



Family Health *Dataline*

IN THIS ISSUE

In Alaska during 1993-97, after excluding births whose outcomes were unlikely to be related to perinatal care decisions:

- Among infants <1500 g birth weight, 16% of infants born outside of a tertiary care facility died compared to 10% born at a tertiary care facility.
- Among infants born at >1500 g, few infants died regardless of birth facility.
- Transport and referral patterns had only a small impact on mortality among all infants <2500 g birth weight.
- Alaska Native and non-Native low and very low birth weight infant mortality rates were similar when examining only births and deaths that were possibly related to Alaska perinatal care issues.

Perinatal care regionalization and mortality among low birth weight infants in Alaska

Introduction

Perinatal care regionalization, i.e., the consolidation of tertiary perinatal care services, has been associated with improvements in neonatal outcomes. More recently, there has been a trend toward deregionalization of perinatal care that has resulted from a proliferation of perinatal subspecialists and increased competition for patients among smaller hospitals. Few studies, however, have examined the extent of inappropriate referral and transport of high-risk pregnant women and critically ill newborns and inappropriate treatment at non-tertiary care centers. This information is necessary for deciding whether or not resources should be invested in efforts to further regionalize perinatal care. The current study examined whether or not referral, transport, or treatment patterns led to preventable deaths among infants born at a potentially viable age.

Methods

Data sources

We examined a data file from the Alaska Bureau of Vital Statistics to identify all Alaska resident births with a birth weight <2500 g during the period 1993-97; for infants who died before 1 year of age, the file included linked death certificate information. This database was then linked to a previously existing Alaska Maternal-Infant Mortality Review (AMIMR) database housed at the State Section of Maternal, Child, and Family Health using an exact match of date of birth, date of

death, first name, and last name. Through this process, all but four deaths recorded by the Bureau of Vital Statistics during the study period were linked to the AMIMR database. In addition to information from birth and death certificates, complete copies of maternal and infant medical records were collected for AMIMR and were available for review.

Perinatal Services Delivery in Alaska

During 1993-97, 24 hospitals in Alaska delivered care to pregnant women and newborns including private for-profit, private non-profit, military and Alaska Native Corporation entities. The majority of Alaska's approximately 600,000 residents had access to these hospitals via intra- or inter-city road systems. Many rural villages, though, did not have road access to hospitals and instead relied on air transport. For most of these villages, health care was provided at clinics staffed by health aides, nurse practitioners, or physicians assistants.

One hospital in Alaska provided tertiary level obstetric services and this same hospital had a level III neonatal intensive care unit (NICU). This hospital provided perinatal services to all state

residents and maintained an emergency airplane transport system for critically ill newborns and pregnant women. Approximately 45% of low birth weight (<2500 g) infants born in Alaska were born at this hospital and the average monthly number of NICU admissions was 34. The remaining 23 in-state hospitals provided a variety of services although none provided non-emergent mechanical ventilation for newborns or tertiary care obstetric services. During the study period, 4% of low birth weight deliveries occurred at out-of-state facilities.

During the study period the widely accepted standard in Alaska for transport of a pregnant woman or infant to a tertiary care facility was at least 24 weeks gestation (i.e., the age of viability); women expected to deliver earlier or infants born at a younger gestation were generally not transferred. Standard of care also dictated that mothers with infants expected to be born or infants born at < 1500 g birth weight should be transferred to the tertiary care facility. Those at greater birth weight might be treated at a non-tertiary care facility depending on the expertise of the facility and the clinical course of the infant and mother.

Analysis

A primary objective was to determine not just overall low birth weight specific mortality rates but also mortality rates among infants whose outcomes may have been influenced by perinatal care decisions. Consequently, following a review of maternal and infant records, births were divided into two groups: those whose outcomes were unlikely to be and those whose outcomes were possibly related to Alaska perinatal care decisions. Births (and resulting deaths) in the first category were those that resulted in a lethal congenital anomaly, occurred at a pre-viable gestational age (<24 weeks), occurred at an out-of-state hospital or resulted in death following discharge from the hospital. The remaining births, whose outcomes may have been associated with Alaska perinatal care decisions, were placed in the second category.

For deaths in the second category, an objective of the study was to identify mechanisms by which non-tertiary perinatal care decisions may have contributed to death. Consequently, these deaths were divided further into those possibly associated and those not associated with non-tertiary perinatal care decisions. Deaths not associated with non-tertiary perinatal care met the following criteria: the infant's mother resided or received all prenatal care in Anchorage, the mother was not transferred to the

tertiary care center from another hospital, and the infant was born at the tertiary care center. The remaining deaths were considered to be possibly associated with non-tertiary care. Because maternal prenatal care and transport history were documented in the medical records available for infant's who died but incompletely documented on the birth certificate for remaining infants, mortality rates for these categories could not be calculated.

A board-certified perinatologist reviewed deaths possibly associated with non-tertiary level care to identify instances where referral or treatment decisions contributed to death. She completed a standard data abstraction form indicating the conditions surrounding the infant's birth and death, whether or not the death was preventable (yes, probably, possibly, or no) and – if the death was potentially preventable – whether or not changes in referral patterns or treatment decisions could have altered the outcome. Referral patterns were considered to have been associated with an infant's death if the mother or infant was retained at a non-tertiary hospital despite a medical condition that should have prompted transfer to a tertiary care center.

Results

Overall

During 1993-97, maternal race was known for all 168 deaths and 2,793 of the 2,809 births of infants with a birth weight less than

2,500 g. The Alaska Native and non-Native birth weight specific mortality rates for infants less than 2,500 g were 74 and 56 per 1000 live births respectively (RR, 1.3; 95% CI, 0.96, 1.8). Most of the difference in rates between Alaska Natives and non-Natives occurred among infants less than 1500 g (Table 1). The mean birth weights for Alaska Natives and non-Natives were similar for both weight categories examined, although Alaska Natives had a lower average gestational age among the 1500-2499 birth weight category births.

Births whose outcomes were unlikely to be related to perinatal care

Two hundred and forty births, and a resulting 115 deaths,

Table 1. Birth weight specific mortality rates by Alaska Native status; Alaska, 1993-97.

Category	Alaska Natives	Non-Natives
0-1499 g		
Births	128	380
Mean birth weight (grams)	1015	1016
Mean gestational age (weeks)	27.3	27.9
Deaths	36	87
Mean birth weight (grams)	764	707
Mean gestational age (weeks)	24.1	24.5
Birth weight specific mortality rate per 1000 live births (rate ratio; 95% CI)	281 (1.2; 0.88 to 1.7)	229 (Ref.)
1500-2499 g		
Births	504	1781
Mean birth weight (grams)	2164	2185
Mean gestational age (weeks)*	35.1	35.6
Deaths	11	34
Mean birth weight (grams)*	1887	2158
Mean gestational age (weeks)*	33.1	35.5
Birth weight specific mortality rate per 1000 live births (rate ratio; 95% CI)	22 (1.1; 0.58 to 2.2)	19 (Ref.)

* Means are statistically different at the 95% confidence level.

were placed in this category (Table 2). Thirty-eight births resulted in a lethal congenital anomaly and 23 others resulted in an infant who died following discharge from the hospital. One hundred and twelve births and four deaths occurred at out-of-state facilities. Sixty-seven births occurred at <24 weeks gestation of which 50 resulted in death.

Births whose outcomes may have been related to perinatal care

The remaining 2,553 births, and resulting 53 deaths, were placed in this category. Among infants with a birth weight <1500 g, 17 of 108 (16%) born outside of the tertiary care center died compared to 30 of 286 (10%) born at the tertiary

care center (RR, 1.5; 95% CI 0.86 to 2.6). Among infants with a birth weight of 1500-2499 g, 1 of 1265 (0.080%) born outside of the tertiary care center died compared to 5 of 894 (0.56%) born at the tertiary care center (RR, 0.14; 95% CI 0.02 to 1.2). Compared to non-Natives, Alaska Native infants delivering at the tertiary care center did not have statistically significant increased risk of death (Table 3).

Expert review of deaths to evaluate referral and treatment decisions at non-tertiary care hospitals

Of the 53 deaths possibly related to perinatal care issues, 15 infants <1500 g and four 1500-2499 g birth weight received only tertiary level perinatal care (i.e., the mother resided or received all prenatal care in Anchorage and was not transferred to the tertiary care center from another hospital and the infant was born at the tertiary care center). The remaining 34 deaths were examined further to identify non-tertiary level referral and treatment decisions that may have contributed to death.

Maternal transfer before delivery: Fifteen infants < 1500 g and one 1500-2499 g who died had a mother that was transferred to the in-state tertiary care center before delivery. The study perinatologist determined that five of the 16 deaths were possibly or probably preventable. For two of these infants, referral patterns contributed to death. A Native infant delivered at 24

Table 2. Infant deaths unlikely to be related and possibly related to Alaska perinatal care, by birth weight and Alaska Native status; Alaska, 1993-97.

	Native		Non-Native	
	<1500g	1500-2499g	<1500 g	1500-2499 g
Overall	36	11	87	34
Infant deaths unlikely to be related to Alaska perinatal care				
Lethal congenital anomaly	4	4	12	18
Died following hospital discharge	3	6	4	10
Died out-of-state	0	0	3	1
Born at <24 weeks gestation (previable)	14	0	36	0
Infant deaths possibly related to Alaska perinatal care				
Infant deaths not associated with non-tertiary care	1	1	14	3
Infant deaths possibly associated with non-tertiary care				
Maternal transfer pre-delivery	7	0	8	1
Infant transfer post-delivery	4	0	4	1
No transfer	3	0	6	0

weeks after a village health worker sent the mother home instead of initiating transport despite identification of placenta previa. A non-Native infant was the 27-week product of a mother with multiple previous episodes of preterm labor that nevertheless was sent home twice with a dilated cervix; transfer to the tertiary care center should have occurred at 20 weeks gestation for this woman. Both of these women subsequently had the acute onset of labor and were transferred urgently to the tertiary care center.

For three infants (two Native and one non-Native), treatment rather than referral decisions were identified as contributory to death. For each, however, the problematic treatment decision was made at the tertiary care hospital rather than non-tertiary care hospitals: in each case a non-urgent intervention performed after transfer likely precipitated delivery at 24 weeks gestation with death occurring soon after.

Among the 11 mothers of infants whose deaths were judged to be not preventable, two were managed at local hospitals until 24 weeks gestation and then in accordance with standard practice were transferred to the tertiary care center, five had precipitous labor without known risk factors and were transferred to the tertiary care center immediately upon presentation, and four were identified early as high-risk and transferred well in advance of delivery (11 days to 8 weeks).

Infant transfer post-delivery: Eight infants < 1500 g and one 1500-2499 g who died were born outside of the in-state tertiary care center but were referred before death. The study perinatologist identified two deaths each as definitely or possibly preventable. For two of these infants, both non-Natives, referral patterns were important. A nurse midwife retained care of a woman until 30 weeks gestation despite the identification of pregnancy induced hypertension and oligohydramnios and a physician kept a mother in a local hospital at 24 weeks gestation (who subsequently delivered at 25 weeks) based on an assumption of infant nonviability. For two infants treatment decisions contributed to death: a non-Native woman had not received a cervical cerclage despite appropriate indications for this and a caesarian section was delayed for a Native woman despite the identification of a prolapsed cord. The remaining five women had uncomplicated pregnancies until presenting acutely in labor.

No transfer: The remaining nine infants were born at <1500 g, born outside of the in-state tertiary care center, and not referred

before death. One non-Native death was identified as preventable because of questionable treatment decisions: a vaginal infection was left untreated and a cervical cerclage was not placed despite clinical indications for both. Seven of the remaining eight deaths occurred to infants whose mothers had an uncomplicated pregnancy until the acute onset of labor. For the final infant, information in the medical chart was not sufficient to determine whether or not the death was preventable.

Summary: Ten of 32 deaths among infants <1500 g and none of two deaths among infants 1500-2499 g birth weight were definitely, probably, or possibly preventable. Four of 14 deaths among Alaska Natives and six of 20 among non-Natives were definitely, probably, or possibly preventable. Six of the ten potentially preventable deaths were related to treatment decisions while four were related to referral decisions.

Discussion

We found that infants under 1500 g birth weight had lower mortality if born at the tertiary care center, that for infants with birth weights of 1500-2499 g few infants died

regardless of birth facility, and that transport and referral issues played only a minor role in the mortality rates of low birth weight infants. During the study period, Alaska providers had a policy of transferring mothers or infants when the infant birth weight was expected to be < 1500 g. Based on the current study results, it would seem prudent to reinforce and facilitate this practice. While the current study suggests that increased referral to the tertiary care center of infants with birth weights of at least 1500 g will not impact mortality, it is important to remember that the effect of tertiary care on non-lethal outcomes was not measured.

During the five-year study period, the majority of infant deaths for which referral issues could potentially have played a role involved pregnant women who delivered precipitously. In all, perinatal referral decisions played a role among only four of 168 low birth weight infant deaths. Even for these four deaths, there was little evidence in the medical records that providers identified a high-risk condition and then intentionally elected to treat the patient locally; instead, the problem was a failure to correctly interpret the severity of the patient’s clinical condition.

Three deaths occurred following inappropriate treatment decisions at non-tertiary care facilities. In each case appropriate care could have been provided without transfer to the tertiary care center. These findings suggest that other than promoting a policy of having all pregnant women in Alaska temporarily relocate near a tertiary care center, efforts to increase perinatal care centralization will not significantly reduce low birth weight infant mortality in Alaska.

Alaska Natives are the largest minority population in Alaska and live predominantly in rural villages that require airplanes to access local hospitals and the tertiary care center. Despite this, there was little disparity between Native and non-Native low birth weight infant mortality rates. Furthermore, only one death

Table 3. Birth weight specific mortality rates by Alaska Native status for births and deaths possibly related to Alaska perinatal care*; Alaska, 1993-97.

Birth weight-specific categories	Infant delivered at tertiary care center		Infant not delivered at tertiary care center	
	Alaska Native	Non-Native	Alaska Native	Non-Native
<i>0-1499 g</i>				
Deaths	8	22	7	10
Births	58	228	45	63
Birth weight specific mortality rate (per 1000 live births)	138	97	156	159
Rate ratio (95% CI)	1.4 (0.67, 3.0)	Ref.	0.98 (0.40, 2.4)	Ref.
<i>1500-2499 g</i>				
Deaths	1	4	0	1
Births	98	796	386	879
Birth weight specific mortality rate (per 1000 live births)	10	5.0	0	1.1
Rate ratio (95% CI)	2.0 (0.23, 18)	Ref.	0	Ref.

* Births and deaths considered unlikely to be related to Alaska perinatal care, and thus removed from this analysis, included infants born with a lethal congenital anomaly, at an out-of-state hospital, or at a previable gestational age (<24 weeks) or who died following discharge from the hospital

was identified that was related to treatment or referral in a rural village where care is frequently provided by village health aides. It is possible that successful efforts at educating rural health providers and past efforts to centralize perinatal care for very low birth weight infants has led to this result.

Recommendations

The current practice of referring all mother-infant pairs to a tertiary care hospital when the infant is expected to be or has been born at <1500 g should be continued and reinforced.

Based on an analysis that included mortality but not morbidity outcomes, there is no evidence to support a discontinuation of the current practice of treating stable non-critically ill infants with a birth weight >1500 g at non-tertiary care centers with appropriate staff and facilities.

Efforts should be made to conduct an analysis similar to the current one for non-lethal outcomes. This may be difficult for infants with birth weights >1500 g because serious non-lethal outcomes such as bronchopulmonary dysplasia, high-grade intraventricular hemorrhage, and retinopathy of prematurity are rare among this group.

Establishment of routine surveillance and review of all infants with a birth weight <1500 g may assist with identification and development of appropriate public health interventions.

Future efforts in Alaska to decrease low birth weight infant mortality may need to focus on prevention of preterm and low birth weight birth, educating providers on appropriate treatment of pregnant women, introduction of new technologies in the medical care of critically ill infants, and the care of vulnerable infants once they are discharged from the hospital.

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Family Health *Dataline* is a publication of the Alaska Department of Health and Social Services; Division of Public Health; Section of Maternal, Child, and Family Health, MCH Epidemiology Unit, 1231 Gambell Street, Anchorage, AK 99501, (907) 269-3400 (fax) 269-3414.



Vol. 6, No. 1

Corrected June 2004

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