Neonatal and Postneonatal Mortality

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PUBLIC HEALTH IMPORTANCE

By convention, infant mortality analysis is subdivided into two stages—the neonatal and postneonatal periods.* More than a century ago, William Farr recognized that factors affecting the death rate vary at different stages of infancy and wrote about the need to subdivide the first year of life into months or even days (*1*). He also noted that the effect of environmental factors on mortality varied by age of the infant, with those who are older experiencing substantially higher mortality rates than younger infants. Today, neonatal and postneonatal mortality are examined separately because most deaths during the neonatal period are associated with events surrounding the prenatal period and the delivery, whereas postneonatal deaths are more likely to be associated with conditions or events that arise after the delivery and, thus, reflect environmental factors. This division into neonatal and postneonatal periods is not completely satisfactory, however. For example, deaths from birth defects are common during both the neonatal and postneonatal periods, but the causes of birth defects are related to events that occur from conception to birth. Likewise, delivery of preterm infants (born <37 completed gestational weeks) is caused by conditions arising during the antepartum and intrapartum periods, but deaths related to prematurity may be postponed to the postneonatal period (*2,3*).

The proportionate contribution of neonatal and postneonatal mortality to the infant mortality rate has varied over the past century. In general, infant mortality declined throughout the 20th century. Rates of decline were rapid for the first four decades but were slower from 1950 to 1964 and again from 1981 to 1989. In the first two decades of this century, two thirds of infant deaths occurred during the postneonatal period, and until the late 1960s, improvement in infant mortality was primarily the result of declines in postneonatal mortality (*1,4*). Environmental changes that resulted in fewer infections, the use of antibiotics, and improved nutrition are thought to have contributed to the decline in postneonatal mortality from the 1900s to the 1950s (*5*). As a result, deaths in the postneonatal period contributed a progressively smaller proportion of total infant deaths in the United States: 50% in the 1920s, 35% in the 1940s, and 25% in the mid-1960s (*4*).

As early as the late 1920s, neonatal mortality began to command relatively greater attention as a health concern than postneonatal mortality. In the ensuing decades, while postneonatal mortality continued to fall, neonatal mortality rates also

* **Neonatal mortality**—defined as the death of a live-born infant in <28 days of life—can be further subdivided into **early neonatal mortality**, an infant death that occurs in <7 days of birth, and **late neonatal mortality**, a death from 7 to <28 days of age. **Postneonatal mortality** is defined as the death of a live-born infant from 28 through 364 days of life.

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declined, though less rapidly than postneonatal mortality. From 1950 to 1964, very little decline occurred in either neonatal or postneonatal mortality. From 1965 to 1970, a sharp drop in postneonatal mortality coincided with the implementation of Medicaid and other federal programs targeted at the poor (*1,6*). With the introduction of neonatal intensive care units that improved survival of low-birth-weight infants, neonatal mortality declined rapidly from 1970 through 1980. Beginning in 1970, the rate of decline in neonatal mortality exceeded that of postneonatal mortality for the first time. Although the rate of decline was slower, regionalization of perinatal intensive care services contributed to further improvements in the survival of low-birth-weight babies in the 1980s. In the late 1980s, therapeutic advances in the treatment of respiratory distress syndrome probably contributed substantially to the 6% decline in infant mortality reported between 1989 and 1990 (*7*).

Neonatal mortality continues to account for the largest proportion (63.5%) of infant deaths. However, since 1970, because postneonatal mortality has declined at a slower rate than neonatal mortality (*8*), the proportion of infant deaths occurring in the postneonatal period has increased steadily from 24.7% in 1970 (*1*) to 36.6% in 1990 (*9*). In recent years, postneonatal mortality has declined only slightly (*10*), and the United States continues to have higher postneonatal rates than many industrialized countries (*6*).

These trends since 1970, combined with the relative lack of improvement in postneonatal mortality rates in the 1980s, suggest that postneonatal deaths should receive more attention than they have in the past few decades. The reasons for the relatively low importance given to postneonatal mortality in the United States may include the false perception that postneonatal mortality is a disappearing problem, the possibility that infants dying in the postneonatal period are less likely to be seen by clinicians or hospital professionals before death and therefore tend to not attract their attention, and the possibility that factors related to postneonatal mortality deaths are social rather than medical and are less studied in a research environment dominated by the medical model of disease causation. For additional information about related topics and surveillance activities, see the Preterm Birth, Low Birth Weight and Intrauterine Growth Retardation, Prevalence of Birth Defects, Infant Mortality, and Injury and Child Abuse chapters.

HISTORY OF DATA COLLECTION

The concept of neonatal and postneonatal mortality surveillance is not new, but until recently, the purpose for tracking these rates was limited to the collection, analysis, and dissemination of data (*11*). Surveillance focused on reporting declines in rates of neonatal and postneonatal deaths by cause of death. In the late 1960s, public health surveillance for infectious disease incorporated the idea that surveillance should have an action component that results in disease prevention and control (*12*); however, action steps related to prevention, planning, and evaluation did not become a priority for neonatal and postneonatal surveillance until the 1980s, coinciding with the availability of linked birth certificates and infant death certificates (*13*). Surveillance is now used to describe families at risk for neonatal or postneonatal death so that they can be targeted for prevention services; to set priorities for directing scarce resources to programs that will do the most to improve neonatal and postneonatal survival; to evaluate the effectiveness of those programs; and to determine whether preventive public health services are reaching populations in need of those services. Neonatal surveillance has focused on planning and evaluating efforts to improve birth-weight-specific mortality and birth-weight distribution, such as early prenatal care, appropriate referrals to tertiary care facilities for women who have severe maternal risk factors or who are likely to deliver a very-low-birth-weight or preterm infant. Postneonatal surveillance has focused on planning and evaluating preventable causes of death such as infections and injuries.

Although vital records form the basis of surveillance, many state programs are beginning to link other health systems records such as Medicaid, the Special Supplemental Food Program for Women, Infants, and Children (WIC), and hospital discharge data to the birth and infant death certificate linked file. Linkage to information on sources and details of care allow for more extensive risk factor identification, assessment of the extent to which programs reach targeted populations, and a more complete evaluation of the effectiveness of programs. However, these additional linkages require a large commitment of resources for computer time and data management. Some program files may not contain an adequate set of variables to allow for individual linkage.

CDC SURVEILLANCE ACTIVITIES

Routine reports of mortality statistics remain an important source of information for surveillance. Mortality reports are available sooner than linked vital records data. Therefore, the cause of death can be examined within 2 years after the event.

The first national linkage of birth and infant death certificates was generated for the 1960 birth cohort by NCHS (*14*). The 1980 birth cohort was linked by the National Infant Mortality Surveillance project (*15*). This cohort provided information from 50 states, New York City, the District of Columbia, and Puerto Rico; the data were presented in tabular form rather than in individually linked birth and infant death certificate records. Beginning with the 1983 birth cohort, NCHS has generated individually linked birth and infant death certificates for each cohort. This method represents a change in the population used to estimate yearly neonatal mortality rates. The neonatal mortality rate estimated by using the linked file reflects the mortality experience of all infants born to a specific birth cohort based on the calendar year of birth. The major advantages of using the linked file is that it provides more information about the mothers and infants who died. The major disadvantage is the lack of timeliness in producing the files. State files are usually produced within 2–3 years of the last infant death. (See the Infant Mortality chapter.) National files lag 4–5 years behind the year of death.

Neonatal and postneonatal mortality rates are generally reported by race, with the most striking differences reported between white and black infants (neonatal and postneonatal rates) and between white and Native American infants (postneonatal rates). Before 1989, infant race, which served as the denominator for neonatal and postneonatal mortality rates, was tabulated on the basis of the race of the child, as generated by on an algorithm developed by NCHS. Since 1989, NCHS has tabulated infant race based on the race of the mother, as reported directly on the birth certificate. Race-specific rates of neonatal and postneonatal mortality may vary in the same year depending on whether the denominator of live births is based on the race of the child or of the mother. When reporting mortality by race, one must indicate whether rates are based on use of the race of the child or of the mother. Unless otherwise noted, rates reported in the General Findings section of this chapter are based on the mother's race. Variations in these rates may be related to socioeconomic factors rather than to race or ethnicity per se.

Ethnicity is classified as Hispanic or non-Hispanic. Reporting of ethnicity varies by state. For example, during 1983–1987, only 23 states and Washington, D.C., reported Hispanic ethnicity on the birth certificate. For these states, the Hispanic origin of the mother and father was reported; persons of Hispanic origin were further identified as being of Mexican, Puerto Rican, Cuban, Central or South American, or other Hispanic culture of origin, regardless of race. When reporting mortality by ethnicity, methods used to determine ethnicity should be cited in reports. In this chapter, and in most published reports, rates generated from the linked birth and infant death certificates are based on the mother's ethnicity.

GENERAL FINDINGS

Geographic, Race-Specific Time Trends

From 1978–1980 to 1988–1990, the U.S. neonatal mortality rate declined by 31%, from 8.9 per 1,000 live births to 6.1 per 1,000 live births (see Table 22 in NCHS [*16*]). Neonatal mortality rates varied by race and region of the country (time trends are based on unlinked files). Black infants experienced a twofold higher rate of neonatal deaths (15.1 for 1978–1980 and 11.8 for 1988–1990) than white infants (7.8 for 1978–1980 and 5.1 for 1987–1989).

In 1990, the black-to-white infant mortality rate ratio (based on race of the child) was 2.2—an increase of 22% over the lowest ratio of 1.77 attained in 1971. This overall trend was a product of two diverging trends: one for neonatal mortality and one for postneonatal mortality. From 1960 to 1973, neonatal mortality for black and white infants declined at similar rates so that the rate ratio remained relatively stable (1.62 in 1960 and 1.64 in 1973). Since 1973, however, neonatal mortality declined much more rapidly for white than for black infants, leading to an increase in the ratio from 1.64 in 1973 to 2.21 in 1990. (*16–17*).

In contrast to the trend in neonatal mortality, the black-to-white ratio in postneonatal mortality based on race of child declined rapidly between 1966 and 1975 (from 2.86 in 1966 to 2.08 in 1975), reflecting a more rapid rate of decline for black than white infants (*17*). From 1975 to 1988, black and white postneonatal mortality declined at about the same rate so that the rate ratio changed little. The rate ratio for postneonatal mortality in 1990 was 2.18 (see Table 20 in NCHS [*16*].

From 1987 to 1990, neonatal mortality among white infants was lowest in the Pacific States (Washington, Oregon, California, Alaska, and Hawaii) and the West North Central States (Minnesota, Iowa, Missouri, North Dakota, South Dakota, Iowa, Nebraska, and Kansas); for that same period, neonatal mortality for black infants was lowest in the West South Central States (Arkansas, Louisiana, Oklahoma, and Texas). Between 1978–1980 and 1988–1990, the greatest percentage declines in neonatal mortality for both black and white infants occurred in the West North Central and the West South Central States.

From 1987 to 1990, postneonatal mortality among white infants was lowest in the New England States (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut). Black postneonatal mortality was also low in the New England States, but rates were based on only three of the six states because the small number of black live births in the other three states resulted in highly unreliable estimates of postneonatal mortality (see Table 22 in NCHS [*16*]). Among regions that had reliable estimates, postneonatal mortality was lowest in the South Atlantic States (Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida).

For both races, the largest percentage declines in postneonatal rates occurred in the South Atlantic States (Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida) and the West South Central States (Arkansas, Louisiana, Oklahoma, and Texas).

Birth-Weight-Specific Mortality Rates

Birth weight is a major predictor of neonatal mortality. Neonatal mortality may improve because of a decline in the proportion of births that are low birth weight (LBW, <2,500 g) or because of improvements in the survival of LBW infants. Therefore, when evaluating neonatal mortality, we must examine both the proportion of births in each birth-weight category and the mortality experience in each category.

Compared with the 1960 U.S. birth cohort, the 1980 U.S. birth cohort experienced a substantially lower neonatal mortality rate (based on linked files)—16.7 vs. 7.3 per 1,000 live births—reflecting a decline of 56%. However, 91% of this decline can be attributed to reductions in the birth-weight-specific neonatal mortality risk and the remainder to improvements in birth-weight distribution. Although birth-weight-specific neonatal mortality risk decreased among all birth-weight groups, the greatest percentage decline occurred among infants weighing 1,500–1,999 g. A small shift from a lighter to a heavier range of birth weight accounted for the small contribution to the overall decline between 1960 and 1980. Similarly, virtually all of the change in postneonatal mortality risk between 1960 and 1980 resulted from declines in birth-weight-specific mortality. Postneonatal mortality risks decreased among all birth-weight groups except for neonatal survivors weighing 500–999 g (*18*).

In the United States, rate of very low birth weight (VLBW, <1,500 g) is the principal predictor of neonatal mortality (*19*). In the 1980s, <1.5% of all live-born infants were VLBW, but these infants account for >50% of all neonatal deaths (*15*).

Racial and Ethnic Differences in Neonatal and Postneonotal Mortality

The neonatal mortality rate is a crude weighted average of race and ethnicity, birth-weight distribution and birth-weight-specific experience, and many other factors. As noted previously, linked infant birth certificates and death certificates provide more accurate information on neonatal mortality by race and ethnicity (Table 1). Data for the 1985–1987 birth cohorts show that neonatal and postneonatal mortality risks varied widely by race and ethnicity. Infants born to black mothers had the highest neonatal mortality risks followed by those born to Puerto Rican mothers. Overall, Asians had the lowest neonatal mortality risks whereas the risks among whites, Native Americans, and Hispanics (except Puerto Ricans) were somewhat similar.

Postneonatal mortality risks were highest among Native Americans and blacks. Rates among Native Americans were 2.4 times the rates among non-Hispanic whites, and rates among blacks were 2.2 times the rates among non-Hispanic whites. Mortality risks among the other racial and ethnic groups were relatively low and showed little variation. Postneonatal deaths accounted for over half of the total infant deaths among Native Americans compared with approximately a third among other groups (*20*).

The variation in mortality risks among race/ethnic groups may be related to differences in birth-weight distribution or from differences in

TABLE 1. Infant, neonatal, and postneonatal mortality rates, by race and Hispanic origin of mother — United States, 1985–1987 birth cohorts

	Deaths per 1,000 live births		
Race and Hispanic origin of mother	**Infant**	**Neonatal**	**Postneonatal**
All mothers	10.1	6.6	3.6
Race			
White	8.5	5.5	3.0
Black	18.2	12.0	6.2
Native American or Alaska Native	13.3	6.1	7.2
Asian or Pacific Islander	7.6	4.7	2.9
Chinese	6.0	3.4	2.6
Japanese	6.6	3.9	2.7
Filipino	7.2	4.7	2.5
Other Asian or Pacific Islander*	8.3	5.2	3.2
Hispanic origin†	8.5	5.5	3.0
Mexican American	8.1	5.2	2.9
Puerto Rican	10.9	7.3	3.6
Cuban	7.7	5.5	2.2
Central and South American	7.8	5.2	2.6
Other and unknown Hispanic	9.1	5.7	3.4
Non-Hispanic white†	8.4	5.4	3.0
Non-Hispanic black†	17.9	11.6	6.3

* Includes Hawaiians and part Hawaiians.

† Includes mothers of all races. Data shown only for states with an Hispanic-origin item on their birth certificates. In 1986–1987, 23 states and the District of Columbia included this item.

Source: NCHS, linked birth/infant death data set.

birth-weight-specific mortality. Analysis of data from the 1983–1984 U.S. birth cohorts revealed that blacks had nearly three times (2.60%) and Puerto Ricans 1.6 times (1.48%) the incidence of VLBW as did non-Hispanic whites (0.93%) (*21*). Little or no excess in VLBW incidence was observed among other groups. Blacks and Puerto Ricans also had an elevated rate of moderate-low-birth-weight (MLBW, 1,499–2,499 g) births. The relatively high VLBW and MLBW incidence among blacks and Puerto Ricans is reflected in their high neonatal mortality risks. Mortality risks for VLBW did not vary substantially by race/ethnic groups, although Japanese and Filipino mothers had particularly low rates. However, elevated mortality risks among normal-birth-weight (NBW, 2,500–4,500 g) black and Puerto Rican infants contributed to their high neonatal mortality risks.

An examination of the mortality risk difference between non-Hispanic white and black infants for the 1983 birth cohort showed that black infants weighing <3,000 g had a lower neonatal mortality risk than whites. However, this survival advantage was outweighed by the far greater incidence of LBW in general and VLBW in particular among black infants than among white infants. In the postneonatal period, mortality risks for black infants were generally higher than risks for white infants in all birth-weight groups. After considering the relative contribution of differences in birth-weight distribution and birth-weight-specific neonatal mortality risks, investigators found that deaths among VLBW babies accounted for about 84% of the black-to-white gap in the neonatal mortality risks. In the postneonatal period, higher mortality risk among babies weighing >1,500 g—including those of MLBW (23.4%) and NBW (48%)—accounted for 72.3% of the black to white risk difference in postneonatal mortality (*22*).

In evaluating neonatal mortality surveillance among Hispanic populations,using the 1983 and 1984 linked birth and infant death data set, Becerra and colleagues identified infants born to Hispanic mothers in 24 reporting areas that included a Hispanic identifier on the birth certificate if the mother was reported as Hispanic (*20*). By also including infants born in any of the 50 states and Washington, D.C., whose mothers who were born in Mexico, Puerto Rico, or Cuba, the investigators identified 3% more Mexican Americans, 27% more Puerto Rican Americans, and 17% more Cuban Americans than originally indicated on the linked data set. To compare outcomes by geographic location, the investigators included infants born to residents of the Commonwealth of Puerto Rico. The VLBW rate was higher among Puerto Ricans born in the continental United States (but not Puerto Rican islanders) than among other Hispanics. Compared with neonatal mortality rates among non-Hispanic whites, neonatal mortality rates were higher among Puerto Rican islanders and Puerto Ricans living in the continental United States. Puerto Rican islanders had the highest birth-weight-specific mortality for all groups except infants weighing >4,000 g.

Causes of Death

The leading cause of neonatal deaths for all infants (based on unlinked files) was birth defects, followed by disorders related to short gestation and unspecified low birth weight, and respiratory distress syndrome (Table 2) (*23*). However, among black infants, the ranking of leading causes of neonatal deaths was disorders related to short gestation and unspecified low birth weight, followed by respiratory distress syndrome and birth defects. In the postneonatal period, the leading cause of death was sudden infant death syndrome, followed by birth defects and injuries (Table 2). Native Americans and blacks had postneonatal mortality rates of sudden infant death syndrome, infections, and injuries that were two to three times the rates among whites. The least variation in cause-specific mortality among racial and ethnic groups occurred for deaths caused by birth defects.

INTERPRETATION ISSUES

Many of the methodologic and interpretation issues associated with the surveillance of neonatal and postneonatal mortality are similar to those cited for the surveillance of chronic diseases (*24*). Surveillance involves multiple diseases, rather than a single disease, as well as a complicated

TABLE 2. Mortality from 10 leading causes of neonatal and postneonatal death — United States, 1989

Rank order	Cause of death and rank (ICD codes)*	Number	Rate	Percentage of total deaths
Neonatal				
All causes		**25,168**	**622.8**	**100.0**
1	Congenital anomalies (740–759)	5,902	146.1	23.5
2	Disorders relating to short gestation and unspecified low birth weight (765)	3,878	96.0	15.4
3	Respiratory distress syndrome (769)	3,386	83.8	13.5
4	Newborn affected by maternal complications of pregnancy (761)	1,520	37.6	6.0
5	Newborn affected by complications of placenta, cord, and membranes (762)	973	24.1	3.9
6	Infections specific to the perinatal period (771)	833	20.6	3.3
7	Intrauterine hypoxia and birth asphyxia (768)	653	16.2	2.6
8	Sudden infant death syndrome (798.0)	398	9.8	1.6
9	Neonatal hemorrhage (772)	262	6.5	1.0
10	Birth trauma (767)	215	5.3	0.9
	All other causes (residual)	7,148	176.9	28.5
Postneonatal				
All causes		**14,487**	**358.5**	**100.0**
1	Sudden infant death syndrome (798.0)	5,236	129.6	36.1
2	Congenital anomalies (740–759)	2,218	54.9	15.3
3	Accidents and adverse effects (E800–E949)	900	22.3	6.2
4	Pneumonia and influenza (480–487)	536	13.3	3.7
5	Septicemia (038)	290	7.2	2.0
6	Homicide (E960–E969)	266	6.6	1.8
7	Respiratory distress syndrome (769)	245	6.1	1.7
8	Meningitis (320–322)	193	4.8	1.3
9	Human immunodeficiency virus infection (*042–*044)†	119	2.9	0.8
10	Viral diseases (045–079)	107	2.6	0.7
All other causes (residual)		4,377	108.4	30.2

* ICD, International Classification of Diseases.
† Asterisks in HIV code indicate category numbers introduced in the United States in 1987.

Source: NCHS (*23*).

array of risk factors that vary with the disease. Surveillance staffers frequently use existing databases not designed or established for disease surveillance purposes. Furthermore, although mortality reduction will always be the surveillance goal, program managers need a system flexible enough to allow them to make modifications and track a variety of indicators that influence survival.

Another issue to consider is that the surveillance of nonbirth defects-related neonatal mortality has not focused on the individual causes of death but, rather, on the contribution of low birth weight to all-cause mortality. Although low birth weight is a very important determinant of neonatal mortality, this single-minded focus on low birth weight may lead to missed opportunities to conduct routine surveillance and to plan prevention activities for other causes of death (such as maternal medical complications or birth asphyxia) that have high case-fatality rates and that are amenable to medical intervention (*25*). Although some efforts have been made to address postneonatal mortality among normal-birth-weight infants, more attention needs to be directed to planning prevention strategies for this highly preventable subset of infant deaths (*26,27*).

EXAMPLES OF USING DATA

South Carolina

Public health surveillance data are useful when associated with action. In the area of neonatal and postneonatal mortality, these actions are usually related to policy development and resource allocation at the state and local levels. For example, neonatal surveillance data can be used to evaluate health service delivery issues related to regionalization. The South Carolina Department of Health and Environmental Control has a perinatal regionalization surveillance system that helps providers of maternofetal and neonatal intensive care services to evaluate risk-appropriate referral patterns and mortality experience and to identify areas for further improvement (*28*).

In an assessment of neonatal mortality experience, South Carolina analyzed birth-weight-specific neonatal mortality rates for VLBW infants (500–1,499 g) by level of hospital care for selected years during 1983–1991 (Table 3) (*28*). Delivery and infant care in a tertiary care hospital (level III) that provides fetal medicine and neonatal intensive care improves the survival of this vulnerable group of infants. The 3-year neonatal mortality rate for white and black VLBW infants is given to smooth the variability associated with small annual numbers. For each period, infants who were born in a level III facility tended to have lower neonatal mortality. Those infants weighing 500–999 g who were born in level III facilities consistently had lower neonatal mortality rates than those treated in level I hospitals.

South Carolina's 3-year direct-adjusted neonatal mortality rate varied by perinatal region for infants weighing 500–1,400 g (Figures 1 and 2). The adjusted mortality rate was estimated by multiplying the birth-weight-specific neonatal mortality rate by the proportion of live births in each weight group of a standard population. This adjustment allowed the comparison of mortality between different regions and periods and removed the effect of differences in birth-weight distribution (*28*). Investigators observed a decline in neonatal mortality among white infants residing in three of the four regions (Figure 1). Similar declines were found for black and other minority infants, but not in the same regions (Figure 2).

Puerto Rico

Puerto Rico evaluated its regionalized perinatal health-care system after an initial study showed that from 1980 through 1984, the system was deficient and that the survival of newborns in Puerto Rico was much worse than for Puerto Ricans in the continental United States (*29*). Nevertheless, the neonatal mortality rate declined by an annual average of 5% from 1980 through 1988. Data for the 1981–1988 linked birth and infant death certificates were used to measure any contributions of the regionalized perinatal health-care system to the declining neonatal mortality rate in Puerto Rico. These data include approximately 265,000 singleton infants whose mothers were residents of Puerto Rico in 1981–1984 and 252,000 infants whose mothers were residents in 1985–1988. Analysts found that from 1981 to 1988, Puerto Rico experienced

FIGURE 1. Three-year, direct-adjusted neonatal mortality risk for white live-born infants weighing 500–1499 g at birth, by perinatal region — South Carolina, 1983–1992

FIGURE 2. Three-year, direct-adjusted neonatal mortality risk for black and other minority live-born infants weighing 500–1499 g at birth, by perinatal region — South Carolina, 1983–1992

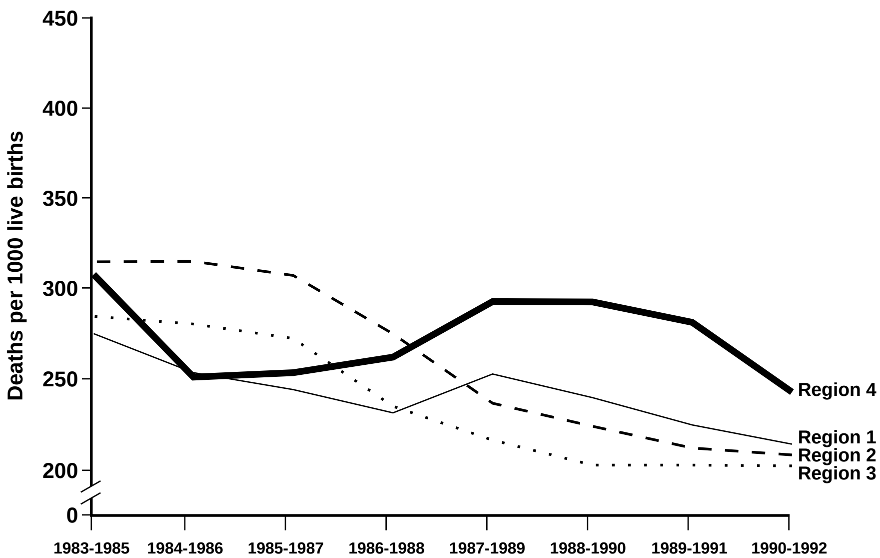

TABLE 3. Three-year low-birth-weight-specific neonatal mortality rate, by level of hospital care for white infants — South Carolina, 1983–1991

	Deaths per 1,000 live births								
	1983–1985			1986–1988			1989–1991		
Birth weight (g)	Level I	Level II	Level III	Level I	Level II	Level III	Level I	Level II	Level III
500–749	936	952	750	840	958	712	809	1,000	638
750–999	515	476	404	583	538	344	429	440	223
1000–1,249	256	133	101	273	179	163	100	205	146
1250–1,499	98	103	114	62	100	65	158	93	52
% of all births*	17	9	62	10	10	72	5	15	71
Total nmber of births		928			962			1,036	

*Percentages may not add to 100 because percentage distribution of all births is shown only for hosptial births.
Source: Liu Q et al. (*28*).

significant improvement in the regionalization of the perinatal health-care system. Improvement was reflected in the increased proportion of VLBW newborns delivered in hospitals with neonatal intensive care units and in the survival advantage provided by these hospitals to premature babies. In addition, from 1981 to 1988, Puerto Rico experienced significant reductions in the neonatal mortality rate because of better newborn survival—a reflection of better access to and quality of hospital care. Neonatal survival varied by perinatal region.

Florida

Surveillance also has been used to evaluate the effects of expanded services on neonatal mortality. The evaluation of Florida's statewide Improved Pregnancy Outcome (IPO) program examined how 1985–1988 neonatal mortality rates were affected by IPO comprehensive services (prenatal care, health and nutritional counseling, education, assistance with delivery arrangements, postpartum and well-baby care, family planning, and WIC and Medicaid enrollment) (*30*). Birth certificate data, infant death certificate data, and program records of participating women were linked. Linked birth certificate and infant death records were used to identify nonparticipants matched for race, age, education, marital status, and number of prenatal-care visits (<7 or ≥7). Neonatal mortality was 33% lower among black IPO enrollees than among black nonparticipants. Neonatal mortality declined faster among white enrollees than among white nonparticipants.

West Virginia

In West Virginia, health officials developed a birth scoring system to identify newborns at risk for postneonatal mortality. They used vital records data from 1980–1983 births to develop the risk score (*Myerberg and Myerberg, West Virginia University, unpublished data, 1992*). Infants born in 1985–1987 were assigned a birth score. In an evaluation of the program, using birth scores linked to birth and infant death certificates, they demonstrated that the rate of postneonatal death was six times higher among infants with high birth scores than among those with lower scores.

United States

National surveillance for neonatal and postneonatal mortality can be useful for identifying areas in need of prevention activities. In a national study of 1986–1987 case-fatality rates associated with conditions arising in the perinatal period, the results indicated that maternal medical conditions were associated with high case-fatality rates (*25*). Since then, national linked birth certificate and infant death certificate files for 1983–1987 are being used to describe infant deaths caused by maternal medical conditions. Preliminary results indicate that infants born to multiparous (parity of 2) women <20 years of age have the highest rates of neonatal death from medical conditions associated with the pregnancy.

FUTURE ISSUES

During the 1980s, the surveillance of neonatal and postneonatal mortality moved beyond monitoring to include public health action. In the future, state and local health officials will need to 1) clarify priority issues that should be addressed by surveillance; 2) determine whether the efficient linkage of additional health databases (such as Medicaid data, hospital discharge records, or WIC records) to vital records data at the state and local levels will be useful in addressing priority areas related to neonatal and postneonatal deaths; and 3) determine how surveillance can be used as a risk assessment tool.

Because so many causes of death and potential risk factors exist for neonatal and postneonatal death, the traditional surveillance loop of data collection, analysis, reporting, and action must include the establishment of priorities to determine which types of analyses must be done. Furthermore, because of the multifactorial etiologies and the difficulty in linking exposures, risk factors, interventions, and outcomes (*12*), public health officials will continue to be in constant pursuit of more detailed data sets that provide more information on risk factors. Surveillance is usually based on the preventability of the outcome of interest. To prevent infant deaths, program directors expect surveillance data to help them identify infants at the highest risk of neonatal and postneonatal deaths. Like West Virginia and other states that use linked vital records data to develop risk assessment measures, more states need to begin using these data to determine which infants are at the highest risk of postneonatal mortality.

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