Until 1957, the national infant mortality rate had been decreasing. In 1957, there was an interruption of this trend by a rise in the rate. For this reason a review was undertaken and the findings are presented here. The authors discuss their findings in relation to such factors as population shifts and changing needs.

RECENT TRENDS IN INFANT MORTALITY IN THE UNITED STATES

Eleanor P. Hunt, Ph.D., F.A.P.H.A., and Alice D. Chenoweth, M.D., F.A.P.H.A.

FOR THE first time since the mid-1930's, the national infant mortality rate increased from 26.0 in 1956 to 26.3 per 1,000 live births in 1957. The increase among white infants was from 23.2 per 1,000 in 1956 to 23.3 in 1957, and among nonwhite, from 42.1 to 43.7. Rates for 1958 and 1959 showed continued elevation of infant mortality.[24,25] In 1958, the rate increased to 26.9 per 1,000. In 1959, the provisional rate, 26.4 (January-December), was as high as for the year 1955.

Reduction in infant mortality in the United States has been slower in the 1950's than in the decades just preceding. The decrease from 1950 to 1957 has meant that annually for any 100,000 infants born alive, an additional 41 on the average have survived to their first birthday. In contrast, for a similar period in the 1930's (1930-1937), the increased number of survivors per 100,000 live births was on the average about 146 infants annually and during 1940-1947, there were annually some 211 additional infant survivors.

The slower pace in reducing infant mortality in the United States calls for a review of recent trends to identify, if possible, particular areas, or groups of infants, or periods in infancy, where the decrease in rate has lagged or failed to occur. This report summarizes the results of such a review. The findings offer some answers to such general questions as where, among whom, from what causes, and at what ages in infancy has the downward trend of the death rate leveled off notably, or been reversed in recent years.

A relatively detailed picture of recent national trends will, we hope, be of assistance in planning local studies, and in focusing attention where continuing or greater efforts are specially needed if there is to be steady improvement.

On Data and Methods

The recent trends examined are those during the years 1950-1957. To evaluate national trends in mortality rates at detailed ages in infancy during 1950-1957 as a whole, an annual percentage change in rate over these years was estimated for each of the age groups from the regression coefficient in a linear regres-

sion of log rate on the years 1950-1957. Annual per cent change was used also to describe mortality rate trends in metropolitan and in other counties for early and late infancy.* These estimates of annual per cent change in rate were evaluated for statistically significant difference from zero, under the hypothesis of absence of trend during 1950-1957, using the t-distribution in a test of the regression coefficients.

For an indication of trends in infant mortality in each state, the state average annual rate for the period 1954-1957, was compared with the average annual rate for 1950-1953. This procedure was used as well to examine national trends in death rate by cause. Differences in rate between the two periods were tested for statistical significance relative to an hypothesis of a constant probability of death 1950-1957, using chi-square.

All of these examinations of trend by age group, by area, and by cause were carried out by the color group as well.

Asterisks are used in the tables to denote statistical significance of change in rate. One asterisk indicates significance at the 5 per cent level; two asterisks, "highly significant" values at the 1 per cent level.

All data on births and deaths are those published by the National Office of Vital Statistics.[6-25] The numbers of live births and infant deaths registered in the United States (48 states and District of Columbia) in the four-year periods, 1950-1953 and 1954-1957, are shown in the tabulation below, by color and broad-age grouping. Rates for the United States are based on 48 states and District of Columbia.

Infant Mortality Trends by Age

During the period 1950-1957, seven out of ten infant deaths in the United States occurred in the neonatal period (under 28 days). Within the neonatal period, half of the deaths were of infants on their first day of life, and three-fourths were before three days of age. During later months of the first year,

*The expression used was, $\log Y = \log \bar{y} + b(X - \bar{x})$, where Y is the annual mortality rate in the particular age, color, and county grouping, $\bar{y}$ is the average mortality rate, 1950-1957 in this group, X is year of experience, and $\bar{x}$ the mean year.

	Total	White	Nonwhite
Deaths		Number	
Infant (under 1 year), 1950-1957	862,316	664,986	197,330
1954-1957	433,971	330,497	103,474
1950-1953	428,345	334,489	93,856
Neonatal (under 28 days), 1950-1957	614,454	491,513	122,941
1954-1957	313,822	248,045	65,777
1950-1953	300,632	243,468	57,164
Postneonatal (1-11 months), 1950-1957	247,862	173,473	74,389
1954-1957	120,149	82,452	37,697
1950-1953	127,713	91,021	36,692
Live Births, 1950-1957	31,536,636	27,049,013	4,487,623
1954-1957	16,482,531	14,068,884	2,413,647
1950-1953	15,054,105	12,980,129	2,073,976

Table 1—Infant Mortality Rate, and Average Annual Per cent Change in Rate, by Age, County Group, and Color (United States, 1950-1957)

Total Infants
(By place of residence)

Age and County Group	Rate per 1,000 Live Births								Annual Per cent Change in Rate 1950-1957
	1950	1951	1952	1953	1954	1955	1956	1957	
Infant (under 1 year)	29.2	28.4	28.4	27.8	26.6	26.4	26.0	26.3	−1.7**
Metropolitan	26.4	25.9	26.1	25.8	25.3	25.0	24.9	25.4	−1.3*
Nonmetropolitan	32.6	31.7	31.6	30.5	28.4	28.4	27.6	27.8	−2.7**
Neonatal (under 28 days)	20.5	20.0	19.8	19.6	19.1	19.1	18.9	19.1	−1.1**
Metropolitan	19.8	19.4	19.2	19.1	19.0	19.0	18.9	19.2	−0.5*
Nonmetropolitan	21.4	20.9	20.6	20.1	19.2	19.3	19.0	18.9	−1.9**
Under 1 week	17.9	17.5	17.3	17.2	16.7	16.9	16.5	16.6	−1.1**
Under 3 days	15.3	15.0	14.8	14.7	14.4	14.7	14.4	14.5	−0.7**
Under 1 day	10.2	9.8	9.7	9.7	9.6	10.0	9.9	9.9	−0.1
1 day	3.1	3.1	3.0	3.0	2.9	2.9	2.8	2.8	−1.6**
2 days	2.0	2.1	2.1	2.0	1.9	1.8	1.7	1.8	−2.8**
3-6 days	2.6	2.5	2.5	2.5	2.3	2.2	2.1	2.1	−3.4**
7-27 days	2.6	2.5	2.5	2.4	2.3	2.2	2.3	2.4	−1.7*
Postneonatal (1-11 months)	8.7	8.4	8.6	8.2	7.5	7.3	7.1	7.2	−3.3**
Metropolitan	6.6	6.5	6.9	6.7	6.3	6.0	6.0	6.2	−1.6*
Nonmetropolitan	11.2	10.8	11.0	10.4	9.2	9.1	8.6	8.9	−4.2**
1-5 months	6.0	5.8	6.0	5.8	5.2	5.2	5.0	5.4	−2.4*
6-11 months	2.7	2.5	2.6	2.5	2.2	2.2	1.9	1.9	−5.5**

* Significant at the 5 per cent level.
** "Highly significant" values at the 1 per cent level.

about 70 per cent of the postneonatal deaths (1-11 months) were of infants 1-5 months of age, as compared with some 30 per cent in infants 6-11 months.

Annual death rates, 1950-1957, by detailed age and annual per cent change in rate over these years are shown by color in Tables 1-3. Infant mortality decreased from 29.2 per 1,000 live births in 1950 to 26.3 in 1957, at an annual decrease of 1.7 per cent. This reduction was much slower than in recent preceding periods of comparable length, such as 1943-1950 and 1936-1943.

For these period-comparisons, over-all per cent changes between the first and last year of the seven-year spans are given in Table 4, by age. While the infant mortality rate from 1950 to 1957 was reduced a total of 9.9 per cent, the drop between the years 1943 to 1950 was 27.7 per cent and that between 1936 and 1943, 29.3 per cent. Only at one, two, and from three to six days of age, the seven-year per cent decreases in rate from 1950 to 1957 were larger than those of an earlier period, namely 1943 to 1950.

During the years 1950-1957, annual percentage reduction in neonatal mortality rate was about one-third that of the postneonatal rate, 1.1 per cent as compared with 3.3 per cent for infants 1-11 months of age (see Table 1). The relatively small gains in the neonatal period reflect (a) a more or less stationary rate on the first day of life (under one day) during 1950-1957, and (b) a relatively small annual percentage decrease in neonatal death rate after the first week, 1.7 per cent (7-27 days). Mortality on the first day rose after 1954 and remained elevated.

In the postneonatal period, the annual percentage reduction in mortality rate in the period, 1-5 months was less than half the percentage decrease at 6-11 months. Thus in 1950-1957, the age-specific death rates with the smallest annual percentage reductions were those under a day, one day, 1-3 weeks, and 1-5 months. This pattern was evident in the white group as well as the nonwhite group, but was more marked among the latter. The mortality rate for nonwhite infants on the first day was not stationary during 1950-1957, but rose significantly. The upward trend appears

Table 2—Infant Mortality Rate, and Average Annual Per cent Change in Rate, by Age, County Group, and Color (United States, 1950-1957)

White Infants
(By place of residence)

Age and County Group	Rate per 1,000 Live Births								Annual Per cent Change in Rate 1950-1957
	1950	1951	1952	1953	1954	1955	1956	1957	
Infant (under 1 year)	26.8	25.8	25.5	25.0	23.9	23.6	23.2	23.3	−2.2**
Metropolitan	24.5	23.9	23.9	23.6	23.0	22.6	22.4	22.6	−1.3**
Nonmetropolitan	29.7	28.4	27.7	27.0	25.1	25.0	24.3	24.4	−3.1**
Neonatal (under 28 days)	19.4	18.9	18.5	18.3	17.8	17.7	17.5	17.5	−1.5**
Metropolitan	18.6	18.2	18.0	17.9	17.7	17.5	17.3	17.4	−1.0**
Nonmetropolitan	20.4	19.8	19.2	18.8	18.0	18.1	17.7	17.7	−2.1**
Under 1 week	17.0	16.7	16.3	16.3	15.8	16.0	15.7	15.7	−1.1**
Under 3 days	14.7	14.3	14.1	14.0	13.7	13.9	13.7	13.7	−0.9**
Under 1 day	9.7	9.3	9.2	9.1	9.0	9.3	9.3	9.3	−0.3
1 day	3.0	3.0	2.9	2.9	2.8	2.8	2.7	2.6	−2.0**
2 days	2.0	2.0	2.0	2.0	1.9	1.8	1.7	1.8	−2.3**
3-6 days	2.3	2.4	2.2	2.3	2.1	2.1	2.0	2.0	−2.6**
7-27 days	2.3	2.3	2.1	2.1	1.9	1.8	1.9	1.9	−3.5**
Postneonatal (1-11 months)	7.4	6.9	7.0	6.7	6.1	5.9	5.7	5.8	−4.0**
Metropolitan	5.9	5.7	5.9	5.7	5.3	5.1	5.1	5.2	−2.4**
Nonmetropolitan	9.3	8.6	8.5	8.2	7.1	6.9	6.6	6.7	−5.4**
1-5 months	5.2	4.7	4.8	4.7	4.2	4.2	4.2	4.2	−3.1**
6-11 months	2.3	2.1	2.2	1.9	1.8	1.6	1.6	1.6	−6.0**

** "Highly significant" values at the 1 per cent level.

Table 3—Infant Mortality Rate, and Average Annual Per cent Change in Rate, by Age, County Group, and Color (United States, 1950-1957)

Nonwhite Infants
(By place of residence)

Age and County Group	Rate per 1,000 Live Births								Annual Per cent Change in Rate 1950-1957
	1950	1951	1952	1953	1954	1955	1956	1957	
Infant (under 1 year)	44.5	44.8	47.0	44.7	42.9	42.8	42.1	43.7	−0.9
Metropolitan	40.0	39.9	41.2	39.8	39.4	39.5	39.1	41.3	−0.0
Nonmetropolitan	49.0	50.1	53.6	50.5	47.2	47.2	46.2	47.3	−1.3
Neonatal (under 28 days)	27.5	27.3	28.0	27.4	27.0	27.2	27.0	27.8	−0.1
Metropolitan	28.1	27.5	27.7	27.3	27.5	28.0	27.9	29.1	+0.4
Nonmetropolitan	26.9	27.2	28.4	27.5	26.3	26.1	25.8	25.9	−1.0*
Under 1 week	22.8	22.7	23.0	22.6	22.6	23.1	22.6	23.1	+0.1
Under 3 days	19.0	18.8	19.1	18.8	19.2	19.6	19.5	19.7	+0.6**
Under 1 day	13.0	12.7	12.8	12.9	13.3	13.9	13.7	13.9	+1.4**
1 day	3.7	3.8	3.8	3.6	3.5	3.5	3.5	3.6	−1.1*
2 days	2.3	2.3	2.5	2.3	2.4	2.2	2.3	2.2	−0.8
3-6 days	3.8	3.9	3.9	3.8	3.4	3.5	3.1	3.4	−2.9*
7-27 days	4.8	4.7	5.0	4.7	4.4	4.2	4.3	4.6	−1.6
Postneonatal (1-11 months)	17.0	17.5	19.0	17.3	15.9	15.6	15.1	15.9	−2.3*
Metropolitan	11.9	12.4	13.5	12.5	11.9	11.5	11.2	12.2	−1.0
Nonmetropolitan	22.1	22.9	25.2	23.0	20.9	21.1	20.4	21.4	−1.7
1-5 months	11.8	12.1	13.3	12.4	11.4	11.3	10.9	11.6	−1.5
6-11 months	5.3	5.4	5.7	5.0	4.5	4.3	4.1	4.4	−4.4**

* Significant at the 5 per cent level.
** "Highly significant" values at the 1 per cent level.

to have set in about 1952. Among older nonwhite infants, the rates for 1-3 weeks and for 1-5 months showed minor and doubtful annual percentage decreases. These were about half the size of corresponding percentage decreases for white infants, although the death rates for nonwhite infants were about double those in the white group.

This slower annual reduction of infant mortality in the nonwhite group during 1950-1957 resulted in widening differences in mortality levels between white and nonwhite. By 1957, the neonatal mortality rate of the nonwhite group was 59 per cent higher than in the white group, as compared with 42 per cent higher in 1950. In the postneonatal period, the rate for nonwhite infants in 1957 exceeded the rate for white infants by 174 per cent, while in 1950, it was 130 per cent.

Infant Mortality Trends in Metropolitan and Other Counties

Reduction in infant mortality between the years 1950-1957 proceeded more slowly in metropolitan than in nonmetropolitan counties; 1.3 per cent an-

nually as compared with 2.7 per cent (Table 1). This slow rate of gain was in sharp contrast to the preceding decade, when per cent decrease in infant death rate in metropolitan counties was larger than in nonmetropolitan counties, where mortality levels were higher.

The lag in reducing mortality in the metropolitan counties during 1950-1957 was about equally pronounced in the neonatal and postneonatal periods. The per cent decrease in neonatal death rate annually in metropolitan counties was 0.5 per cent; in nonmetropolitan counties, 1.9 per cent. At age 1-11 months the annual percentage decrease in rate in metropolitan counties was 1.6 per cent, compared to 4.2 per cent in other counties.

The relatively slow pace of reduction was especially marked in the white group. Among nonwhite infants, different trends between the two county groups were clearly evident only in the neonatal period, when the metropolitan rate showed signs of increase while rates for nonmetropolitan counties decreased significantly at 1.0 per cent annually. These opposite trends resulted in higher neonatal rates in metropolitan than in other counties, among nonwhite infants, each year except 1952 and 1953. This excess in mortality of the newborn nonwhite infants in metropolitan counties is in contrast to the general situation for white infants and for older nonwhite infants. For the latter groups metropolitan county rates remained considerably lower than those for nonmetropolitan counties throughout 1950-1957.

State Experience, 1954-1957 Compared With 1950-1953

Infant Mortality

Average annual infant mortality rates of the states in the period 1954-1957 ranged from a low of 21.2 per 1,000 in Utah and in Iowa to rates 68 per cent higher in Arizona (35.6 per 1,000), and 89 per cent higher in New Mexico (40.1 per 1,000). Rates more than double the lowest rate in Utah and in

Table 4—Infant Mortality Rate, by Age (United States 1936, 1943, 1950, and 1957)

Age	Rate per 1,000 Live Births				Per cent Decrease in the Seven-Year Period		
	1936	1943	1950	1957	1936 to 1943	1943 to 1950	1950 to 1957
Infant (under 1 year)	57.1	40.4	29.2	26.3	−29.3	−27.7	− 9.9
Neonatal (under 28 days)	32.6	24.7	20.5	19.1	−24.2	−17.0	− 6.8
Under 1 week	25.8	19.9	17.9	16.6	−22.9	−10.1	− 7.3
Under 3 days	21.5	16.8	15.3	14.5	−21.9	− 8.9	− 5.2
Under 1 day	15.1	11.6	10.2	9.9	−23.2	−12.1	− 3.0
1 day	3.9	3.2	3.1	2.8	−18.0	− 3.1	− 9.7
2 days	2.5	2.0	2.0	1.8	−20.0	0	−10.0
3-6 days	4.3	3.1	2.6	2.1	−27.9	−16.1	−19.2
7-27 days	6.8	4.7	2.6	2.4	−30.9	−44.7	− 7.7
Postneonatal (1-11 months)	24.5	15.7	8.7	7.2	−35.9	−44.6	−17.3
1-5 months	15.7	10.3	6.0	5.4	−34.4	−41.8	−10.0
6-11 months	8.8	5.1	2.7	1.9	−42.1	−47.1	−29.6

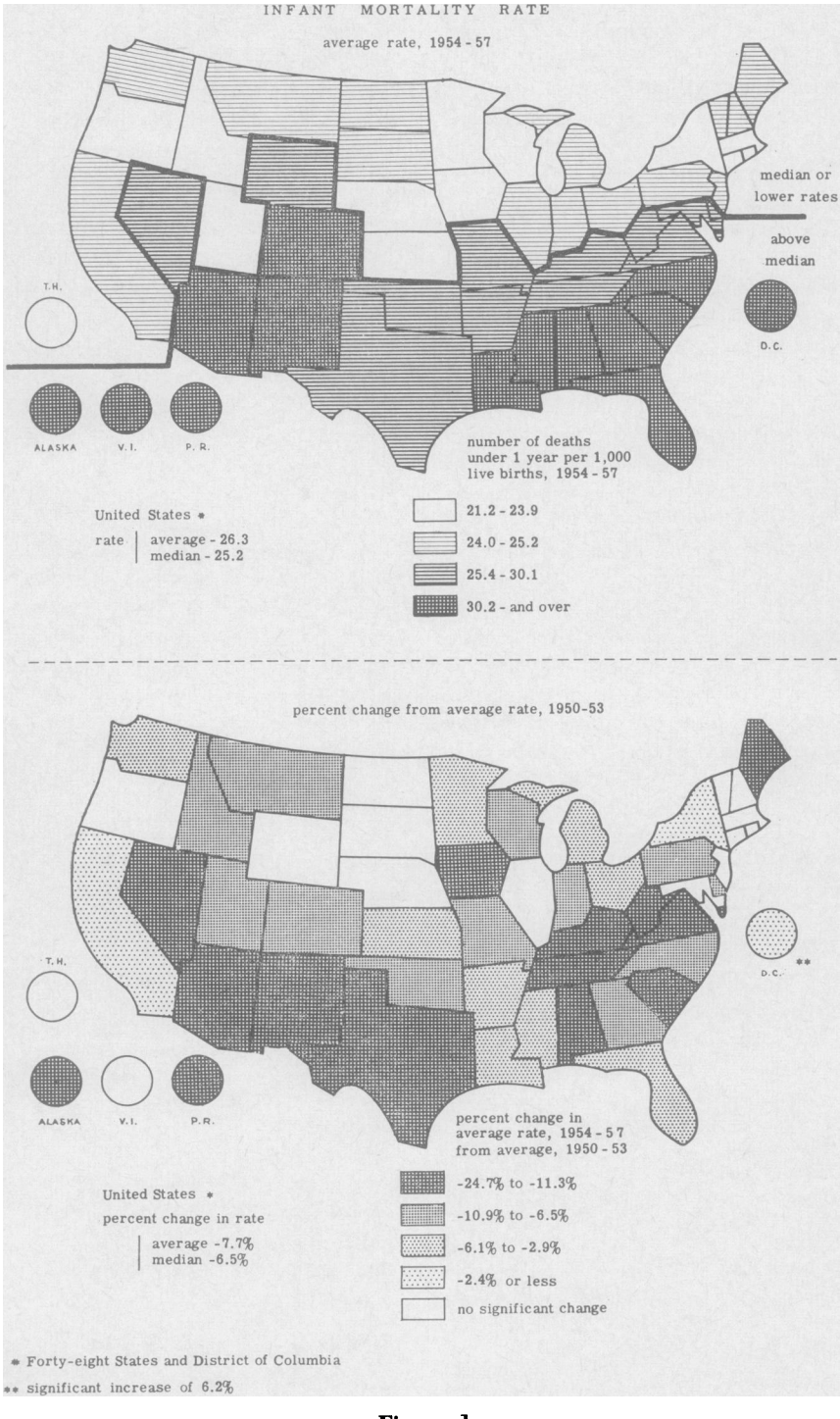
INFANT MORTALITY RATE
average rate, 1954 - 57
median or lower rates
above median
T.H.
D.C.
ALASKA
V.I.
P.R.
number of deaths under 1 year per 1,000 live births, 1954 - 57
United States *
rate
average - 26.3
median - 25.2
21.2 - 23.9
24.0 - 25.2
25.4 - 30.1
30.2 - and over
percent change from average rate, 1950-53
T.H.
D.C. **
ALASKA
V.I.
P.R.
percent change in average rate, 1954 - 57 from average, 1950 - 53
United States *
percent change in rate
average -7.7%
median -6.5%
-24.7% to -11.3%
-10.9% to -6.5%
-6.1% to -2.9%
-2.4% or less
no significant change
* Forty-eight States and District of Columbia
** significant increase of 6.2%

Figure 1

Iowa were registered in the Virgin Islands (50.4) and in Puerto Rico (54.7).

The quartile position of the infant mortality rate of each state, 1954-1957, is shown in the upper panel of Figure 1. Rates above median (25.2) prevailed in the southern tier of states, and in the bordering or mountain states of Missouri, Colorado, Wyoming, and Nevada. Maryland was a newcomer in this group, having had, in 1950-1953, a rate no higher than median. Median or lower rates for 1954-1957, characterized the states of the New England, Middle Atlantic, North Central (except Missouri), and Pacific divisions, and the remaining states of the mountain division (Montana, Idaho, Utah). Maine and Montana, which had relatively high rates for 1950-1953, belong in this group in 1954-1957, as a result of above average decrease in their infant mortality rates.

The geographic pattern of relatively high infant mortality rates in states of the southern divisions, as compared with northern and far western divisions was evident throughout the years 1950-1957. However, the differences among divisions were less marked in 1954-1957 than in 1950-1953, and in still earlier years.

Percentage change in infant mortality rate is illustrated in the lower panel of Figure 1. Fifteen jurisdictions showed no significant change in 1954-1957 in infant death rate from average in 1950-1953. With the exception of Wyoming and the Virgin Islands, these were areas with median or lower infant mortality rates for 1950-1953. In the District of Columbia the average infant mortality rate increased 6.2 per cent. In general the largest percentage reductions in rate were in states with higher than median rates in 1950-1953. Iowa, Idaho, Utah, and Wisconsin were exceptional in having substantial percentage reductions of already quite low rates. Despite relatively high infant mortality levels in Mississippi, Louisiana, Florida, and Arkansas, percentage reduction in rate was considerably below average and below the median for the United States.

Neonatal and Postneonatal Mortality of White and of Nonwhite Infants

While 35 states, Alaska, and Puerto Rico reduced their average infant mortality rates in 1954-1957 as compared with average for 1950-1953, only 19 states and Puerto Rico had decreased infant death rates in both the neonatal and the postneonatal periods. The experience of the states in reducing neonatal and postneonatal death rates (for all infants) is illustrated at the top of Figure 2.

In the lower panel of Figure 2 are shown significant changes in neonatal and postneonatal mortality rates for white and nonwhite infants. Reduction in death rate, early as well as later in infancy, in both white and nonwhite groups, occurred in eight states, all of which had relatively high rates throughout 1950-1957 (Alabama, Arizona, Oklahoma, New Mexico, South Carolina, Tennessee, Texas, and Virginia).

For the United States as a whole the pattern was one of reduction in postneonatal mortality among white and nonwhite infants, while decrease in neonatal mortality was confined to white infants. Ten states followed this pattern (Georgia, Indiana, Maine, Michigan, Missouri, North Carolina, Pennsylvania, Utah, West Virginia, and Wisconsin). Three others (Arkansas, California, and Ohio) deviated in having an increased, instead of unchanged, neonatal rate for nonwhite infants.

In the neonatal period, 17 states or jurisdictions in 1950-1957 appear to have had essentially unchanged or rising mortality levels for both white and nonwhite infants. Included were eight states with more or less stationary age and color-specific rates (Massachusetts,

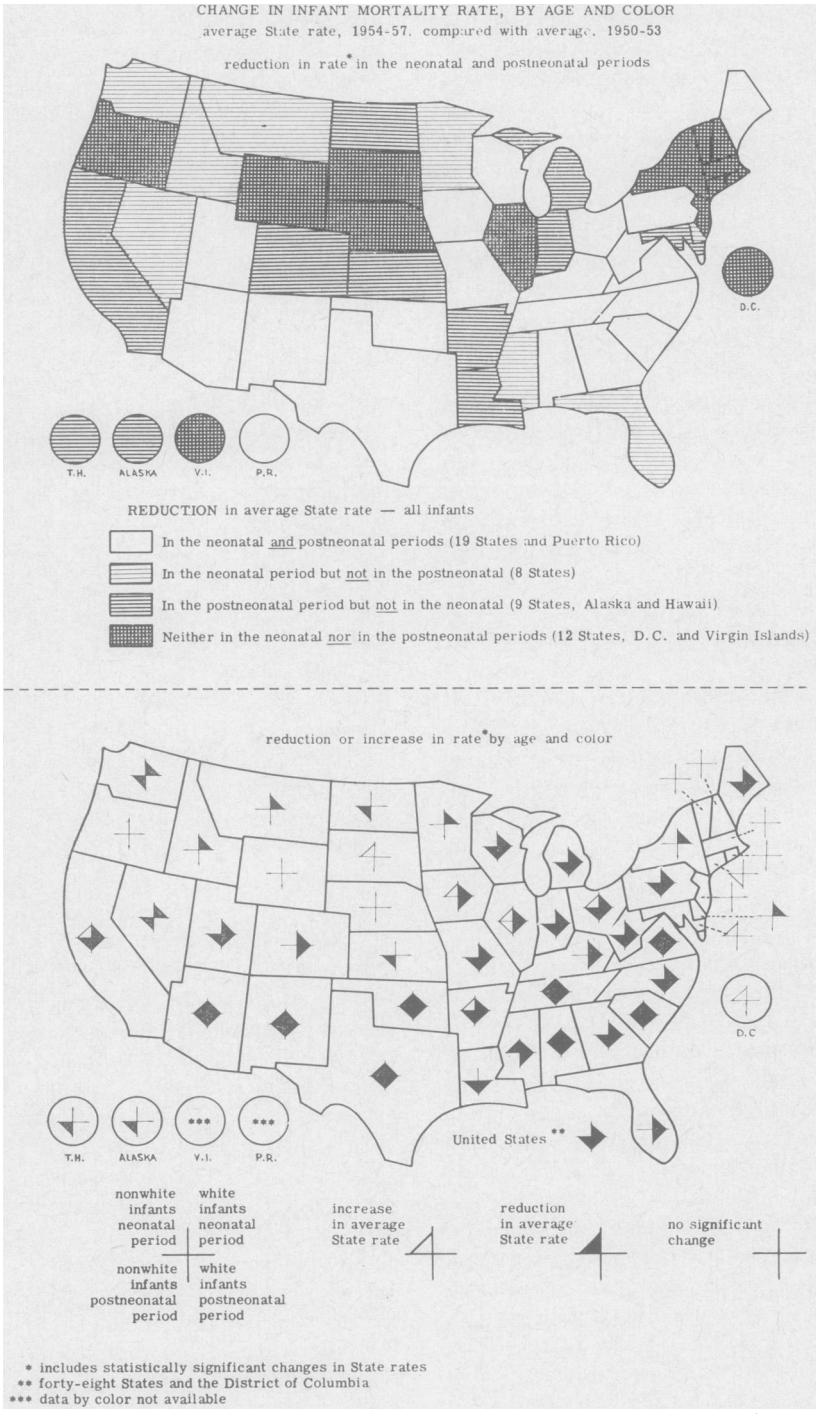
CHANGE IN INFANT MORTALITY RATE, BY AGE AND COLOR
average State rate, 1954-57, compared with average, 1950-53
reduction in rate* in the neonatal and postneonatal periods
D.C.
T.H.
ALASKA
V.I.
P.R.
REDUCTION in average State rate — all infants
In the neonatal and postneonatal periods (19 States and Puerto Rico)
In the neonatal period but not in the postneonatal (8 States)
In the postneonatal period but not in the neonatal (9 States, Alaska and Hawaii)
Neither in the neonatal nor in the postneonatal periods (12 States, D.C. and Virgin Islands)
reduction or increase in rate* by age and color
D.C
T.H.
ALASKA
V.I.
P.R.
***
***
United States **
nonwhite infants neonatal period
white infants neonatal period
nonwhite infants postneonatal period
white infants postneonatal period
increase in average State rate
reduction in average State rate
no significant change
* includes statistically significant changes in State rates
** forty-eight States and the District of Columbia
*** data by color not available

Figure 2

Nebraska, New Hampshire, New Jersey, Oregon, Rhode Island, Vermont, and Wyoming); three others were in this category, but with definite increases in the neonatal rate for nonwhite infants (Maryland, South Dakota, and the District of Columbia); Connecticut, which showed no drop in rate for any of the color or age groupings with a significant increase in postneonatal mortality of nonwhite infants; and five other jurisdictions where some gains were made after (but not during) the neonatal period (Louisiana, Kansas, North Dakota, Alaska, and Hawaii).

Postneonatal mortality of white as well as nonwhite infants was not decreased by statistically significant amounts in Delaware, Idaho, Montana, Minnesota, and New York, in addition to the 11 states and District of Columbia, just mentioned, where rates throughout infancy in both color groups were not definitely lower in 1954-1957 than in 1950-1953.

A few states showed reduction of mortality throughout infancy in the white group, but stationary or rising rates for the nonwhite group in postneonatal as well as neonatal periods (Colorado, Florida, Illinois, Iowa, and Kentucky). Washington and Nevada showed gains for white infants in the neonatal period, and for nonwhite infants in the postneonatal period.

Trends in Causes of Infant Death

The United States average annual infant mortality rate for all causes in 1954-1957, 26.3 per 1,000, was 7.7 per cent lower than in 1950-1953. The neonatal rate decreased only 5 per cent (from 20.0 to 19.0 per 1,000) while the rate for the postneonatal period dropped 14.1 per cent (from 8.5 to 7.3 per 1,000). Average annual rates for 1950-1953 and for 1954-1957 are shown in Table 5, by age, color, and broad cause groupings. In this table, cause categories are grouped under the headings, "Prenatal and natal causes," "Postnatal causes," and "Other causes."

Prenatal and Natal Causes—Included under "Prenatal and natal causes" are categories pertaining primarily to conditions arising from factors effective before and/or during birth, for example, conditions such as immaturity, postnatal asphyxia and atelectasis, congenital malformations, birth injury, and the like. Certain diseases of the respiratory system which included hyaline membrane not otherwise specified are also included.* About two-thirds of all infant deaths were from prenatal and natal causes. Nine out of ten deaths from these causes occurred in the neonatal period. In comparison with the other broad cause groups ("Postnatal," "Other causes"), they showed the smallest per cent reduction in infant death rate, namely 4.3 per cent, from 18.6 per 1,000 in 1950-1953 to 17.8 in 1954-1957. While infant death rates decreased for certain causes in this grouping (congenital malformations, birth injuries, and blood dyscrasias), rates increased for postnatal asphyxia and atelectasis, for immaturity with a subsidiary condition, and for the respiratory group including hyaline membrane not otherwise specified. In the nonwhite group, the rate for congenital malformations also increased. Some of the increase in rate for these relatively specific causes was probably due to improved diagnostic reporting on the death certificates. While the rates for these more specific cause categories increased, the rate for the vague category, immaturity unqualified, dropped off from 6.1 to 5.1 per 1,000.

Postnatal Causes—Under "Postnatal causes" (conditions stemming primarily from factors operative after birth) are

* A death for which the certificate reported hyaline membrane with mention of an underlying cause, such as birth injury, pneumonia, immaturity, was counted under the underlying cause.

Table 5—Infant Mortality Rate, by Specified Types of Cause Groups, Color, and Age Group (United States, 1950-1953 and 1954-1957)

Color and Type of Cause Group†	Infant (under 1 year)			Neonatal (under 28 days)			Postneonatal (1-11 months)		
	Average Annual Rate per 1,000 Live Births		Per cent Change 1950-1953 to 1954-1957	Average Annual Rate per 1,000 Live Births		Per cent Change 1950-1953 to 1954-1957	Average Annual Rate per 1,000 Live Births		Per cent Change 1950-1953 to 1954-1957
	1954-1957	1950-1953		1954-1957	1950-1953		1954-1957	1950-1953	
All infants									
All causes	26.3	28.5	— 7.7	19.0	20.0	— 5.0	7.3	8.5	—14.1
Prenatal and natal	17.8	18.6	— 4.3	15.9	16.7	— 4.8	1.9	1.9	0
Postnatal	6.1	6.8	—10.3	1.7	1.6	+ 6.3	4.4	5.2	—15.4
Other	2.5	3.0	—16.7	1.4	1.6	—12.5	1.1	1.4	—21.4
White infants									
All causes	23.5	25.8	— 8.9	17.6	18.8	— 6.4	5.9	7.0	—15.7
Prenatal and natal	17.0	18.0	— 5.6	15.2	16.1	— 5.6	1.8	1.9	— 5.3
Postnatal	4.7	5.5	—14.6	1.4	1.4	0	3.3	4.1	—19.5
Other	1.8	2.3	—21.7	1.1	1.2	— 8.3	0.8	1.0	—20.0
Nonwhite infants									
All causes	42.9	45.3	— 5.3	27.3	27.6	— 1.1	15.6	17.7	—11.9
Prenatal and natal	22.7	22.5	+ 0.9	20.4	20.3	+ 0.5	2.3	2.2	+ 4.5
Postnatal	14.1	15.4	— 8.5	3.6	3.3	+ 9.1	10.6	12.1	—12.4
Other	6.0	7.3	—17.8	3.3	3.9	—15.4	2.8	3.4	—17.7

† In the "Prenatal and natal" grouping of causes are included the following categories of the International Statistical Classification of Diseases, Injuries and Causes of Death (sixth revision), listed here according to size of the corresponding death rates for total infants, 1954-1957: immaturity unqualified (776), postnatal asphyxia and atelectasis (762), congenital malformations (750-759), birth injuries (760-761), blood dyscrasias (770-771), certain other diseases of respiratory system including hyaline membrane, not otherwise specified (511-517, 520, 522-527), immaturity with mention of any other subsidiary condition (774), and congenital syphilis (020).

Inclusions in the "Postnatal" grouping, listed in the same order, are influenza and pneumonia, except pneumonia of newborn (480-493), diseases of the digestive system (530-587), pneumonia of newborn (763), accidents (E-800-E-962), infective and parasitic diseases, except congenital syphilis (001-019, 021-138), diarrhea of newborn (764), and "other infections of newborn" (765-768), diseases of the nervous system and sense organs (330-398), and acute upper respiratory infections, bronchitis, etc. (470-475, 500-510, 518, 519, 521).

The miscellaneous grouping "Other" includes: ill-defined disease peculiar to early infancy (773) and nutritional maladjustment (772), symptoms and ill-defined conditions (780-795), and all other causes (residual).

included the various infective and parasitic diseases, diseases of digestive and nervous systems, and accidents. In 1950-1953, 76 per cent of deaths from postnatal causes were of infants 1-11 months of age; 24 per cent were of infants in the neonatal period. By 1954-1957 the proportion occurring in the neonatal period had increased to 28 per cent, due to rise in the neonatal death rate for these causes from 1.6 per 1,000 to 1.7 per 1,000, while the death rate at 1-11 months decreased by 15 per cent from 5.2 to 4.4 per 1,000. The increase in the neonatal rate for postnatal causes evidently reflected an increase in mortality from "other infections of the newborn" (765-768), not entirely offset by a decrease in the rate for diarrhea of the newborn. In the case of nonwhite infants, the increase in neonatal rate for postnatal causes was attributable to increase in the rates for pneumonia of newborn (from 1.6 to 1.8 per 1,000) as well as for "other infections of newborn" (765-768), from 0.2 to 0.4 per 1,000.

In view of the widespread maternal and child health problem in hospital-acquired staphylococcal disease, a more detailed examination was made of the trends in rates for certain cause categories of infections of unspecified types. Particular categories examined were those for which infant death rates appeared to be on the increase fairly steadily, year after year during 1950-1957, namely, pneumonia of the newborn; acute upper respiratory infection, bronchitis, etc.; meningitis, except meningococcal and tuberculous meningitis; "other infections of newborn" (765-768); and septicemia and pyemia (1-11 months). Numbers of deaths for each of these categories and rates per 100,000 live births in 1954-1957 compared with 1950-1953 are shown by color in Tables 6-8.

In the neonatal period, mortality from "other infections of newborn," (765-768) and from meningitis, except meningococcal and tuberculous, increased significantly among white and nonwhite infants. The neonatal rate among total infants for "other infections of newborn" (765-768) rose 57 per cent from 9.9 to 15.5 per 100,000 on the basis of 1,494 deaths in 1950-1953 and 2,556 in 1954-1957. The meningitis rate increased 43 per cent from 2.8 to 4.0 per 100,000. For the nonwhite group, there was also a significant increase in mortality rate for pneumonia of the newborn, from 162.8 to 182.0 per 100,000.

The rate for septicemia and pyemia in the postneonatal period increased 75 per cent in the nonwhite group from 8.3 to 14.5 per 100,000, while among white infants this rate likewise increased but more slowly (38 per cent) and from a lower rate, 5.2 in 1950-1953 to 7.2 per 100,000 in 1954-1957. Infant mortality from acute upper respiratory infection, bronchitis, and other conditions mentioned, showed a small but significant increase in rate among white infants and the total group.

The slight upward trends of the mortality rates for several of these categories, indicative of infections of unspecified types are in contrast to the substantial reductions made during 1950-1957 in the infant death rates for infective and parasitic diseases as a group; influenza and pneumonia, except of newborn; diarrhea of newborn; and for diseases of the digestive system.

Jointly the selected categories of infections of unspecified types shown in Tables 6-8, accounted for 152 infant deaths per 100,000 live births in 1954-1957, as compared with 137 in 1950-1953. Had the mortality rate for these causes decreased from 1950-1953 to 1954-1957, instead of increased, and by the same proportion as for the rate for infective and parasitic diseases as a group, the lives of about 10,000 infants would have been spared in the latter four year period, or 2,500 annually. This saving of infant life would prob-

Table 6—Infant Mortality from Selected Causes Indicative of Infection of Unspecified Type, by Age and Color (United States, 1950-1953 and 1954-1957)

Total Infants

Selected Causes		Infant (under 1 year)		Neonatal (under 28 days)		Postneonatal (1-11 months)	
		1954-1957	1950-1953	1954-1957	1950-1953	1954-1957	1950-1953
		Rate per 100,000 Live Births					
Pneumonia of newborn	763	81.1	77.1	81.1	77.1	—	—
Acute upper respiratory infection, bronchitis, etc.	470-475, 500-510, 518, 519, 521	29.2**	27.6	—	—	—	—
Meningitis, except meningococcal and tuberculous	340	17.2	16.4	4.0**	2.8	13.2	13.6
Other infections of newborn	765-768	15.8**	10.3	15.5**	9.9	0.3	0.4
Septicemia and pyemia	053	8.3**	5.6	—	—	8.3**	5.6
		Number of Deaths					
Pneumonia of newborn	763	13,363	11,613	13,363	11,613	—	—
Acute upper respiratory infection, bronchitis, etc.	470-475, 500-510, 518, 519, 521	4,818	4,151	—	—	—	—
Meningitis, except meningococcal and tuberculous	340	2,837	2,470	656	429	2,181	2,041
Other infections of newborn	765-768	2,607	1,554	2,556	1,494	51	60
Septicemia and pyemia	053	1,366	849	—	—	1,366	849

** "Highly significant" values at the 1 per cent level.

ably prove to be an under estimate, were the true number of deaths from these infections known. Neonatal deaths from "infections of newborn" (763-768) have been found to be under-reported by some 10 per cent in a recent study in New York City,[4] and by an estimated 50 per cent in another study in Baltimore.[5]

Comment

This review of trends in infant mortality in 1950-1957 shows again the usefulness of vital records data to provide leads for more intensive study of present problems in maternal and child health.

In 1950-1957, the early age of most infant deaths (seven out of ten in the first month, and half of these before a day of age), their high association with prenatal and natal factors, and the relatively stationary mortality rate, point again to the need for accelerated effort toward improving maternal health.

Much could be accomplished by a wider and more even application of what is known about maternal and infant care, as is evident from the slower pace in 1950-1957 in reducing neonatal mortality in metropolitan counties than elsewhere, the relatively high mortality levels of some states as compared with others, and of nonwhite infants as compared to white.

Well over half of neonatal deaths are of premature infants. Special services for the mothers threatened with premature delivery, and for premature infants, have been shown to increase greatly the infant's chance of survival. Present "know-how" in care of the premature baby if extended nation-wide could reduce neonatal mortality to the level experienced in many widely separated maternity hospitals, namely 13 per 1,000, and would represent a potential national saving of 25,000 neonates annually.[2] The ten-year study at the Colorado Premature Infant Center on prevention of premature delivery, as well as care of premature infants, has shown how prevention and better control of medical and obstetric complications during pregnancy can (a) reduce the incidence of prematurity at the smallest birth weights (under 1,500 grams) and (b) in combination with high quality newborn infant care, reduce by some 30 per cent perinatal mortality among premature infants whose mothers have complications during pregnancy or delivery.[26]

Studies need to be made in states and local communities on specific aspects of changing health needs of mothers and infants, to determine whether needed services are available, whether they are adequate, and what, if any, are the barriers to their use. Health needs in maternity and infancy in many metropolitan areas were greatly altered in 1950-1957 as a result of interregional migration. In these streams of migration during 1950-1958 were almost 1,000,000 nonwhite persons leaving the South for other geographic divisions, going particularly to industrial and commercial centers.[1] Central cities in the 1940's in most regions gained two nonwhite persons for each three white persons who moved to the suburbs. This selective process continued in the 1950's to bring families of newcomers with limited incomes to many of the larger cities of the United States, while families with larger resources moved to the outlying areas.

The finding in this review of increased mortality from certain causes pertaining to infection unspecified as to type, points to a need for epidemiologic studies in hospitals and communities, not only to determine the specific cause of infections, but also the reasons for this increase, including any relationship to hospital-acquired staphylococcal disease. Increase in mortality in the total population (except neonates) of the United States from staphylococcal

Table 7—Infant Mortality from Selected Causes Indicative of Infection of Unspecified Type, by Age and Color (United States, 1950-1953 and 1954-1957)

White Infants

Selected Causes		Infant (under 1 year)		Neonatal (under 28 days)		Postneonatal (1-11 months)	
		1954-1957	1950-1953	1954-1957	1950-1953	1954-1957	1950-1953
		Rate per 100,000 Live Births					
Pneumonia of newborn	763	63.8	63.5	63.8	63.5	—	—
Acute upper respiratory infection, bronchitis, etc.	470-475, 500-510, 518, 519, 521	24.7*	23.5	—	—	—	—
Meningitis, except meningococcal and tuberculous	340	13.5	13.1	3.4**	2.5	10.1	10.6
Other infections of newborn	765-768	12.5**	8.2	12.2**	7.9	0.3	0.3
Septicemia and pyemia	053	7.2**	5.2	—	—	7.2**	5.2
		Number of Deaths					
Pneumonia of newborn	763	8,971	8,236	8,971	8,236	—	—
Acute upper respiratory infection, bronchitis, etc.	470-475, 500-510, 518, 519, 521	3,468	3,044	—	—	—	—
Meningitis, except meningococcal and tuberculous	340	1,900	1,699	473	323	1,427	1,376
Other infections of newborn	765-768	1,753	1,067	1,715	1,025	38	42
Septicemia and pyemia	053	1,015	677	—	—	1,015	677

* Significant at the 5 per cent level.
** "Highly significant" values at the 1 per cent level.

Table 8—Infant Mortality from Selected Causes Indicative of Infection of Unspecified Type, by Age and Color (United States, 1950-1953 and 1954-1957)

Nonwhite Infants

Selected Causes		Infant (under 1 year)		Neonatal (under 28 days)		Postneonatal (1-11 months)	
		1954-1957	1950-1953	1954-1957	1950-1953	1954-1957	1950-1953
		Rate per 100,000 Live Births					
Pneumonia of newborn	763	182.0**	162.8	182.0	162.8	—	—
Acute upper respiratory infection, bronchitis, etc.	470-475, 500-510, 518, 519, 521	55.9	53.4	—	—	—	—
Meningitis, except meningococcal and tuberculous	340	38.8	37.2	7.6**	5.1	31.2	32.1
Other infections of newborn	765-768	35.4**	23.5	34.8**	22.6	0.5	0.9
Septicemia and pyemia	053	14.5	8.3	—	—	14.5**	8.3
		Number of Deaths					
Pneumonia of newborn	763	4,392	3,377	4,392	3,377	—	—
Acute upper respiratory infection, bronchitis, etc.	470-475, 500-510, 518, 519, 521	1,350	1,107	—	—	—	—
Meningitis, except meningococcal and tuberculous	340	937	771	183	106	754	665
Other infections of newborn	765-768	854	487	841	469	13	18
Septicemia and pyemia	053	351	172	—	—	351	172

** "Highly significant" values at the 1 per cent level.

and certain other infections in the period 1949-1957 has been noted.[3]

The failure of the mortality rate on the first day of life to show a significant downward trend during 1950-1957 raises the question of possible effects of more complete reporting of deaths, especially of very small infants. During the 1950's, a number of factors have been favorable to more complete reporting, for example, increase in proportion of births in hospitals, especially in the nonwhite group, and widespread efforts to secure registration of death as well as birth of prematurely born infants, regardless of birth weight, or judgments as to "viability." Specially designed studies in local communities are needed to evaluate such effects, if any.

Summary

1. Because of an interruption of the national downward trend in infant mortality in 1957, trends in infant mortality, 1950-1957, by age and color, in the country as a whole, in metropolitan and other counties, and in the several states, as well as for different types of reported causes of infant death, were reviewed.
2. During 1950-1957, about 70 per cent of infant deaths were in the neonatal period, and of neonatal deaths, half were on the first day. Postneonatal deaths were concentrated at 1-5 months of age, with only 30 per cent occurring at 6-11 months.
3. Annual percentage decrease in infant mortality, 1950-1957, was 1.7 per cent; neonatal mortality, 1.1 per cent; postneonatal, 3.3 per cent. Mortality on the first day did not decrease significantly during 1950-1957, and annual percentage decreases in rates at 1 day, at 1-3 weeks and at 1-5 months were smaller than later in the first week, and at 6-11 months. These tendencies were more pronounced in the nonwhite than in the white group. Nonwhite mortality rate on the first day showed an annual percentage increase (1.4 per cent); their mortality at 1-3 weeks, and at 1-5 months was without definite trend.
4. Annual percentage reduction in infant mortality, 1950-1957, has been smaller in metropolitan counties than in nonmetropolitan, 1.3 per cent annually as compared with 2.7 per cent. The difference was greater for white than nonwhite infants.
5. Average annual infant mortality rates, 1954-1957, in each state were compared with corresponding average rates in 1950-1953 for indications as to trends in state rates. Fifteen states or areas, all but two with rates below or at median, 1950-1953, showed no significant change in rate. In the District of Columbia, the infant mortality rate increased 6.2 per cent.

   In 19 states and Puerto Rico, significant reductions were made in both neonatal and postneonatal mortality.

   Eight states reduced mortality throughout infancy among white as well as nonwhite infants. These were states of the southern divisions where mortality rates were above median. In the United States as a whole, and in 13 states, postneonatal mortality decreased significantly among both white and nonwhite infants, but reduction in the neonatal rate was among white infants only.

   Neonatal mortality levels over the years 1950-1957 remained about the same, or were elevated in 14 states, Alaska, Hawaii, and the District of Columbia. In 11 of the same states, the District of Columbia, and five additional states, postneonatal mortality rates were not significantly lower in 1954-1957 than in 1950-1953.
6. The United States infant mortality rate for all causes decreased 7.7 per cent from an annual average of 28.5 per 1,000 in the period 1950-1953 to 26.3 per 1,000 in 1954-1957. Deaths attributed to prenatal and natal causes comprised two-thirds of all deaths under one year, and in 1954-1957 had the smallest relative decrease in rate, 4.3 per cent from 1950-1953. On the other hand, the infant death rate for cause categories grouped together under postnatal causes decreased 10 per cent between the same periods.
7. Neonatal mortality among all infants from "other infections of the newborn"; from meningitis, except meningococcal and tuberculous; and from pneumonia of the newborn in the nonwhite group showed small increases in rate over the years 1950-1957. Postneonatal mortality from septicemia and pyemia gradually increased in rate during these years.
8. State and community studies of the changing needs of mothers and infants, especially in metropolitan areas, are needed for local interpretation of recent infant mortality trends, and for planning services to insure comprehensive maternity and newborn care for all mothers and infants.

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Dr. Hunt is assistant chief, Program Analysis Branch, Division of Research, and Dr. Chenoweth is chief, Program Services Branch, Division of Health Services; Children's Bureau, Department of Health, Education, and Welfare, Washington, D. C.

This paper was presented before the Maternal and Child Health Section of the American Public Health Association at the Eighty-Seventh Annual Meeting in Atlantic City, N. J., October 22, 1959.