and child health (MCH) funding a step further and implemented additional services and programs for women eligible for Medicaid funding.[16] The legislation, referred to as the First Steps Program began to provide:

- State-funded prenatal and postpartum care, case management and maternity support services for undocumented aliens under 185% FPL
- Maternity support services during pregnancy and through two months postpartum, including nursing, nutritional and psychosocial services, counseling, community health workers, and childbirth education
- Case management for pregnant teens, substance abusers or others at high risk for adverse pregnancy outcomes; services may continue until the infant's first birthday
- Transportation and child-care for Medicaid-funded health care visits
- Continuum of treatment for chemically dependent women
- Increased reimbursement for maternity care providers
- Distressed area designation, alternative delivery systems, and discretionary funds: identified counties may obtain additional assistance for improving access or implementing alternative care systems, such as nurse midwifery clinics

[A] In 1989, FPL threshold was $12,674 per year for a family of four. The expansion in medicaid eligibility brought the threshold level to $23,447 per year for a family of four.

- Accelerated application and eligibility determination process: eligibility is determined in 15 days and Department of Social and Health Services staff are outstationed in some communities to streamline the Medicaid application process
- Public education and outreach to clients: multi-media education campaigns were administered by Healthy Mothers, Healthy Babies Coalition, including implementation of a toll-free telephone referral hotline, television and radio announcements, and educational booklet enticements

In addition to funding outreach services, Washington State implemented a database to assist in evaluating the effect of these programs. The First Steps Database (FSDB) was originally created for the purposes of evaluating the First Steps Program and contains information from live birth certificates, death certificates, and Medicaid claims on all births in Washington State.[12]

Summaries from the First Steps Database show a dramatic reduction in infant mortality, particular to American Indians and Alaska Natives (AI/ANs) from July 1988 to June 1994. The IMR of AI/AN in Washington before the First Steps expansion in August 1989 was 19.6 deaths per 1000 live births. During the period of January 1991 through December 1992, this rate dropped to 13.9, a 29% decrease. An even larger decrease in infant mortality rate to 7.1 was observed for births from January 1993 through December 1994, an overall decrease of 64%. A reduction in the infant mortality rate was also observed for the Black population, with an overall decrease of 29%, from July 1988 to December 1994. The statewide decrease in the infant mortality rate for the same period was 32% (data provided by internal FSDB summaries). These preliminary findings provide a unique opportunity to further explore potential factors contributing to the decline of infant mortality for the American Indians and Alaskan Natives

Aims of this Study

The overall aim of this study is to analyze Washington State's AI/AN infant deaths and associated maternal risks to identify factors that may be involved in the successes or failures of maternal and child health care from July 1988 through June 1996. In addition, the aims presented below will evaluate the impact of interventions implemented during the study time period for the reduction of infant mortality. It is the hope of this author that this study provides Washington State with compelling reasons to continue services and supplement resources for the well being of the child and mother, especially for the American Indian and Alaskan Natives (AI/AN).

The following questions are explored in this study:

1. **For the AI/AN population in Washington State, was the reduction in infant mortality the result of a decrease in a specific death cause, such Respiratory Distress Syndrome or Sudden Infant Death Syndrome (SIDS)?**
   a. The Food and Drug Administration's approval for surfactant therapy in 1990 has led to national reductions in neonatal deaths due to prematurity and very low birthweight infants.[17] The new treatment for respiratory distress syndrome (RDS) may have significant impact on AI/AN infants, as RDS is the fourth leading cause of infant deaths in AI/AN populations nationwide.[9] **Did the FDA's approval of surfactant therapy in 1990 contribute to the decline in AI/AN neonatal mortality in infants born with birthweight**

between 600-1350 grams? This study will compare statistically the infant mortality rates due to very low birthweight deaths before and after the nationwide implementation of surfactants.

b. Several studies from the late 1980s to early 1990s compared infant mortality rates of American Indians and Alaska Natives and other ethnic groups. These studies concluded that SIDS deaths in American Indian infants were on average 1.6 times higher than White infants.[18,19,20] In 1987, SIDS accounted for an estimated 39% of all postneonatal AI/AN infant deaths; a rate 50% higher than for all races in the US.[19] Though the etiology for SIDS remains a mystery, risk factors associated with SIDS (such as smoking) were higher for AI/AN mothers than Whites. **Did the "Back to Sleep" program implemented in 1994 contribute to the decline in AI/AN SIDS infant mortality rate?** This study will compare statistically the infant mortality rates due to SIDS deaths for the time periods before and after the implementation of the nationwide program "Back to Sleep" to place babies on their backs in August 1994.[21]

2. **Did expanded Medicaid eligibility and other Washington State provisions for prenatal care contribute to the decline of AI/AN infant mortality?**

The medical literature supports low birthweight and preterm births being identifiable risks for increased infant mortality.[2] Several studies have suggested that increasing access to prenatal care has been associated with a reduction in preterm birth and/or low birthweight.[22] In light of the implementation of Washington State's First Steps program to increase prenatal care access in 1989,

was the reduction in AI/AN infant mortality rate greater in Medicaid assisted mothers?

METHODS

Ethnic terms designated for this thesis are: Black for African American, White for non-Latino or non-Hispanic Whites, and American Indian and Alaska Natives for Native American. These terms are different from the recommended terms published in a report by the American Academy of Pediatrics[4] but are consistent with other literature references describing and comparing national racial health statistics.[9, 23, 24, 25, 26] Also, American Indian is the preferred designation by American Indians.[27]

The study population included all births to AI/AN, Black, and White populations residing in Washington State from July 1988 through June 1996. Racial groupings were determined by mother's race as recorded on the child's birth certificate. Mother's race was used to determine child's race in this study for two reasons. First, racial classifications on the death certificate are often inaccurate, undercounting the total number of deaths (one study found misclassification of up to 46% for AI/AN).[28] Second, by identifying AI/AN infants based on the mother's race, the birth outcome is consistently viewed through the context of the mother. Since the database contains information mostly describing the maternal conditions during the perinatal period, the study only included infants defined by the mother's race, and does not use father's race or child's race. Under these selection criteria, Washington State's American Indian and Alaska Native population had 13,574 live births and a subsequent 177 infant deaths during the period of July 1988 through June 1996 available for review. Comparison of this data to publications from Indian Health Service (IHS) should be made with caution, as IHS includes infants whose mother's or father's race is AI/AN.

Sampling and Subject Selection

The FSDB includes all Medicaid clients with birth related services (prenatal care or delivery) who gave birth and are linked to Medicaid claims, birth certificates, and infant death certificates. Over 100 infant and maternal variables were available through the FSDB. These variables are categorized into three groups for conceptual purposes:

a. Maternal Background Variables, such as, but not limited to: mother's age, parity, educational level, smoking history, marital status, area of residence (Appendix B lists Washington's reservation zip codes)
b. Social and Medical Intervention Variables, such as, but not limited to: use of Medicaid after expansion to 185% of the Federal Poverty Level, number of visits for prenatal care, trimester prenatal care began, maternity case management, maternity support services.
c. Birth Outcomes Variables, such as, but not limited to: birth weight, gestational age, Apgar score taken at 5 minutes, gender, transfer of child at birth, birth place type, ICD-9 cause of death.

The FSDB collects vital statistics data in six month cycles. Infant deaths within the first year of life were identified by a flag variable "DEATH" created by FSDB, which matches birth records with death records one year after the birth of the child. In this regard, infant deaths are prospective cohorts. The most recent infant death records available for this study were matched through June 1996. All fetal deaths were excluded from the study population.

Approval for access and use of the First Steps Database was obtained through the Department of Social and Health Services, Human Research Review Section, P.O. Box 45205, Olympia, Washington 98504-5205 (DSHS project A-051298-S "Infant Mortality in Native Americans in Washington State during 7/88 – 6/96"). Concomitant application for the use of human subjects for research was submitted and exempted by the Oregon Health Sciences University's Institutional Review Board (OHSU Research Support Office).

The DSHS Human Research Review Board believes that reporting small categorical groups from this study population may compromise the confidentiality of the small population. Hence, in agreement with DSHS HRRB safeguards, this study cannot disclose any sample size of five or less. Where appropriate, a rate or p-value has been calculated based on a numerator of six and italicized.

Data Analysis

For purposes of comparing maternal trends and birth outcomes over time, the data were divided into three periods. Period one (P1) was July 1988 through December 1990, period two (P2) was January 1991 through June 1993, and period three (P3) was July 1993 through June 1996. These periods correspond to the observed three-stage decline in AI/AN infant mortality: 1) a baseline followed by 2) a downward slope followed by 3) a new lower plateau. This pattern corresponds to the division of eight years into the three time periods designated in the study.

A different division for the study time period was created for the analysis of intervention programs. Period one remains the same, period two encompasses January

1991 through December 1993, and period three spans January 1994 through June 1996. This division was more appropriate for the analysis of the "Back to Sleep" program which began in August 1994. Ideally, the division for period two would have been made after June 1994, but the subsequent small sample size for infant death in period three would have prohibited any meaningful analyses. Tables 6b, 9a, and 9b use these divisions.

The statistical program SPSS 8.0 was used to create all cross tabulations and the logistic regression analysis of AI/AN infant deaths. Tables and charts were created using Microsoft's Excel 97. Statistical tests, Chi-Square (Mantzel-Hansen or Yates corrected, two tailed), and Student's t-tests were performed in EpiInfo version 6.0. Confidence intervals for the mortality rates were calculated using a formula specific for small proportions.[29]

Logistic Regression

General maternal characteristics and birth outcomes hypothesized to predict infant mortality were entered into a logistic regression. This study makes an assumption that unknown maternal characteristics such as mother's age and parity, and birth outcomes, such as birthweight and gestational age, are a reflection of incomplete records and may indicate the infant is at a greater risk for unfavorable outcomes (more infant deaths are observed in infants with missing data Tables 7a, 7b, 8a, and 8b). The sample number for the "missing" and "unknown" category was included in this study, as excluding these infants would decrease the total number of infant deaths, hence reducing the already small sample size for infant deaths (observed probability of death is 177/13574 live births, 1.3%). Because the sample number for "Unknown" or Missing" category for each variable was too small to be considered as a separate grouping for logistic regression analysis, infants with variables "unknown or missing" were grouped with the higher risk. For example, infants with unknown or missing birthweights was grouped with low birthweight infants. Lower risks for each variable (e.g. answered "no" to smoking) were assigned "0." The "unknown" category was grouped with the higher risk, (e.g. answered "yes" to smoking). Variables were first analyzed by univariate logistic regression (dependent variable associated with one independent variable) then entered in a forward stepwise and backward stepwise selection procedure along with other variables with the criteria for entry with p-value 0.25 and removal with p-value 0.30. Appendix C lists the coding scheme for each variable.

RESULTS

Infant Mortality Rates

Postneonatal AI/AN deaths accounted for more than half of all the AI/AN infant deaths from July 1988 to June 1996. Approximately 62% of infant deaths occurred during the postneonatal period. In comparison, 36% of the Black infant deaths and 46% of the White infant deaths occurred during the postneonatal period (Figure 1).

The infant mortality rate for Washington's AI/AN population dropped, from 20.9 to 3.3, between July 1988 to June 1996. A downward trend in IMR was also observed for Blacks from 18.1 to 10.2 and for Whites from 7.6 to 5.6 (Table 1). Of the three groups, AI/ANs experienced the greatest IMR reduction from period one to period three, a decline of 74.8%, compared to a 34.5% reduction for Whites and a 21.8% reduction in Blacks (Figure 1).

Stratification of infant mortality by cause of death showed that the AI/AN population had an overall reduction of 67.8% in SIDS and 81.1% in non-SIDS deaths (Figure 2 and Table 2). For Blacks, a decrease of 30% in non-SIDS deaths was observed. SIDS rates for the Black population did not change. The White population had a reduction of 45.5% in SIDS and 17% in non-SIDS deaths. Further stratification of AI/AN infant deaths during the neonatal and postneonatal periods revealed that infant deaths from postneonatal SIDS decreased by 67.4% and neonatal non-SIDS decreased by 87.6% (Figure 3 and Table 3).

Death cause groupings, SIDS, congenital anomalies, perinatal conditions, and other types of deaths (Appendix D lists the ICD9CODES used to determine these groupings) were compared for each ethnicity between the three time periods. The infant mortality rate in periods one and three for the AI/AN population decreased significantly in death cause groupings congenital anomalies, SIDS, and perinatal conditions (Table 4). The decline in AI/AN infant deaths attributed to other causes was not significant. The White population experienced similar declines in group death causes, though their decline in IMR was not as dramatic as the AI/AN population (Table 4). Though the Black population experienced an overall reduction in infant mortality, the death cause groupings used in this study did not reflect the decline in infant mortality for Washington State's Blacks.

AI/AN Maternal and Infant Characteristics for Periods One, Two, and Three

Several demographic variables, such as marital status of mothers, mother's level of education, mother's area of residence, did not change significantly over the three time periods (Table 5a). However, significant changes were observed for the mother's age group, parity, and access to prenatal care funding assistance. Most of the significant changes occurred from period one to period two. The average number of births per month for Washington's AI/AN population decreased significantly from 148.2 live births per month in the first period to 137.9 live births per month the second period (t-test, $p<0.001$), but remained unchanged from the second to third time period 139.6 live births per month (t-test, $p=0.64$).

From period one to period three, the proportion of mothers under the age of 20 years having their first or second child increased from 19.71% to 21.9% ($p=0.002$), whereas the proportion of mothers aged 20 or older having their third or more child decreased from 38.2% to 33.8% ($p<0.001$) in periods one to three. The proportion of mothers under the age of 20 having their third or more child also decreased (1.4%, 0.8%, p=0.005). The proportion of mothers aged 20 or older having their first or second child increased from 39.8% to 41.7% (p=0.061).

The proportion of mothers at 60% of the FPL, qualifying for cash assistance (welfare), decreased after the second period from 51.6% to 43.6% (p<0.001) in period three (Table 5a). The proportion of mothers receiving non-Medicaid funding decreased (34.2%, 24.0%, 25.6%; P1 *v.* P3, p<0.001). In periods one to two (4.9% *v.* 10.8%, p<0.001) and periods one to three (4.9% *v.* 12.5%, p<0.001), the proportion of mothers who received funding from expanded Medicaid eligibility at 185% of the FPL increased. The proportion of mothers at 90% of the FPL receiving Medicaid funded prenatal care increased in periods two to three (12.4% *v.* 17.9%, p<0.001) and in periods one to three (12.0% *v.* 17.9%, p<0.001). The proportion of AI/AN mothers using Medicaid for prenatal care services increased from 65.8% in period one to 74.4% in period three (p<0.001). The proportion of mothers on reservation or trust lands receiving Medicaid reimbursements increased from 30.5% in period one to 33.5% in period three (p=0.002). The proportion of mothers living off reservation or trust lands receiving Medicaid reimbursements increased from 35.3% in period one to 40.9% in period three (p<0.001). The proportion of mothers living on reservations receiving non-Medicaid funding decreased from 12.5% to 7.7% (p<0.001) in periods one to three. The proportion of mothers living off reservation receiving non-Medicaid funding decreased from 21.7% to 17.9% (p<0.001) in periods one to three.

Several maternal risks and behaviors changed significantly. From period one to period two to period three, the proportion of mothers who had answered "No" to smoking increased from 55.4%, 63.0%, to 68.1% (P1 *v.* P3, p<0.001). Yet, the proportion of mothers answering "Yes" to smoking did not change, and fewer mothers smoking history was "Unknown" (13.6%, 7.1%, 2.2%; P1 *v.* P3, p<0.001) (Table 5b). The proportion of mothers who had initiated prenatal care during their first trimester of pregnancy increased (55.6%, 60.3%, 66.2%; P1 *v.* P3, p<0.001). The proportion of mothers diagnosed with gestational diabetes (1.4%, 2.0%, 2.4%; P1 *v.* P3, p<0.001) increased. The proportion of mothers with Medicaid funding diagnosed with alcohol abuse decreased (1.3%, 1.4%, 0.7%; P1 *v.* P3, p=0.013). The proportion of mothers that did not abuse alcohol or drugs decreased (91.6%, 88.2%, 88.0%; P1 *v.* P3, p<0.001). The proportion of mothers with prenatal diagnosis of abuse of both alcohol and drugs increased (3.8%, 4.4%, 8.1%; P1 *v.* P3, p<0.001). The proportion of mothers using Maternity Case Management (MCM) and Support Services (MSS) paid by Medicaid increased (2.6%, 17.7%, 21.8%; P1 *v.* P3, p<0.001). The proportion of mothers using MCM (1.6% to 3.8%, p<0.001) or MSS (8.0% to 25.3%, p<0.001) increased from period one to period three.

Infant outcome variables for gestational age, Apgar scores, gender, or birthplace facility did not change significantly (Table 5c). Decreases were observed for the low birthweight rate (6.8%, 5.6%, 5.3%; P1 *v.* P3, p=0.002) and proportion of children transferred at birth (1.7%, 1.0%, 0.9%; P1 *v.* P3, p<0.001). The low birthweight rate to smoking mothers decreased significantly (9.4%, 6.9%, 6.8%; P1 *v.* P3, p=0.001). The low birthweight rate for mothers whose smoking status was unknown increased significantly from periods one to two (7.8% to 8.9%, p=0.019).

Comparison of AI/AN Infant Mortality Rates by Maternal Characteristics and Birth Outcomes

Table 6a lists infant mortality rates grouped by selected maternal characteristics and birth outcomes. All categories, except for gestational age of less than 37 weeks or unknown, and smoking status unknown, and transferred at birth, experienced a decline in infant mortality.

Table 6b (note change in time period divisions) compares the reduction in IMR rates stratified by program intervention. Reduction in birthweight specific mortalities was not significant at the $p=0.05$ level. Significant reductions were observed for the SIDS death rate from period two to period three (6.3 to 2.6, $p=0.011$), as well as from period one to period three (9.4 to 2.6, $p<0.001$). Reduction in SIDS death rate from period one to period two were not significant (9.4 to 6.3, $p=0.079$). Reduction in the overall infant mortality rate for Medicaid clients were significant for all three periods (P1 *v.* P2, $p<0.001$, P2 *v.* P3, $p<0.001$, and P1 *v.* P3, $p<0.001$). Reduction in the infant mortality rate for Non-Medicaid mothers was not significant.

Comparison of Alive and Dead Infant AI/AN Characteristics from July 1988 through June 1996

The proportion of mothers answering "yes" to smoking was higher for infants who had died (37.9%) than for infants who had survived (30.1%, $p=0.026$). The proportion of mothers residing on reservation lands was higher for infants that died (51.4%) than for infants that survived (42.6%, $p=0.019$) (Table 7a). The proportion of mothers who had initiated prenatal care during the first trimester was higher for infants that survived (61.2%) than for infants that died (40.1%, p<0.001). The proportion of mothers who initiated prenatal care during the third trimester was higher for dead infant (10.7%) than alive infants (6.8%, p<0.001). The proportion of mothers who had no prenatal care was higher for dead infants (10.2%) compared to alive infants (2.3%, p<0.001). The proportion of mothers who did not utilize MCM and/or MSS was higher for infant that died (72.4%) than for infants that survived (60.7%, p=0.002). The proportion of mothers aged 20 years or older with their first or second child was higher for alive infants (40.1%) than dead infants (32.2%, p=0.033). The proportion of mothers aged 20 years or older with their third or more child was higher for alive infants (37.6%) than for dead infants (30.5%, p=0.089). The proportion of primiparous women under the age of 20 years higher for dead infants (32.8%) than alive infants (21.2%, p<0.001). The proportion of multiparous women under the age of 20 years was higher for dead infants (3.4%) than for alive infants (1.2%, p=0.023). The proportion of mothers' eligibility for Medicaid, substance abuse, and maternal diabetes was not significantly different for infant survival or death.

The proportion of infants born with birthweight less than 2500 grams was higher for infants who died (38.4%) than infants who survived (5.4%, p<0.001). The proportion of infants born with a gestational age of less than 27 weeks was higher for infant who died (16.4%) than for infants who survived (0.3%, p<0.001). The proportion of infants born with gestational age between 28 and 36 weeks was higher for infants who died (20.9%) than for infants who survived (9.6%, p<0.001) (Table 7b). The proportion of infants with Apgar score less than eight was higher for infants who died (25.4%) than for infants who survived (3.0%, p<0.001). The proportion of infants who were transferred at birth was higher for infants who died (16.4%) than for infants who survived (1.0%, p<0.001). The proportion of infants born in facilities equipped with NICU was higher for infants who died (22.6%) than for infants who survived (14.4%, p=0.002).

Comparison of SIDS and Non-SIDS AI/AN Infant Characteristics from July 1988 through June 1996

The differences in maternal characteristics for SIDS and Non-SIDS deaths were not statistically significant for mother's smoking status, maternal diabetes, substance abuse, MCM and/or MSS program intervention, mother's age, parity, area of residence and Medicaid eligibility. However, the proportion of mothers who initiated early prenatal care was higher for SIDS deaths (75.2%) than Non-SIDS deaths (59.1%, p=0.016). (Table 8a).

Several birth outcomes differed significantly between SIDS and Non-SIDS deaths (Table 8b). The differences in adverse birth outcomes reflected that the SIDS infants are more likely to survive the neonatal period and not have the risks associated with neonatal deaths. Hence, most of the adverse birth outcomes, such as low birthweight and prematurity, was observed in Non-SIDS deaths. The proportion of normal birthweight births was higher for SIDS victims (81.0%) than for Non-SIDS (40.9%, p<0.001). The proportion of infants carried to full term was higher for SIDS deaths (66.7%) than for those of Non-SIDS deaths (34.4%, p<0.001). The proportion of infants with an Apgar score of eight or greater was higher for SIDS deaths (91.7%) than for Non-SIDS deaths (54.8%, p<0.001). The proportion of infants that were not transferred at birth was less for SIDS deaths (71.0%) than Non-SIDS deaths (96.4%, p<0.001). The proportion of infants transferred at birth was higher for SIDS deaths (28.0%) than for Non-SIDS deaths (7.1%, $p<0.001$).

Logistic Regression for Infant Death

The overall number of infant deaths in this study population (observed probability of death is 177 per 13574 live births, 1.3% of live births resulted in infant deaths) were used for associating maternal characteristics and birth outcomes. Apgar score, gestational age less than 37 weeks, birthweight less than 2500 grams, and the birth of a child during July 1988 through December 1993 were significantly associated with infant death (Table 9a) independent of other variable effects. Two models for infant death were fitted by logistic regression analysis using SPSS version 8.0. In the first model, which controls for all variables listed in Appendix D, Apgar score (OR=5.9), prematurity (OR=1.7), and low birthweight (OR=3.9) were significantly associated with infant deaths (Table 9b). In the second multivariate logistic regression, birth outcome variables were excluded, as these variables over control for birth outcomes and would obscure associations of maternal characteristics with infant death. Late initiation or no prenatal care (OR=2.4) and single mothers or mothers with unknown marital status (OR=1.5) were significantly associated with infant death (Table 9b).

DISCUSSION

In general, several significant changes were observed in maternal characteristics and birth outcomes during July 1988 through June 1996 in Washington State's AI/AN population. The changes in maternal characteristics, such as increased use of Medicaid for perinatal services, earlier initiation of prenatal care, increased detection of alcohol and drug abuse, and changes in birth outcomes, such as fewer low birthweight births, may have indirectly contributed to the infant's improved survival. Interventions such as the FDA approval of surfactants and HRSA's "Back to Sleep" SIDS prevention program also contributed to the reduction of Washington's AI/AN infant mortality rates. In addition, expanded Medicaid eligibility, implemented during the beginning of the study time period, coincided with the changes in observed maternal trends, as well as the decline in AI/AN infant mortality.

AI/AN Trends in Maternal Characteristics and Birth Outcomes

Maternal characteristics changed significantly over the time period July 1988 through June 1996 for the American Indian and Alaskan Native mothers residing in Washington state. The increased use of Medicaid for prenatal care services occurred after the expansion of Medicaid eligibility in August 1989. The trends shown in Table 5a show a significant increase in Medicaid reimbursements for prenatal care across income eligibility categories of 60%, 90%, and 185% of the FPL and decreases in non-Medicaid or unknown eligibility of mothers after December 1993. This is consistent with an earlier study evaluating the use of Medicaid immediately after the eligibility expansion which found significant increases in Medicaid reimbursements for prenatal care services.[12] The significant increases in using Medicaid for perinatal services three years after the eligibility expansion suggest that the use of Medicaid funding was slower in reaching the AI/AN population.

Along with increased use of Medicaid funding, mothers were also initiating prenatal care earlier and fewer mothers lacked prenatal care. The proportion of mothers diagnosed with gestational diabetes increased over the three time periods. This may be due to better detection of diabetes because of the increased access and earlier initiation of prenatal care. In Medicaid funded mothers, the proportion of mothers with alcohol abuse decreased, but the proportion of mothers diagnosed to abuse both alcohol and drugs increased. This suggests that the screening of substance abuse by pregnant mothers was more thorough and accurate in detecting the true prevalence of maternal substance abuse. In addition, the increased detection for substance abuse also coincides with the increased proportion of mothers using maternity case management, provided mainly for teens and mothers predicted to have a high risk for adverse birth outcomes. The proportion of mothers using maternity support services also increased during periods two and three, suggesting AI/AN mother's using Medicaid had more comprehensive prenatal care services, as MSS is available up to two months postpartum and MCM is provided up to the child's first birthday.

Though the proportion of mothers answering "no" to having a smoking history increased, the proportion of mothers whose smoking status was "unknown" decreased. This suggests that the smoking status in mothers has not changed. However, smoking during pregnancy and the infant's subsequent exposure to environmental smoke are not reflected in the FSDB measure of "mother smokes." This variable is collected from the birth certificate and is based on a single question of "has the mother ever smoked?" As smoking during pregnancy and perinatal exposure to environmental tobacco smoke is becoming recognized as a significant risk for infant mortality, especially for SIDS, further information is needed to assess the true impact of smoking on the decline of infant mortality for Washington's AI/AN population.

Most trends in birth outcomes for the AI/AN population did not change over the study time period, except for the low birthweight rate and the proportion of infants transferred at birth. Prematurity among singleton births is the second leading cause for US all race neonatal mortality. Medical knowledge of preterm births is limited and does not explain the majority of short gestational ages and subsequent low birthweight contributing to the US neonatal mortality rates. Though few changes have occurred for the overall preterm birth rate, changes in rates occurred in some racial/ethnic groups.[23] AI/AN nationally, from 1989 to 1996 experienced a 3% decrease in singleton preterm births. Many potential risk factors for preterm birth, such as urogenital tract infections and history of subfertility or infertility, cannot be examined using the standard birth certificate. However, the proportion of preterm births did not change for Washington's AI/AN infants during July 1988 – June 1996 (Table 5c).

The proportion of low birthweight infants decreased from period one to period two ($p=0.023$) and from period one to period three ($p=0.002$). As a result, the proportion of infants born with birthweight 2500g or more increased for the same periods (P1 *v.* P2, $p=0.004$, P1 *v.* P3, $p=0.003$). The literature cites smoking, nutrition, previous low birthweight births, and maternal low birthweight as possible causes for low birthweight.[2,5] The low birthweight rate for smokers (Table 5c) was significantly higher for all three periods (P1, $p<0.001$, P2, $p=0.001$, P3, $p=0.001$). The reduction in the low birthweight rate for smoking mothers decreased significantly from periods one to two ($p=0.019$), and from periods one to three ($p=0.011$). The reduction in the low birthweight rate for non-smoking mothers only decreased significantly from periods one to two ($p=0.039$). Other risks for low birthweight, such as nutrition, and previous low birthweight births, were not documented nor explored in this study.

Decline in Non-SIDS Neonatal Mortality: Possible Impact of Surfactants

The dramatic decline in American Indian and Alaska Native infant mortality in Washington State from July 1988 through June 1996 can be attributed directly to the diminution of two components of AI/AN infant mortality: neonatal Non-SIDS and postneonatal SIDS. In the August 1990, the FDA approved surfactant therapy for treating very low birthweight (VLBW) babies (600 –1350 grams) suffering from acute respiratory distress syndrome (RDS).[17] It is estimated that 50% of very low birthweight babies born in North America have received surfactants, and the widespread introduction has been credited with the recent reductions in neonatal mortality in New York City and throughout the US.[30,31,32]

The timing of the use of surfactants in VLBW babies should have a significant impact on American Indians because RDS is cited as the fourth leading cause for all neonatal deaths in IHS service areas.[9,18] The reduction of VLBW infant mortality due to surfactant therapy could not be evaluated directly for the data extracted from First Steps. Birthweight categories most likely to be effected by surfactant therapy (600-1350g *v.*

1350g or more) were used to calculate birthweight specific infant mortality rate for Washington's AI/AN VLBW births. The death rate attributed to the VLBW group declined from 421.2 in period one (pre-surfactant approval) to <214.3 in period two, (post-surfactant approval, p=0.078), and to <206.9 in period three (P1 *v.* P3, p=0.064) (Table 6b).

The first hypothesis, 1a, stated in the introduction, asks "Did the FDA approval of surfactants in 1990 contribute to Washington State's American Indian and Alaskan Native infant mortality rate for infants born with birthweight 600 to 1350 grams?" Table 6b compares the infant mortality rate for infants born with birthweights between 600 to 1350 grams (excluding deaths attributable to SIDS and congenital anomalies) for time periods before and after the FDA approval of surfactants. The Chi-Square p-value (0.078) comparing the IMR for period one (421.1) and two (*<214.3*)* for birthweight 600 to 1350 grams is not significant at the 0.05 level. As the number of infant deaths in the 600 to 1350 gram birthweight category is very small for time periods two and three, the true rates were not disclosed. However, the reduction of the infant mortality rate due to deaths in the very low birth weight category is estimated to be greater than 60%. Nationally, the reduction in the infant mortality rate attributed to surfactant therapy is 3%.[31] This suggests the reduction observed in Washington's AI/AN population in the birthweight category 600 to 1350 grams was significant and the reduction in infant mortality for birthweight category 600 to 1350g is most likely to be attributable to the FDA approval of surfactants.

Possible reasons other than surfactant therapy contributing to the reduction in AI/AN neonatal mortality rate include improved birthplace facilities and advances in neonatology. Birthplace type and transfer at birth were used as proxies for measuring access to a NICU but inadequately address the potential impact of NICU or technological advances in neonatology for Washington's AI/AN population. Also, changes in clinical procedures or diagnosis of neonates may have had an impact on neonatal mortality not documented on the birth certificate.

The significant decline in infant deaths during the neonatal period due to congenital anomalies for this population remains unexplained for this study (Table 4a). Reduction in congenital anomalies may be due to better nutrition or genetic screening, neither of which is documented in FSDB. Nationally, from 1980 to 1995, a downward trend is reported with an overall 43.2% decrease in AI/AN infant mortality attributed to congenital defects.[24] The infant mortality rate for congenital anomalies in Washington State's AI/AN infants declined by 48%. The reduction in deaths due to congenital anomalies account for 7.9% of the overall 75.5% AI/AN decline in the infant mortality rate.

Decline in SIDS Postneonatal Mortality: Possible Impact of "Back to Sleep"

Low birthweight and preterm births account for a majority of the US infant mortality.[33] Approximately 20% of low birthweight is attributed to smoking, but a majority of medical risks for low birthweight remain a mystery.[33] Studies by Vanlandingham show that the AI/AN population experienced the same rates of neonatal mortality as Whites.[34] Thus, the disproportionate IMR between Whites and AI/ANs before the 1980s was mostly attributed to postneonatal deaths in infants with birthweights

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* Estimated rate, as sample sizes of five or less cannot be disclosed.

of 2500 grams or more. The authors cited SIDS and infections as the leading cause of death for AI/ANs.

Dramatic postneonatal SIDS reduction for the AI/AN population have been observed also by Robertson *et al.*[26] in the states of Idaho, Oregon and Washington. Approximately half (48%) of all Northwest AI/AN infant death rate was attributable to SIDS and contributed to the overall IMR reduction from 8.9 to 3.0, between 1985 to 1996. Similarly, 48% of Washington's decline in AI/AN infant mortality rate can be attributed to the reduction in SIDS deaths, from 9.4 to 2.6 (P1 *v.* P3, $p<0.001$) between July 1988 to June 1996.

Though several risk factors associated with SIDS have been identified, a medical cause for SIDS has remained elusive. Hypotheses of undetected heart arrhythmia and sleep apnea have been proposed, but are not supported by the general SIDS literature. Prone sleeping position, maternal smoking, and environmental tobacco smoke have been associated with SIDS deaths.[20,35,36] Studies nationwide and in Washington's King County have evaluated the effects of nonprone sleeping position and its success in reducing SIDS.[37,38,39] Pregnancy Risk Assessment Monitoring System data reported Washington State AI/AN infants' usual sleep position in 1996 was 41% side, 41% back, and 16% stomach.[25] Washington's AI/AN low 1996 SIDS IMR corresponded with the lower proportion of infants placed to sleep on their stomachs, whereas higher SIDS IMR was observed in comparative states reporting higher percentage of babies put to sleep on their stomachs.[25]

The emphasis on nonprone sleeping position in 1994 had an impact on the reduction in SIDS deaths. Before the "Back To Sleep" SIDS prevention program, Washington's AI/AN population had a SIDS IMR of 6.3 in period two. The SIDS IMR dropped further to 2.6 ($p=0.011$) during the period of January 1994 through June 1996 (period three). Prior to "Back to Sleep," SIDS IMR for the AI/AN population was 9.4 in period one (Table 6b).

The second hypothesis, part 1b, stated in the introduction, asks "Did the nationwide program, 'Back to Sleep' contribute to the decline in the SIDS infant mortality rate for Washington State's American Indians and Alaskan Natives?" Referring to Table 6b, time periods one and two represent "pre-Back to Sleep" implementation, whereas period three represents "post-Back to Sleep" program implementation. Chi-Square test comparing infant mortality rates due to SIDS deaths during period two (6.3) to period three (2.6) show a significant reduction ($p=0.011$). The significant reduction in the SIDS infant mortality rate from period two to period three could be attributable to the "Back to Sleep" program, though this study does not directly assess the infant sleep position. A substantial, but not statistically significant reduction (~33%) in the SIDS infant mortality rate is also observed from period one (9.4) to period two (6.3, $p=0.079$), suggesting there may be other factors mitigating the reduction in SIDS deaths.

Other programs or possible interventions not documented in this study may have contributed to the decline in SIDS mortality. In 1992, the American Academy of Pediatrics recommended placing infants to sleep on their sides or backs to prevent SIDS.[20] Internationally, other countries in the early 1990s reported a reduction of SIDS deaths due to SIDS prevention programs, educating the public to place the infant on their backs to sleep, remove loose bedding materials, and prevent over heating the sleeping infant.[35,38,39] IHS health providers may have acted on this information, advising parents to place infants on their back to sleep, prior to the "Back to Sleep" program, as AI/AN infants are at increased risk for SIDS. This study cannot address this issue, as health care providers' awareness of sleep position or advice to the AI/AN women were not surveyed.

Recent studies have shown a high association of SIDS risk to maternal smoking as well as environmental tobacco smoke.[36] The harmful effects of smoking during pregnancy for other adverse birth outcomes were well known in the late 1980s and attempts were being made to modify environmental smoke and maternal behaviors. The anti-smoking message also aimed to reduce the prevalence of cancer and heart disease (diseases that rank high in all AI/ANs in the US) may have inadvertently contributed to the reduction in SIDS.[40] In 1987, IHS eliminated smoking in all of its health facilities, with the intent of making nonsmoking a social norm.[17]

Levels of smoking in the AI/AN population are difficult to generalize, as the population is made of many groups of people with differing customs and norms.[40] The smoking variable used to estimate Washington's AI/AN mothers' smoking during pregnancy did not reveal a significant trend in the reduction in smoking, even though the proportion of mothers that reported "no" to smoking was higher. The reduction in the infant mortality rate among mothers with a smoking history was not significant from period one to period two (24.0 to 18.6, $p=0.339$), but significant from periods two to three (18.6 to 7.4, $p=0.009$) (Table 6a). The reduction in the infant mortality rate among non-smoking mothers was significant for all three periods (17.9 in period one, 9.2 in period two, 4.1 in period three; P1 *v.* P2, $p=0.008$, P2 *v.* P3, $p=0.014$, P1 *v.* P3, $p<0.001$). These data are similar to the trends observed for SIDS deaths due to smoking. However, the proportion of AI/AN mothers smoking in January – June 1996 is still 41% higher than Washington's White mothers (26.0% *v.* 18.4%, p<0.001), as well as 73% higher than Black mothers (26% *v.* 15%, p<0.001) (internal FSDB summaries). In this study, maternal smoking is a significant risk for infant death, as well as for SIDS death, but does not explain for the SIDS reduction observed from period one to period two. Other unknown causes or risks for SIDS may have declined.

Assistance in Prenatal Care Access: Possible Impact of Expanded Medicaid Eligibility

The third hypothesis tested in this study asks "Were the reductions in the infant mortality rate greater for Washington State's AI/AN mothers using Medicaid funding for prenatal care?" Comparisons of infant mortality rates were made for periods one, two, and three by whether the mother received any Medicaid assistance. For all three periods, only Medicaid assisted mothers had significant reductions in infant mortality rates for SIDS and very low birthweight (Table 6b). Reduction in the infant mortality rate for all three periods among Non-Medicaid mothers was not statistically significant, even though they experienced an overall 51.9% decline (P1 *v.* P3, p=0.064). The overall reduction in the infant mortality rate for Medicaid assisted mothers was 81.7% (p<0.001). The proportion of reduction in the infant mortality rate among Washington State's AI/AN mothers was significantly greater for mothers using Medicaid (78.6%) for prenatal care than Non-Medicaid mothers (21.4%, p<0.001).

Prenatal care is broadly defined as "the diagnosis of pregnancy, the medical, educational, social and nutritional services needed to enhance the health and well-being of the woman and fetus during pregnancy, and the counseling and assistance required to plan for labor and delivery, postpartum care for the mother, and pediatric care for the newborn."[41] Several studies have demonstrated that adequate prenatal care is effective in improving pregnancy outcomes by reducing infant mortality rates while being cost effective.[22] Subsequently, programs such as the Healthy Start Initiative, Aid to Families with Dependent Children (AFDC), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and increasing eligibility for Medicaid have been given millions of dollars per year to ensure optimal pregnancy outcomes through the provision of prenatal care and its associated social services.

However, the role of increased prenatal care in reducing infant mortality or low birthweight is currently debated. All adverse birth outcomes cannot be explained by known risk factors targeted by prenatal care enhancements.[42] Several states that have expanded their eligibility for Medicaid have reported no differences in adverse birth outcomes after increasing funding for prenatal care.[43, 44] Stringer contends that in order to properly evaluate prenatal care programs, quantity and content of prenatal services other than the number of visits or month in which care began should be documented.[22] The recent nationwide program "Pregnancy Risk Assessment Monitoring System" (PRAMS) sponsored by the Centers for Disease Control and Prevention provides additional information not collected on the birth certificate in selected states. Questions used in Washington, such as satisfaction with prenatal care and the mother's personal perception of her pregnancy, were designed to evaluate qualitative aspects of pregnancy that could in turn affect birth outcomes, such as low birthweight, prematurity, and ultimately infant death. Because Washington's PRAMS data were available only for a small population sampling of the state in 1993, these data were not accessed for this study.

In a recent study, increased funding in prenatal care and social services resulted in a significant reduction of low birthweight infants in an especially vulnerable group of high risk women.[45] The study also suggested that maternity case management (MCM) and support services (MSS) were important in mitigating physical access to perinatal care. The authors hypothesized that the medical care setting alone cannot mitigate access problems without social intervention programs, such as MCM and MSS. The study compared access and utilization of Medicaid after expansion in 1989 for Washington and Colorado. Both states had expanded Medicaid eligibility, but Colorado did not provide additional support services, such as MSS and MCM. The study suggested that social support and comprehensive prenatal care led to the early detection of medical risks and pregnancy complications. The authors cite low birthweight rates among the medically high-risk populations decreased only in Washington State and implied that increased funding for medical visits during pregnancy alone is not effective in improving birth outcomes in medically high-risk or socially marginalized women. Additional provision of MCM and/or MSS social interventions outside of the medical setting, such as transportation and pre-pregnancy home visits, are needed to utilize effectively expanded medical services.[A]

[A] A Tennessee Medicaid expansion study comments on the difficulty of applying for Medicaid for an already marginalized population.[46] Requirements, such as an assets test, are often difficult to interpret and involve lengthy paper work. Commonly, by the time a pregnant woman seeking obstetric care completes the application and is approved for Medicaid she is already well into the second trimester. Tennessee, for the above reason, decided to eliminate the assets test, as well as provide presumptive eligibility until the application can be processed. Colorado also implemented presumptive eligibility. Washington did not opt to provide presumptive eligibility, rather they streamlined the application process, allowing mail-in applications, and requiring a 15 day maximum processing time.

Use of Medicaid by Washington's AI/AN mothers for MCM and/or MSS increased substantially during July 1988 to June 1996. The proportion of AI/AN mothers initiating prenatal care in the first trimester was higher for periods two and three (Table 5b). These combined findings, suggest that services supplemented by Washington's MCM and MSS ameliorated nonfinancial barriers[B] common to lower income women.[47,48] The increased use and access of prenatal care by AI/AN Medicaid clients may account for the downward trends of low birthweight, preterm births, and higher parity, and hence infant mortality. The timing of prenatal care in Washington's AI/AN population was significantly associated with the reduction in infant mortality after removing the effects of low birthweight, gestational age, and Apgar Score at five minutes. In the second logistic regression model, only late initiation or lack of prenatal care was significantly associated with infant death (OR=2.4) (Table 9b). Furthermore, comparing the improvement for infant survival of Medicaid versus Non-Medicaid funded mothers revealed that most of the reductions occurred in mothers receiving Medicaid funded prenatal care. The dramatic decline in the infant mortality rate attributable low birthweight and SIDS deaths are significant for only mothers receiving Medicaid assistance (Table 6b). Not all reductions in the infant mortality rate can be explained by increased use of Medicaid funds, but overall, most advocates of public health would agree that fewer adverse health events are likely to occur among mothers and infants who have health insurance and access to primary care.[33,49]

[B] Internal barriers identified by women were attitudes associated with low motivation, knowledge deficits, fear, and fatigue. External barriers identified were finances, transportation, system difficulties, lack of support, lack of child care, missed work, and insufficient time.

Limitations of this Study

A growing body of literature related to MCM and MSS assesses the impact of qualitative perinatal intervention that is not recorded on the birth certificate. Home health nurse visits during and after pregnancy that impact lifestyle changes, and attitudes have been shown to effect the overall pregnancy experience and hence reduce adverse outcomes.[50,51] Adhering to better nutritional intake, reduction in harmful behaviors such smoking, reminding clients of their prenatal care appointments, and providing emotional and educational supports are activities of public health nurses in their home visits. Public health home visits also provide an unique perspective for the health care provider, because nurses are in a better position to provide contextual advice. Washington State's First Steps program includes home health visits, up to one year after the child's birth. Documentation of these visits is available but was not accessed for this study. In addition, the impact of Planned Parenthood and health education for decreasing unintended pregnancies was not assessed in this study.

Health belief models can contribute to unique differences in ethnic or cultural perceptions of pregnancy. Washington State's AI/AN population alone is comprised of 27 federally recognized tribes. Two ethnographic studies reported that some AI/AN women perceived interventions during the pregnancy process as harmful to the unborn child.[52,53] Muckleshoot (a small tribe in Washington) mothers believed childbearing was a normal event not requiring biomedical intervention and encouraged women to remain active, eat healthy foods, and abstain from drugs and alcohol. Female relatives were considered sources of information for pregnancy and childbirth, as well as served as the traditional birthing attendants. However, Long notes that many of the traditionally held values and traditions have been lost to acculturation, death of elders, and increased presence of westernized health care facilities. Experiences by Canada's First Nations and US American Indian mothers, such as feeling prenatal care visits are rushed and impersonal, shyness and reluctance to ask questions during prenatal visits, refraining from giving feedback to prenatal care staff, and inappropriateness of strangers asking personal questions, suggest that the standard practices of health care in westernized medicine alienate American Indians from repeating their perinatal care visits. Subsequently, changes to better tailor the US medicalization of pregnancy to AI/AN health beliefs, e.g., Washington's home health visits and creating alternative midwifery clinics, may have a significant impact that is immeasurable.

According to the US Census, in 1990, American Indians comprised 2% of Washington State's total population. Approximately 83% of the Washington's American Indians are spread throughout 20 reservation counties. Forty-three percent of the documented AI/AN women giving birth reside on reservation or trust lands (Table 5a). Funding for perinatal and child health care for AI/AN women residing in Washington State is available from several federal sources. In addition to Medicaid, Women, Infants and Children (WIC) program, and AFDC, a considerable proportion of American Indians that reside on Indian Reservation and Trust Lands are eligible to receive health care from IHS supported clinics and medical facilities. However, IHS by policy, is the payer of last resort. Because most reservation areas provide primary care through ambulatory outpatient clinics of varying size, specialty care is purchased from private health care providers in neighboring communities. A priority system determines which services are purchased, while others queue for more funding or until a condition worsens enough to change priority. Hence, IHS health programs in Washington depend on reimbursements from Medicaid, Medicare, and other privately purchased insurance. An estimated 15-40% of clinic operating budgets draw from non-IHS funding sources.[54] This study did not quantify the impact of expanded Medicaid eligibility on IHS-provided services. In addition, increases in federal funding to IHS areas for improving health care facilities, increasing the number of IHS practicing physicians and additional educational programs targeted to AI/AN mothers may have added benefits not measured by this study.[18,54]

In summary, the overall reduction in Washington State's AI/AN infant mortality is a significant accomplishment for this traditionally underserved population. The current AI/AN IMR of 5.3 from time period three exceeds the goals put forth by the National Health Objectives for the Year 2000 of 8.5. For all AI/AN births, the observed 75.6% reduction in the infant mortality rate from period one (21.6) to period three (5.3), approximately 17.7% (2.6% Non-Medicaid, 15.1% Medicaid) is accounted for by improved survival of infants with birthweight of 600-1350 grams due to surfactants; approximately 41.7% (8.0% Non-Medicaid, 33.7% Medicaid) is accounted for by decreases in SIDS deaths; approximately 16.5% (5.5% Non-Medicaid, 11.0% Medicaid) is accounted for by the decrease in deaths due to congenital anomalies; approximately 18.8% is accounted for by Medicaid alone. The expanded prenatal care access, along with "Back to Sleep" and increased survival of 600-1350g infants, accounted for 78.6% of the 75.6% infant mortality rate decline.

Whether the expansion of Medicaid and other support services by Washington State contributed directly to the reduction in the American Indian and Alaskan Native infant mortality rate will be an ongoing debate by maternal and child health epidemiologists, health care providers, and policy makers. However, it is clear that AI/AN mothers benefited overall by the expanded services and funding, as Medicaid funded mothers experienced significantly greater reductions in infant mortality. Most importantly, FSDB should continue in its efforts to document the progress of American Indians and Alaskan Natives along with other Washington populations, especially because it is the Washington Department of Health's stated goal to "elevate the American Indian and Alaska Native health status to the highest possible level."[54]

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Figure 1. Infant Death Rates for American Indians and Alaskan Natives, Whites and Blacks for Washington State, July 1988 - June 1996

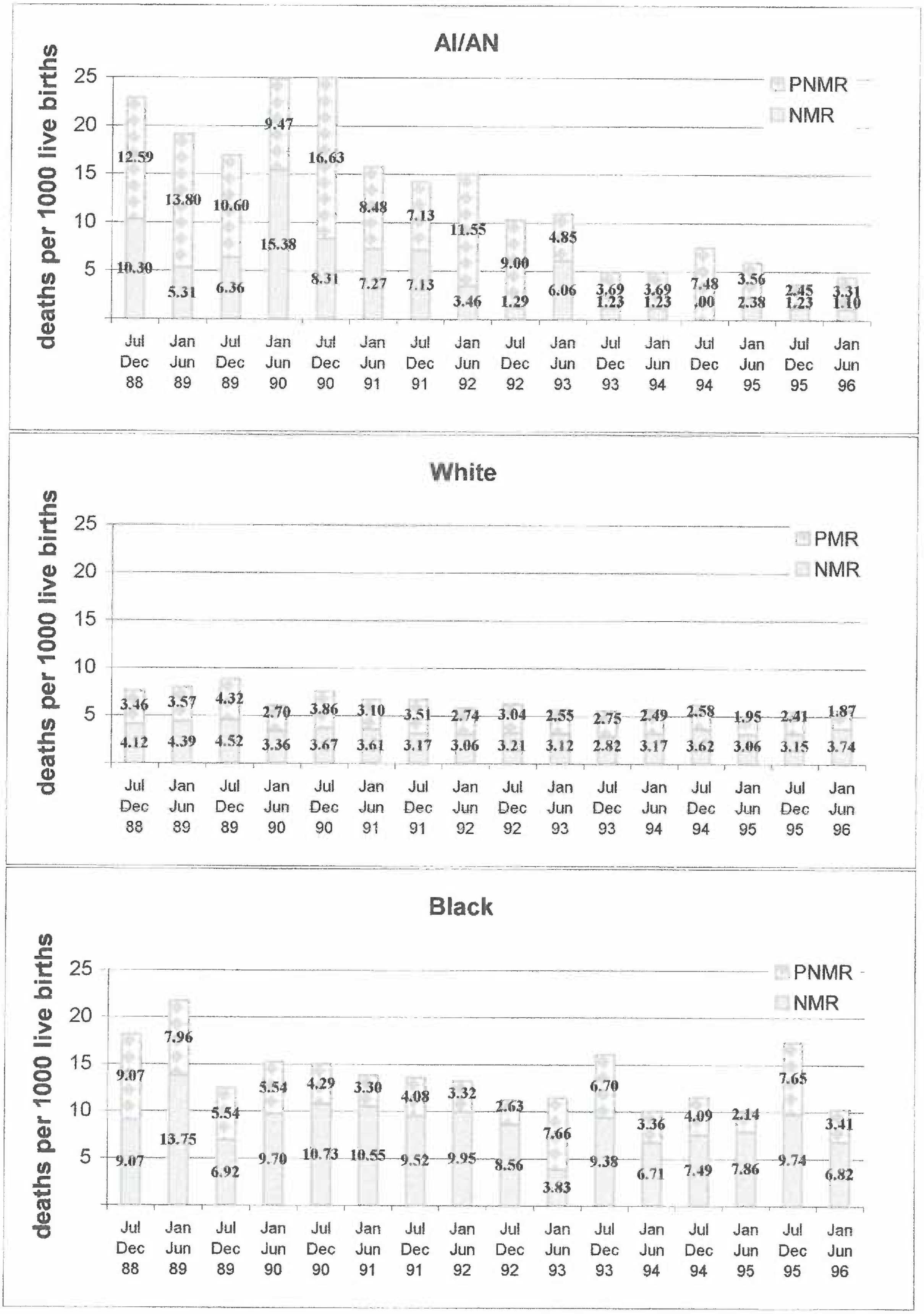
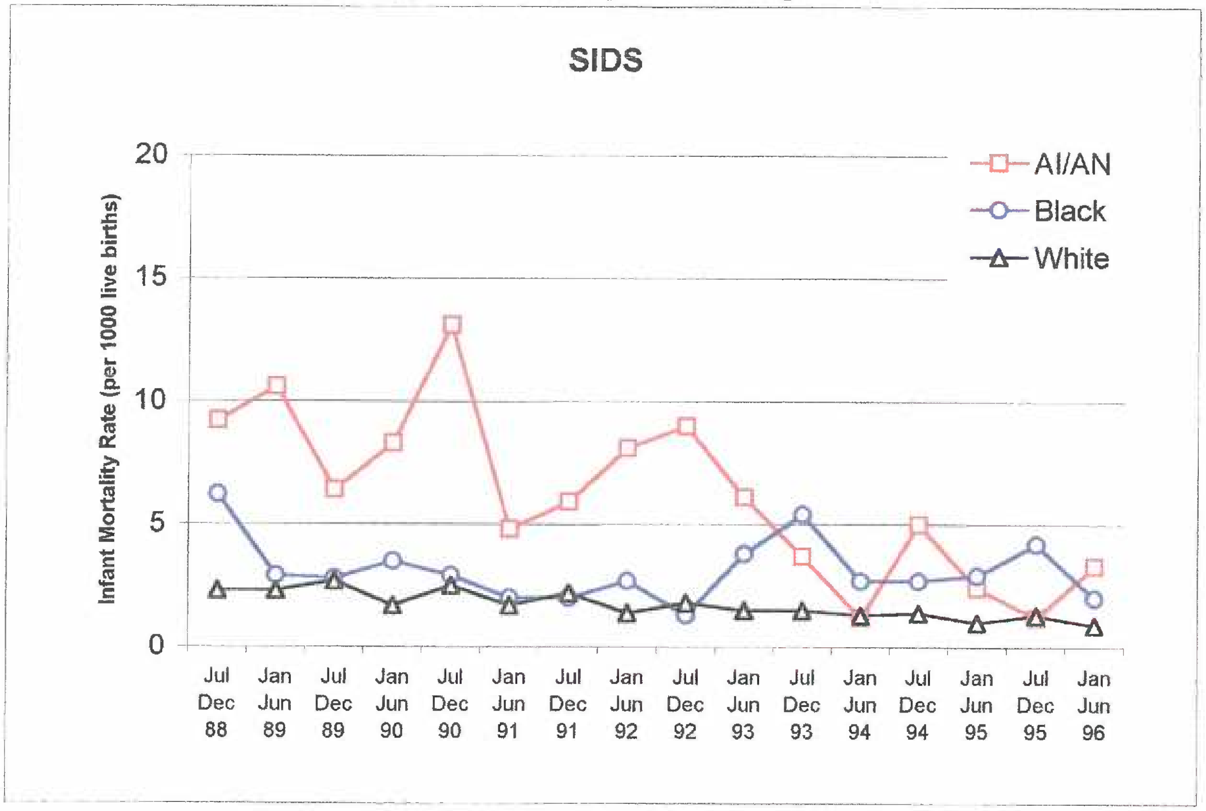


Table 1. Infant Mortality Rate by Ethnicity in Washington State, July 1988 through June 1996

Time Period	AI/AN live births	AI/AN no. deaths	AI/AN IMR	White live births	White no. deaths	White IMR	Black live births	Black no. deaths	Black IMR
Jul. 88 - Dec. 88	874	20	22.9	30077	228	7.6	1433	26	18.1
Jan. 89 - Jun. 89	942	18	19.1	30262	241	8.0	1382	30	21.7
Jul. 89 - Dec. 89	943	16	16.9	30535	270	8.8	1445	18	12.5
Jan. 90 - Jun. 90	845	21	24.8	32169	195	6.1	1445	22	15.2
Jul. 90 - Dec. 90	842	21	24.9	31866	240	7.5	1398	21	15.0
Jan. 91 - Jun. 91	825	13	15.8	31299	210	6.7	1517	21	13.8
Jul. 91 - Dec. 91	842	12	14.3	31886	214	6.7	1471	20	13.6
Jan. 92 - Jun. 92	866	13	15.0	31078	180	5.8	1508	20	19.3
Jul. 92 - Dec. 92	778	8	10.3	30264	189	6.2	1519	17	11.2
Jan. 93 - Jun. 93	825	9	10.9	30151	161	5.8	1567	18	11.5
Jul. 93 - Dec. 93	814	*<6*	*7.3*	29790	166	5.6	1493	24	16.1
Jan. 94 - Jun. 94	813	*<6*	*7.4*	29312	166	5.7	1490	15	10.1
Jul. 94 - Dec. 94	805	6	7.5	28708	178	6.2	1468	17	11.6
Jan. 95 - Jun. 95	842	*<6*	*7.1*	28788	144	5.0	1400	14	10.0
Jul. 95 - Dec. 95	812	*<6*	*7.3*	28596	159	5.6	1438	25	17.4
Jan. 96 - Jun. 96	906	*<6*	*6.6*	28357	159	5.6	1466	15	10.2
Period One	4446	96	21.6	154909	1174	7.6	7103	117	16.5
Period Two	4136	55	13.3	154678	954	6.2	7582	96	12.7
Period Three	4992	25	5.0	173551	972	5.6	8755	110	12.6

Note: italicized values are estimated for n=6, cell sizes n=5 or less are not disclosed

Figure 2. SIDS and Non-SIDS Infant Mortality by Race for Washington State, July 1988 through June 1996



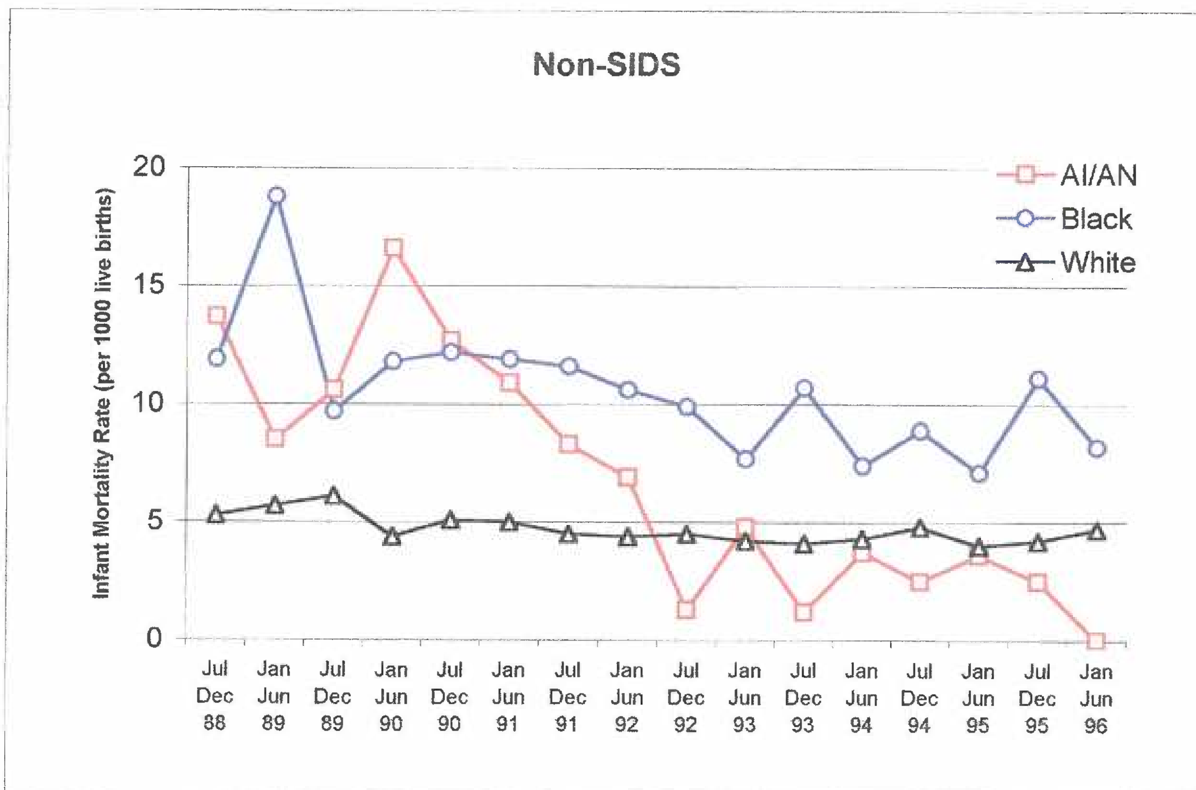
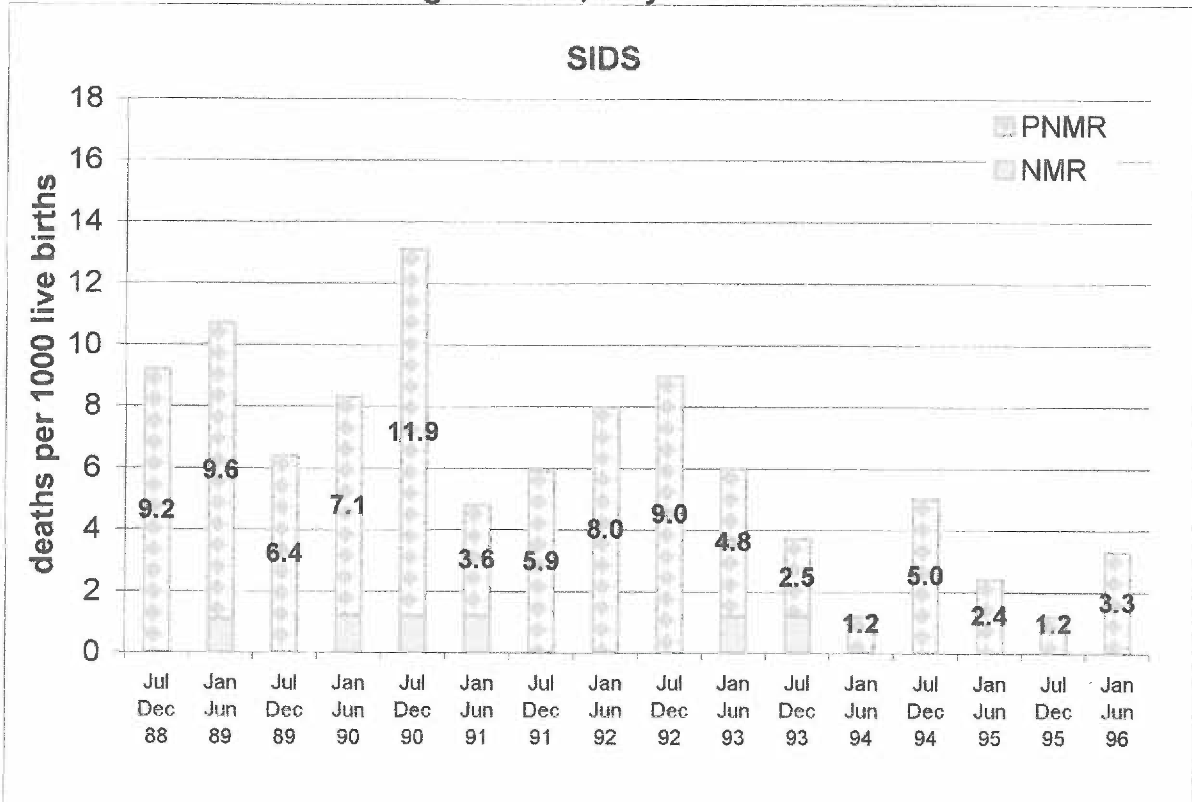


Table 2. SIDS and Non-SIDS Infant Mortality Rates for AIAN, Black, and White populations in Washington State

Year	SIDS			Non-SIDS		
	AI/AN	Black	White	AI/AN	Black	White
Jul 88 - Dec 88	9.2	6.2	2.3	13.7	11.9	5.3
Jan 89 - Jun 89	10.6	2.9	2.3	8.5	18.8	5.7
Jul 89 - Dec 89	6.4	2.8	2.7	10.6	9.7	6.1
Jan 90 - Jun 90	8.3	3.5	1.7	16.6	11.8	4.4
Jul 90 - Dec 90	13.1	2.9	2.5	12.7	12.2	5.1
Jan 91 - Jun 91	4.8	2.0	1.7	10.9	11.9	5.0
Jul 91 - Dec 91	5.9	2.0	2.2	8.3	11.6	4.5
Jan 92 - Jun 92	8.1	2.7	1.4	6.9	10.6	4.4
Jul 92 - Dec 92	9.0	1.3	1.8	1.3	9.9	4.5
Jan 93 - Jun 93	6.1	3.8	1.5	4.8	7.7	4.2
Jul 93 - Dec 93	3.7	5.4	1.5	1.2	10.7	4.1
Jan 94 - Jun 94	1.2	2.7	1.3	3.7	7.4	4.3
Jul 94 - Dec 94	5.0	2.7	1.4	2.5	8.9	4.8
Jan 95 - Jun 95	2.4	2.9	1.0	3.6	7.1	4.0
Jul 95 - Dec 95	1.2	4.2	1.3	2.5	11.1	4.2
Jan 96 - Jun 96	3.3	2.0	0.9	0.0	8.2	4.7
Period One	9.5	3.7	2.3	12.4	12.9	5.3
Period Two	6.8	2.4	1.6	6.4	10.3	4.5
Period Three	2.8	3.3	1.2	2.3	8.9	4.3

Figure 3. AI/AN Infant Death Rates by SIDS or Non-SIDS Death Cause in Washington State, July 1988 to June 1996



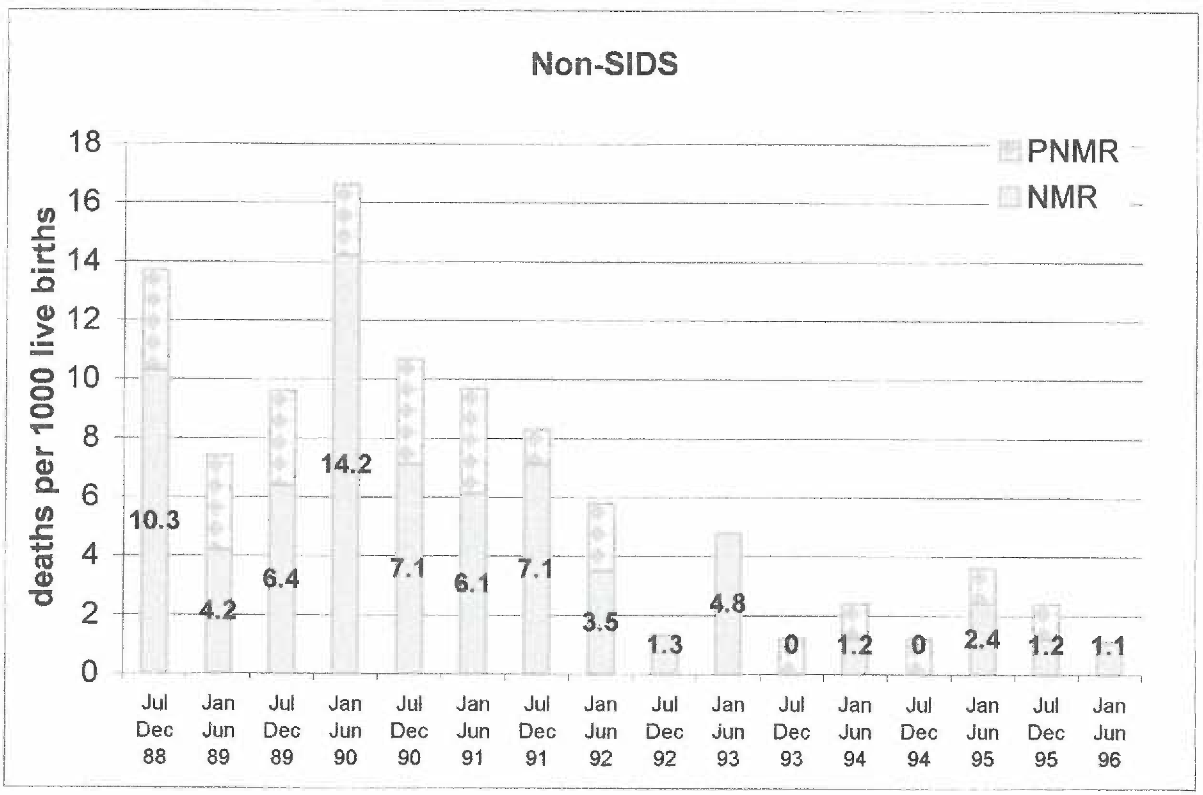


Table 3. AI/AN SIDS and Non-SIDS Death Rates in Washington State, July 1988 to June 1996				
	AI/AN SIDS		AI/AN Non-SIDS	
Time Period	PNMR	IMR	NMR	IMR
Jul 88 - Dec 88	9.2	9.2	10.3	13.7
Jan 89 - Jun 89	9.6	10.6	4.2	8.5
Jul 89 - Dec 89	6.4	6.4	6.4	10.6
Jan 90 - Jun 90	7.1	8.3	14.2	16.6
Jul 90 - Dec 90	11.9	13.1	7.1	12.7
Jan 91 - Jun 91	3.6	4.8	6.1	10.9
Jul 91 - Dec 91	5.9	5.9	7.1	8.3
Jan 92 - Jun 92	8.0	8.1	3.5	6.9
Jul 92 - Dec 92	9.0	9.0	1.3	1.3
Jan 93 - Jun 93	4.8	6.1	4.8	4.8
Jul 93 - Dec 93	2.5	3.7	0	1.2
Jan 94 - Jun 94	1.2	1.2	1.2	3.7
Jul 94 - Dec 94	5.0	5.0	0	2.5
Jan 95 - Jun 95	2.4	2.4	2.4	3.6
Jul 95 - Dec 95	1.2	1.2	1.2	2.5
Jan 96 - Jun 96	3.3	3.3	1.1	1.1
Period One	8.8	15.9	8.4	12.4
Period Two	6.3	6.8	4.6	6.4
Period Three	2.6	2.8	1.0	2.4

Figure 4. Trends in Death Cause of Infants for Washington State July 1988 - June 1996

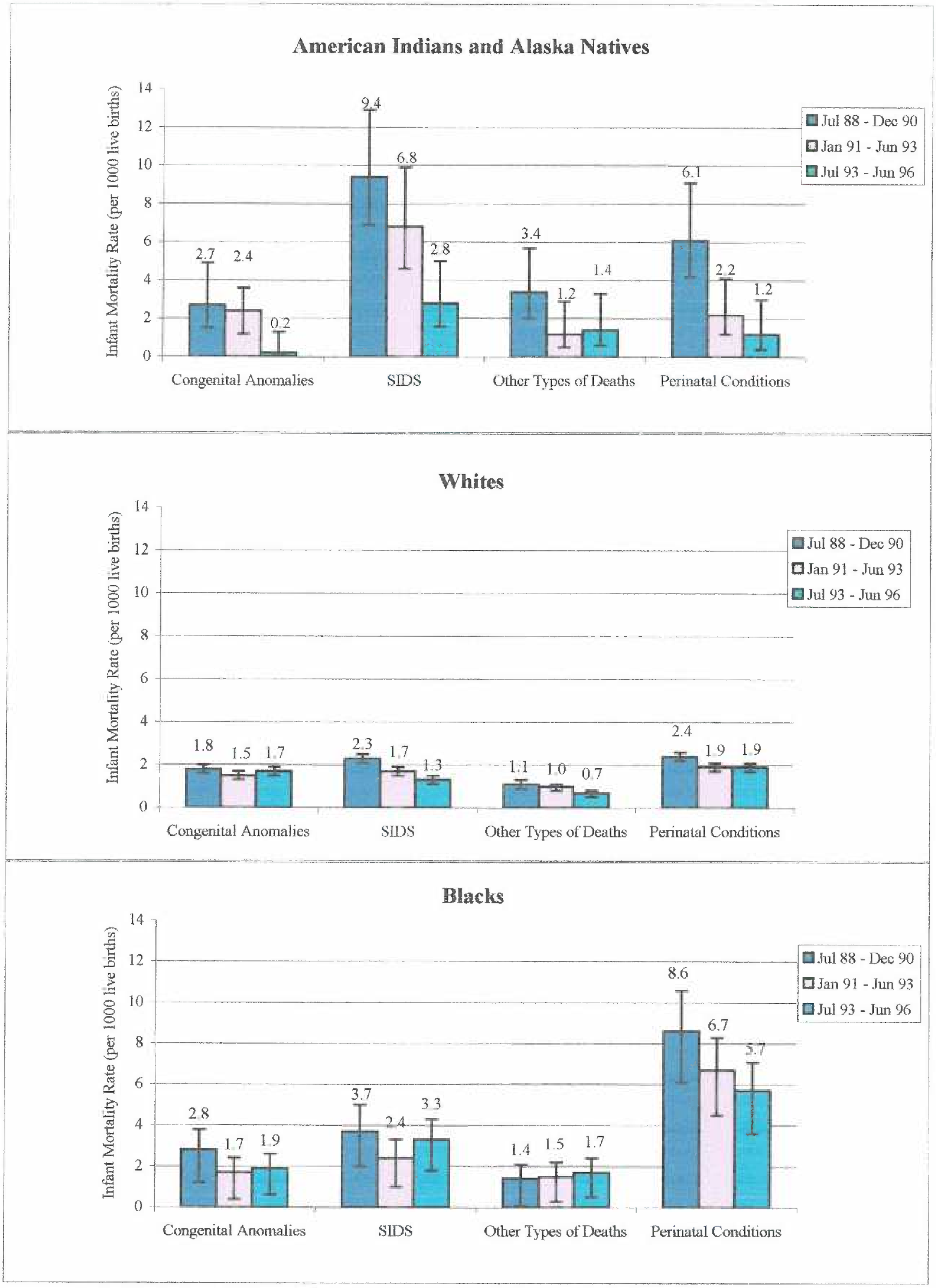


Table 4. Infant Mortality Rates, by Cause of Death Washington State, July 1988 through June 1996

	Jul. 1988 - Dec. 1990			Jan. 1991 - Jun. 1993			Jul. 1993 - Jun.1996		
AI/AN	n=4446			n=4136			n=4992		
	no. deaths	IMR	C.I.	no. deaths	IMR	C.I.	no. deaths	IMR	C.I.
Congenital Anomalies	12	2.7	1.5, 4.9	10	2.4	1.2, 4.6	*<6*	*1.4*	*0.6, 3.3*
SIDS	42	9.4	6.9, 12.9	28	6.8	4.6, 9.9	14	2.8	1.6, 4.8
Other Causes	15	3.4	2.0, 5.7	6	1.2	0.5, 2.8	6	1.4	0.6, 3.3
Perinatal Conditions	27	6.1	4.1, 9.0	11	2.2	1.2, 4.1	*<6*	*1.4*	*0.6, 3.3*
All Causes	96	21.6	17.6, 26.4	55	11.9	9.2, 15.5	26	5.2	3.5, 7.7
White	n=154909			n=154677			n=173551		
	no. deaths	IMR	C.I.	no. deaths	IMR	C.I.	no. deaths	IMR	C.I.
Congenital Anomalies	279	1.8	1.6, 2.0	232	1.5	1.3, 1.7	293	1.7	1.5, 1.9
SIDS	354	2.3	2.1, 2.5	264	1.7	1.5, 1.9	218	1.3	1.1, 1.4
Other Causes	168	1.1	0.9, 1.3	155	1.0	0.9, 1.2	128	0.7	0.6, 0.9
Perinatal Conditions	370	2.4	2.2, 2.6	293	1.9	1.7, 2.1	334	1.9	1.7, 2.1
All Causes	1171	7.6	7.1, 8.0	944	6.1	5.7, 6.5	973	5.6	5.3, 6.0
Black	n=7101			n=7582			n=8755		
	no. deaths	IMR	C.I.	no. deaths	IMR	C.I.	no. deaths	IMR	C.I.
Congenital Anomalies	20	2.8,	1.8, 4.4	13	1.7	1.0, 3.0	17	1.9	1.2, 3.2
SIDS	26	3.7	2.4, 5.4	18	2.4	1.5, 3.8	29	3.3	2.3, 4.8
Other Causes	10	1.4	0.7, 2.7	11	1.5	0.8, 2.7	15	1.7	1.0, 2.9
Perinatal Conditions	61	8.6	6.6, 11.1	51	6.7	5.1, 8.9	50	5.7	4.3, 7.6
All Causes	117	16.5	13.7, 19.8	93	12.3	10.0, 15.1	111	13.1	10.9, 15.8

Note: italicized values are estimated; cell sizes n=5 or less are not disclosed

Table 5a. AI/AN Maternal Characteristics									
Time Period	Jul 88 - Dec 90		Jan 91 - Jun 93			Jul 93 - Jun 96			Overall
Total No. of Live Births	Period One N = 4446		Period Two N = 4136		Chi-Square p-value	Period Three N = 4992		Chi-Square p-value	Chi-Square p-value
Average births per month	148.2		137.9			139.6			
Mother's Age & Parity	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
>= 20 yr, 1st or 2nd child	1768	39.8	1577	38.1	0.105	2081	41.7	0.000	0.061
< 20 yr, 1st or 2nd child	875	19.7	905	21.9	0.012	1114	22.3	0.655	0.002
>= 20 yr, 3rd or more	1698	38.2	1583	38.3	0.919	1688	33.8	0.000	0.000
< 20 yr, 3rd or more	64	1.4	57	1.4	0.975	42	0.8	0.006	0.005
unknown	41	0.9	14	0.3	0.000	67	1.3	0.000	0.063
Marital Status	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Married	1739	39.1	1577	38.1	0.348	2026	40.6	0.015	0.134
Not Married	2697	60.7	2548	61.6	0.393	2947	59.0	0.011	0.090
Marital Status Unknown	10	0.2	11	0.3	0.411	19	0.4	0.374	0.082
Mother's Level	Not available for this time period		N = 2469			N = 4992			
of Education			n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Less than 12 years			793	32.1	-	1661	33.3	0.309	-
12 years or High School			804	32.6	-	1662	33.3	0.552	-
More than 12 years			496	20.1	-	1201	24.1	0.000	-
Unknown			376	15.2	-	468	9.4	0.000	-
Lives on Reservation	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
On Reservation	1912	43.0	1825	44.1	0.306	2059	41.2	0.005	0.077
Not on Reservation	2534	57.0	2311	55.9	0.306	2933	58.8	0.005	0.077
Medicaid Eligibility	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
< 60% FPL (grant)	2086	46.9	2133	51.6	0.000	2177	43.6	0.000	0.001
< 185 % FPL ("post")	217	4.9	446	10.8	0.000	623	12.5	0.012	0.000
< 90% FPL ("pre-")	532	12.0	516	12.5	0.490	894	17.9	0.000	0.000
Unknown	92	2.1	48	1.2	0.001	19	0.4	0.000	0.000
Non-Medicaid	1519	34.2	993	24.0	0.000	1279	25.6	0.080	0.000
Medicaid Use	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Non-Medicaid	1519	34.2	993	24.0	0.000	1279	25.6	0.080	0.000
Medicaid	2927	65.8	3143	76.0	0.000	3713	74.4	0.080	0.000
Medicaid & Reservations	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Medicaid & Res.	1356	30.5	1488	36.0	0.000	1673	33.5	0.012	0.002
Medicaid & No Res.	1571	35.3	1655	40.0	0.000	2040	40.9	0.375	0.000
No Medicaid & Res.	556	12.5	337	8.1	0.000	386	7.7	0.472	0.000
No Medicaid & No Res.	963	21.7	656	15.9	0.000	893	17.9	0.011	0.000
Mother's Age Group	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Less than 20 years	944	21.2	964	23.3	0.020	1168	23.4	0.920	0.011
20 – 24	1517	34.1	1322	32.0	0.040	1541	30.9	0.259	0.001
25 – 29	1168	26.3	1008	24.4	0.044	1151	23.1	0.146	0.000
30 – 34	577	13.0	585	14.1	0.138	765	15.3	0.105	0.001
35 or older	235	5.6	252	6.1	0.117	363	7.3	0.023	0.000
Age Group Unknown	<6	<0.1	<6	0.1	-	<6	0.1	-	-
Mean Age	24.35		24.40		*0.685	24.63		*0.067	*0.021
Standard Deviation	5.61		5.82			6.1			
Parity	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
0 (first child)	1434	32.3	1393	33.7	0.166	1863	37.3	0.000	0.000
1 – 2 (second or third)	2098	47.2	1840	44.5	0.012	2133	42.7	0.084	0.000
3 (fourth) or more	878	19.7	894	21.6	0.031	933	18.7	0.000	0.221
Parity Unknown	36	0.8	9	0.2	0.000	63	1.3	0.000	0.200

*p-value for t-test

Table 5b. AI/AN Maternal Risks and Behaviors									
Time Period	Jul 88 - Dec 90		Jan 91 - Jun 93			Jul 93 - Jun 96			Overall
Total No. of Live Births	Period One N = 4446		Period Two N = 4136		Chi-Square p-value P1 v. P2	Period Three N = 4992		Chi-Square p-value P2 v. P3	Chi-Square p-value P1 v. P3
Average births per month	148.2		137.9			139.6			
Mother Smokes	n	%	n	%		n	%		
Yes	1376	30.9	1239	30.0	0.345	1485	29.7	0.757	0.207
No	2464	55.4	2604	63.0	0.000	3398	68.1	0.000	0.000
Unknown	606	13.6	293	7.1	0.000	109	2.2	0.000	0.000
Trimester PNC Began	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
First	2472	55.6	2496	60.3	0.000	3307	66.2	0.000	0.000
Second	1186	26.7	1043	25.2	0.186	1039	20.8	0.000	0.000
Third	380	8.5	299	7.2	0.018	257	5.1	0.000	0.000
None	132	3	81	2.0	0.002	111	2.2	0.515	0.016
Unknown	276	6.2	217	5.2	0.036	278	5.6	0.388	0.217
Maternal Diabetes	N = 2927		N = 3143			N = 3713			
(no data Jun – Dec 88)	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Gestational	61	1.4	81	2.0	0.023	118	2.4	0.200	0.000
Established	12	0.3	15	0.4	0.374	17	0.3	0.374	0.943
None	4365	98.2	4035	97.6	0.042	4857	97.3	0.350	0.003
Unknown	<6	<0.1	<6	<0.1	-	0	-	-	
Substance abuse	N = 2927		N = 3143			N = 3713			
(Medicaid Women Only)	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Alcohol Only	39	1.3	43	1.4	0.732	26	0.7	0.004	0.013
Drugs Only	94	3.2	190	6.0	0.000	122	3.3	0.000	0.818
Both, Drugs and Alcohol	111	3.8	139	4.4	0.240	299	8.1	0.000	0.000
Neither	2681	91.6	2771	88.2	0.000	3266	88.0	0.791	0.000
Unknown	<6	<0.1	0	-	-	0	-	-	-
Program Intervention	N = 2927		N = 3143			N = 3713			
(Medicaid Women Only)	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Maternity Case Mangmt.	47	1.6	119	3.8	0.000	118	3.2	0.190	0.000
Maternity Support Services	233	8.0	795	25.3	0.000	1077	29.0	0.001	0.000
Both	76	2.6	556	17.7	0.000	810	21.8	0.000	0.000
Neither MCM or MSS	2571	87.8	1673	53.2	0.000	1708	46.0	0.000	0.000

PNC=Prenatal Care

Table 5c. AI/AN Birth Outcomes										
Time Period	Jul 88 - Dec 90		Jan 91 - Jun 93			Jul 93 - Jun 96			Overall
Total No. of Live Births	Period One N = 4446		Period Two N = 4136		Chi-Square p-value	Period Three N = 4992		Chi-Square p-value	Chi-Square p-value
Average births per month	148.2		137.9			139.6			
Birthweight	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
277 - 2499 grams	302	6.8	233	5.6	0.023	266	5.3	0.528	0.002
2500 grams or more	4133	93.0	3908	94.5	0.004	4716	94.5	0.966	0.003
Unknown	11	0.2	5	0.1	0.208	10	0.2	0.208	0.982
Mean Birthweight	3422		3449		*0.042	3444		*0.691	*0.081
Standard Deviation	627.5		598.5			597.9			
Gestational Age	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Very Premature (<28wks)	31	0.7	20	0.5	0.258	21	0.4	0.446	0.050
Premature (28 – 37 wks)	433	9.7	424	10.3	0.350	774	15.5	0.076	0.407
Normal (38 wks or more)	3798	85.4	3628	87.7	0.002	4005	80.2	0.091	0.126
Unknown	184	4.1	64	1.5	0.000	192	3.8	0.000	0.474
Mean Gestational Age	39.37		39.4		-	39.4		-	-
Standard Deviation	2.7		2.8			2.7			
Gender of Child	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Female	2202	49.5	2064	49.9	0.712	2429	48.7	0.252	0.434
Male	2244	50.5	2072	50.1	0.712	2563	51.3	0.252	0.434
APGAR Score (5 min.)	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Less than 8	154	3.5	144	3.5	0.994	137	2.7	0.426	0.413
8 or more	4255	95.7	3974	96.1	0.346	4830	96.8	0.642	0.143
Missing	37	0.8	18	0.4	0.018	25	0.5	0.528	0.062
Child Transferred	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Yes	74	1.7	41	1.0	0.004	45	0.9	0.658	0.000
No	4319	97.1	4075	98.5	0.000	4924	98.6	0.7	0.000
Unknown	53	1.2	20	0.5	0.001	23	0.5	0.963	0.000
Birth Place Type	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
NICU (Level 3)	619	13.9	643	15.5	0.037	4187	14.2	0.083	0.673
Other Facilities	3715	83.6	3388	81.9	0.036	708	83.9	0.011	0.702
Unknown	112	2.5	105	2.5	0.985	87	1.9	0.055	0.049
Smoking and Low BW	n	%	n	%	P1 v. P2	n	%	P2 v. P3	P1 v. P3
Smoke "Yes", LBW	129	9.4	86	6.9	0.039	101	6.8	0.952	0.011
Total Smoke "Yes"	**1376**	-	**1239**	-	-	**1485**	-	-	-
Smoke "No", LBW	126	5.1	111	4.3	0.565	155	4.6	0.59	0.356
Total Smoke "No"	**2464**	-	**2604**	-	-	**3398**	-	-	-
Smoke "Unknown", LBW	47	7.8	26	8.9	0.019	10	9.2	0.925	0.667
Total Smoke "Unknown"	**606**	-	**293**	-	-	**109**	-	-	-

*p-value for t-test

Table 6a. AI/AN Infant Mortality Rates For Selected Variables Washington State, July 1988 to June 1996

	Jul 88 - Dec 90			Jan 91 - Jun 93			Jul 93 - Jun 96			Chi-Square, p-value		
	Period One			Period Two			Period Three					
Birthweight	deaths	live births	IMR	deaths	live births	IMR	deaths	live births	IMR	P1 v. P2	P2 v. P3	P1 v. P3
<1500g	23	49	469.4	10	31	322.6	*<6*	*48*	*<104.2*	0.197	*0.034*	*0.000*
<2500g	39	302	129.1	20	223	89.7	9	266	33.8	0.158	0.009	0.000
2500g or more	55	4133	13.3	34	3908	8.7	17	4716	3.6	0.048	0.002	0.000
Gestational Age												
<28 weeks	7	184	38.0	*<6*	*64*	*<78.1*	*<6*	*192*	*<10.9*	*0.086*	*0.041*	*0.719*
28 - 36 weeks	22	433	50.8	12	424	28.3	*<6*	*460*	*3.5*	0.092	*0.109*	*0.001*
37 weeks or more	50	3798	13.2	33	3628	9.1	15	4319	238.1	0.095	0.001	0.000
Unknown	17	31	548.4	7	20	350.0	*<6*	*21*	*<26.0*	0.170	*0.662*	*0.064*
Parity												
1st child	32	1434	22.3	22	1393	15.8	14	1863	7.5	0.205	0.025	0.000
2nd or 3rd child	43	2098	20.5	26	1840	14.1	9	2133	4.2	0.129	0.001	0.000
4th or more child	20	878	22.8	7	894	7.8	*<6*	*933*	*<5.4*	0.010	*0.722*	*0.003*
unknown	*<6*	*36*	*<27.8*	0	9	-	0	63	-	-	-	-
Smoke												
Yes	33	1376	24.0	23	1239	18.6	11	1485	7.4	0.339	0.009	0.001
No	44	2464	17.9	24	2604	9.2	14	3398	4.1	0.008	0.014	0.000
Unknown	19	606	31.4	8	293	27.3	*<6*	*109*	*<45.8*	0.739	*0.219*	*0.251*
Residence												
On Res. Lands	46	1912	24.1	28	1825	15.3	17	2059	8.3	0.056	0.039	0.000
Off Res. Lands	50	2534	19.7	27	2311	11.7	9	2933	3.1	0.025	0.000	0.000
Trans. at Birth												
Yes	19	74	256.8	9	41	219.5	*<6*	*45*	*<111.1*	0.657	*0.296*	*0.110*
No	76	4319	17.6	46	4075	11.3	25	4924	5.1	0.016	0.001	0.000
Unknown	<6	53	<94.3	0	20	-	0	23	-	-	-	-
Birth Facility												
Level 3/NICU	22	619	35.5	14	643	21.8	*<6*	*708*	*<7.1*	0.142	*0.043*	*0.001*
Other Facilities	71	3715	19.1	40	3388	11.8	22	4187	5.3	0.013	0.002	0.000
Unknown	*<6*	*112*	*<44.6*	*<6*	*105*	*<47.2*	*0*	*97*	-	-	-	-
Medicaid												
Non-Medicaid	24	1519	15.8	10	993	10.1	9	1279	7.0	0.224	0.431	0.032
Medicaid	72	2927	24.6	45	3143	14.3	17	3713	4.6	0.004	0.000	0.000
Suppl. Services												
Either MCM or MSS	7	356	19.7	21	1470	14.2	9	2005	4.5	0.017	0.006	0.002
Neither Services	65	2636	24.7	24	1697	14.1	8	1716	4.7	0.459	0.004	0.000

Note: italicized values are estimated; cell sizes n=5 or less are not disclosed

Table 6b. AI/AN Infant Mortality Rates by Program Interventions
Washington State, July 1988 through June 1996

Interventions	Jul 88 - Dec 90	Jan 91 - Dec 93	Jan 94 - Jun 96
	live births = 4446	live births = 4950	live births = 4178
Medicaid Expansion	present	present	present
1990 FDA Approval	*none	present	present
1994 "Back To Sleep"	none	none	**present

	Jul 88 - Dec 90			Jan 91 - Dec 93			Jan 94 - Jun 96			Chi-Square, p-value		
Impact of Surfactants* **	**deaths**	**IMR**	**C.I.**	**deaths**	**IMR**	**C.I.**	**deaths**	**IMR**	**C.I.**	**P1 v. P2**	**P2 v. P3**	**P1 v. P3**
Weight 600 - 1350g	16	421.1	267.2, 590.6	<6	*214.3*	*90.2, 414.6*	<6	*206.9*	*87.1, 402.6*	*0.078*	*0.945*	*0.064*
Weight 1350g or more	24	5.5	3.6, 8.2	14	2.8	1.6, 4.9	8	1.9	0.9, 4.0	0.049	0.377	0.008
Impact of "Back to Sleep"	**deaths**	**IMR**	**C.I.**	**deaths**	**IMR**	**C.I.**	**deaths**	**IMR**	**C.I.**	**P1 v. P2**	**P2 v. P3**	**P1 v. P3**
All SIDS Deaths	42	9.4	6.9, 12.9	31	6.3	4.3, 9.0	11	2.6	1.4, 4.9	0.079	0.011	0.000
Non-SIDS Deaths	54	12.1	9.2, 15.9	28	5.7	3.8, 8.3	11	2.6	1.4, 4.9	0.001	0.027	0.000
Impact of Medicaid Expan.	**deaths**	**IMR**	**C.I.**	**deaths**	**IMR**	**C.I.**	**deaths**	**IMR**	**C.I.**	**P1 v. P2**	**P2 v. P3**	**P1 v. P3**
Non-Medicaid	24	15.8	10.4, 23.8	11	9.0	4.8, 16.6	8	7.6	3.5, 15.5	0.118	0.704	0.064
Medicaid Recipients	72	24.6	19.4, 31.1	48	12.9	9.6, 17.2	14	4.5	2.6, 7.1	0.000	0.000	0.000
Non-Medicaid <2500g	9	5.9	2.9, 11.7	<6	*4.9*	*2.0, 11.3*	<6	*5.7*	*1.7, 11.7*	*0.726*	*0.804*	0.938
Medicaid <2500g	30	10.2	7.0, 14.8	15	4.0	2.3, 6.8	<6	*1.9*	*0.8, 4.4*	0.002	*0.123*	*0.000*
Non-Medicaid 2500g or more	14	9.2	5.3, 15.8	<6	4.9	2.0, 11.3	<6	*5.7*	*2.3, 13.0*	0.191	*0.804*	*0.316*
Medicaid 2500g or more	33	11.3	7.9, 16.0	33	8.8	6.2, 12.5	10	3.2	1.6, 6.1	0.320	0.003	0.000
Non-Medicaid SIDS	9	5.9	2.9, 11.7	<6	4.9	2.0, 11.3	<6	*5.7*	*2.3, 13.0*	0.726	*0.804*	*0.938*
Medicaid SIDS	33	11.3	7.9, 16.0	25	6.7	4.4, 10.0	8	2.6	1.2, 5.3	0.046	0.014	0.000

* FDA Approval Aug 1990
**"Back to Sleep" Aug 1994
***excludes SIDS and Congenital Anomalies
Note: italicized values are estimated p-values or IMR for n=6; cell sizes n=5 or less are not disclosed

Table 7a. AI/AN Maternal Characteristics for Dead and Alive Infants					
	Infant Deaths		Alive Infants		Chi-Square p-value
Maternal Risks and Behaviors	N=177		N=13397		
Mother Smokes	**dead**	**%**	**alive**	**%**	
Yes	67	37.9	4033	30.1	0.026
No	82	46.3	8384	62.6	0.000
Unknown	28	15.8	980	7.3	0.000
Trimester Prenatal Care Began	**dead**	**%**	**alive**	**%**	
First	71	40.1	8204	61.2	0.000
Second	48	27.1	3220	24.0	0.334
Third	19	10.7	917	6.8	0.040
None	18	10.2	306	2.3	0.000
Unknown	21	11.9	750	5.6	0.000
Maternal Diabetes		N=157		N=12543	
(data not available Jun – Dec 88)	**dead**	**%**	**alive**	**%**	
Gestational	0	-	263	2.1	-
Established	*<6*	*3.3*	43	0.3	-
None	156	99.4	12227	97.5	0.161
Unknown	0	-	10	0.1	-
Substance abuse		N=134		N=9649	
(Medicaid Women Only)	**dead**	**%**	**alive**	**%**	
Either Alcohol, Drugs or both	19	14.2	1044	10.8	0.211
None	115	85.8	8603	89.2	0.158
Unknown	0		*<6*	-	-
Program Intervention		N=134		N=9649	
(Medicaid Women Only)	**dead**	**%**	**alive**	**%**	
Either MCM, MSS, or both	37	27.6	3794	39.3	0.006
None	97	72.4	5855	60.7	0.002
Age and Parity	**dead**	**%**	**alive**	**%**	
20 yrs or older w/ 1 or 2 child.	57	32.2	5369	40.1	0.033
20 yrs or older w/ 3 or more child.	54	30.5	4915	36.7	0.089
<20 years with 1 or 2 children	58	32.8	2836	21.2	0.000
<20 years with 3 or more child.	6	3.4	157	1.2	0.023
Unknown Age or Parity	*<6*	*3.3*	120	0.9	-
Resides on Reservation Lands	**dead**	**%**	**alive**	**%**	
Yes	91	51.4	5705	42.6	0.019
No	86	48.6	7692	57.4	0.019
Medicaid Eligibility	**dead**	**%**	**alive**	**%**	
< 60% FPL (Grant)	90	50.8	6306	47.1	0.321
185% FPL (Post-Expansion)	11	6.2	1275	9.5	0.138
90% FPL (Pre-Expansion)	29	16.4	1913	14.3	0.432
Unknown Eligibility	*<6*	*3.3*	155	1.2	-
Non-Medicaid	43	24.3	3748	28.0	0.275

Note: italicized values are estimated; cell sizes n=5 or less are not disclosed

Table 7b. AI/AN Birth Outcomes for Dead and Alive Infants					
	Infant Deaths		Alive Infants		Chi-Square p-value
Birth Outcomes		N=177		N=13397	
Birthweight	**dead**	**%**	**alive**	**%**	
277 – 2499 grams	68	38.4	723	5.4	0.000
2500 grams or more	106	60.0	12651	94.4	0.000
Unknown	*<6*	*3.3*	23	0.2	-
Birthweight by Periods	**dead**	**%**	**alive**	**%**	
Period One <2500g	42	23.7	306	2.3	0.000
Period One 2500g or more	65	36.7	4847	36.2	0.866
Period Two <2500g	17	9.6	160	1.2	0.000
Period Two 2500g or more	24	13.6	3105	23.2	0.002
Period Three <2500g	9	5.1	257	1.9	0.006
Period Three 2500g or more	17	9.6	4699	35.1	0.000
All Periods, Unknown BW	*<6*	*3.3*	23	0.3	-
Gestational Age	**dead**	**%**	**alive**	**%**	
Very Premature (0 – 27 weeks)	29	16.4	43	0.3	-
Premature (28 – 36 weeks)	37	20.9	1280	9.6	0.000
Normal (37 weeks or more)	98	55.4	11647	86.9	0.000
Unknown	13	7.3	427	3.3	0.003
Gender of Child	**dead**	**%**	**alive**	**%**	
Female	79	44.6	6616	49.4	0.208
Male	98	55.4	6781	50.6	0.208
APGAR Score (at 5 minutes)	**dead**	**%**	**alive**	**%**	
Less than 8	45	25.4	402	3.0	0.000
8 or more	128	72.3	12919	96.4	0.000
Missing	*<6*	*3.3*	76	5.7	-
Child Transferred at Birth	**dead**	**%**	**alive**	**%**	
Yes	29	16.4	131	1.0	0.000
No	147	83.1	13171	98.3	0.000
Unknown	*<6*	*3.3*	95	0.7	-
Birth Place Type	**dead**	**%**	**alive**	**%**	
Level 3 / NICU + Vent	40	22.6	1930	14.4	0.002
Other Facilities	133	75.1	11157	83.3	0.003
Unknown	*<6*	*3.3*	310	2.3	-

Note: italicized values are estimated; cell sizes n=5 or less are not disclosed

Table 8b. AI/AN Birth Outcomes for SIDS and Non-SIDS Infant Deaths					
	Non-SIDS		SIDS		Chi-Square p-value
Birth Outcomes	N=93		N=84		
Birthweight	**deaths**	**%**	**deaths**	**%**	
277 – 2499 grams	52	55.9	16	19.0	0.000
2500 grams or more	38	40.9	68	81.0	0.000
Unknown	*<6*	*6.5*	0	0	-
Gestational Age	**deaths**	**%**	**deaths**	**%**	
Very Premature (<28 weeks)	29	31.2	0	0	0.813
Premature (28 – 36 weeks)	24	25.8	23	27.4	0.500
Normal (37 weeks or more)	32	34.4	56	66.7	0.000
Unknown	8	8.6	*<6*	*7.1*	-
Gender of Child	**deaths**	**%**	**deaths**	**%**	
Female	41	44.1	38	45.2	0.878
Male	52	55.9	46	54.8	0.878
APGAR Score	**deaths**	**%**	**deaths**	**%**	
Less than 8	38	40.9	7	8.3	0.000
8 or more	51	54.8	77	91.7	0.000
Missing	*<6*	*6.5*	0	0	-
Child Transferred at Birth	**deaths**	**%**	**deaths**	**%**	
Yes	26	28.0	*<6*	*7.1*	*0.000*
No	66	71.0	81	96.4	0.000
Unknown	*<6*	*6.5*	0	0	-
Birth Place Type	**deaths**	**%**	**deaths**	**%**	
Level 3 / NICU + Vent	25	26.9	15	17.9	0.152
Other Facilities	65	69.9	68	81.2	0.089
Unknown	*<6*	*6.5*	*<6*	*7.1*	-

Note: italicized values are estimated; cell sizes n=5 or less are not disclosed

Table 9a. Risk Factors for Adverse Outcomes Washington State, AI/AN Births, July 1988 - June 1996 Univariate Logistic Regression				
Variables	**Odds Ratio Exp(B)**	**Signifance**	**S.E.**	**R-value**
Apgar score less than 8	14.5636	0.0000	0.1643	0.3738
Birthweight <2500 grams	11.3506	0.0000	0.1579	0.3526
Gestational period <37 wks	5.3612	0.0000	0.1533	0.2499
Child Born during July 1988 - Dec. 1990	4.1689	0.0000	0.2374	0.1345
Prenatal care after 2nd trimester	2.8215	0.0000	0.1620	0.1437
Child Born during Jan. 1991 - Dec. 1993	2.2788	0.0010	0.2507	0.0682
Not Married or unknown	1.7550	0.0009	0.1700	0.0689
Any MCM or MSS	1.4945	0.0306	0.1858	0.0376
High Parity for Mom's Age	1.4570	0.0226	0.1651	0.0412
Lives on Reservation Lands	1.4265	0.1900	0.1514	0.0431
Answered "Yes" to Smoking Ques.	1.4141	0.0265	0.1561	0.0394
Substance Abuse (Alcohol and/or Drugs)	1.4007	0.1688	0.2449	0.0000
Medicaid Only	1.2104	0.2789	0.1763	0.0000
Gender (male)	1.2102	0.2099	0.1522	0.0000
Grant Recipients 60%FPL	1.1632	0.0000	0.1513	0.0000
Post Medicaid Expansion to 185% FPL	0.6304	0.1400	0.3126	-0.0097

Table 9b. AI/AN Multivariate Logistic Regressions

All Characteristics,
Entered with p-value 0.25 and Excluded with p-value 0.30

Independent Variable	Coeffie-cent (B)	Odds Ratio Exp (B)	Lower C.I. 95%	Upper C.I. 95%	Sig. (p-value)
Constant	-6.5975	-	-	-	0.0000
Apgar score less than 8	1.7825	5.9447	4.0066	8.8202	0.0000
Birthweight less than 2500 grams	1.3732	3.9478	2.5531	6.1044	0.0000
Child Born during Jun 88 - Dec 90	1.3578	3.8878	2.4122	6.266	0.0000
Child Born during Jan 91 - Dec 93	0.8749	2.3985	1.4507	3.9657	0.0006
Gestational Age < 37weeks	0.5072	1.6607	1.1012	2.5044	0.0155
Prenatal Care Unknown, None, or after 2nd Trimester	0.4390	1.5511	1.0911	2.2051	0.0145
Lives on Reservation	0.3053	1.3571	0.9908	1.8589	0.0572
Answered "Yes" to Smoking Ques.	0.2707	1.3109	0.9478	1.813	0.1018
Marital Status Unknown, or Single	0.2534	1.2884	0.9048	1.8346	0.1599
High Parity for Mom's Age	0.2092	1.2327	0.8771	1.7324	0.2283
Male Gender	0.2029	1.2250	0.8967	1.6734	0.2023

Maternal Characteristics Only,
Entered with p-value 0.25 and Excluded with p-value 0.30

Independent Variable	Coeffie-cent (B)	Odds Ratio Exp (B)	Lower C.I. 95%	Upper C.I. 95%	Sig. (p-value)
Constant	-6.0269	-	-	-	0.0000
Child Born during Jun 88 - Dec 90	1.3637	3.9105	2.4527	6.2346	0.0000
Prenatal Care Unknown, None, or after 2nd Trimester	0.8660	2.3775	1.7195	3.2871	0.0000
Child Born during Jan 91 - Dec 93	0.7922	2.2083	1.3500	3.6123	0.0016
Marital Status Unknown, or Single	0.3731	1.4523	1.0329	2.0419	0.0319
Answered "Yes" to Smoking Ques.	0.289	1.3352	0.9792	1.8204	0.0676
Lives on Reservation	0.2848	1.3294	0.9839	1.7964	0.0637
High Parity for Mom's Age	0.2198	1.2458	0.8971	1.7299	0.1895