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CHILDREN'S BUREAU

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MAIN CAUSES OF INFANT, CHILDHOOD AND MATERNAL MORTALITY 1939-1949

in terms of the sixth revision of the international lists

BIOSTATISTICS SERVICE
FIFE-HAMILL MEMORIAL HEALTH CENTER

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE Social Security Administration Children's Bureau

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MAIN CAUSES OF INFANT, CHILDHOOD AND MATERNAL MORTALITY, 1939-49,
in Terms of the Sixth Revision of the International Lists 1/

The International Lists

A new series of statistics on the causes of death began with the year 1949. Some features of the new series were unprecendented in the history of United States vital statistics.

During the decade 1939-48 the Fifth Revision 2/ of the International Lists was used for coding the causes of death. The differences between that Revision and the earlier Revisions were small.

The Sixth Revision 3/, which is being used for the decade 1949-58, was new in respect to the procedure used for selecting the underlying cause of death and in respect to various features of the classification itself. Since no data in this report are for a year earlier than 1939, it is convenient to use the terms "old" and "new", respectively, for the Fifth and Sixth Revisions, as well as for the classification procedures and statistics based on those Revisions.

Death certificates provide for reporting more than one cause of death, and the physician who completes the medical parts of the certificate reports two or more causes for the majority of deaths. Under the old procedure, the selection of the cause used in tabulations was not made by the physician but was made later in accordance with rules which set a certain priority for each cause in relation to all others. The physician set down whatever causes of death were significant in each given case, but did not attempt to decide which was the underlying cause.

1/ Report prepared by Bronson Price and Eleanor P. Hunt, Division of Research. This report supplements one of the previous reports in the Children's Bureau Statistical Series (No. 9, "Charts on Infant, Childhood and Maternal Mortality, 1949") and replaces another (No. 6, "Changes in Infant, Childhood and Maternal Mortality Over the Decade 1939-1948"). The portions of the charts in the present report representing 1949 data differ slightly from the charts on 1949 data in report No. 9, owing to the fact that the reports concern different problems and a limited amount of information is available on comparability of the two Revisions of the International Lists.

2/ "Manual of the International List of Causes of Death (Fifth Revision) and Joint Causes of Death." Department of Commerce, Bureau of the Census, 1940.

3/ "Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death Sixth Revision of the International Lists of Diseases and Causes of Death." World Health Organization, Geneva, Switzerland, 1948 (Volume 1), and 1949 (Volume 2, Alphabetical Index).

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Under the new procedure the physician is responsible for deciding, at the time he fills out the death certificate, the underlying cause to be used in tabulations. If the medical certification is properly completed, the physician's judgment is ordinarily accepted for tabulating purposes. The most important exception from the viewpoint of this report is the case where the physician states both immaturity (premature birth) and some additional condition as causes of an infant's death. The new procedure for classifying cases of this kind, which will be discussed below in connection with infant mortality, is so different from the old procedure that the new series of statistics has no counterpart for the old infant mortality rate from premature birth.

For other causes of death it would be possible, in theory, to make comparisons between the old and new series of statistics in either of two ways. One way would be to adjust the new series to the old, which would mean interpreting the new data in the old terms. If this were done the advantages of the new series would be lost. It would also mean that the data to be used for 1949 or any later year would not be final figures, but only estimates made by adjusting the actual data to the old terms.

The other way of making comparisons is to adjust the old series to the new. This requires changing the figures that were published for 1948 and earlier years; that is, it requires estimating what the figures would have been if the new series had been used then. This procedure, nevertheless, permits the data for 1949 and later years to be used as actually reported, thus keeping the advantages of the new series.

The second procedure is clearly preferable, and it is the one used in this report. The rates for main causes of infant, childhood and maternal mortality in the years 1939 and 1948 have been adjusted to the new series, and percentage changes between these adjusted rates and the final rates for 1949 have been computed. The tables show the data for all three years (1939, 1948, and 1949) while the charts show the changes which have occurred from 1939 to 1949.

Within the total infant, childhood, or maternal rate, the rank order of the cause components differs considerably from one period of time to another. For a consistent presentation of main causes, it has seemed best to determine the main causes and their rank order from data for the year 1949.

Comparability Ratios

For most causes of death the changes introduced with the new Revision are minor enough that old and new rates can be compared through the use of "comparability ratios".

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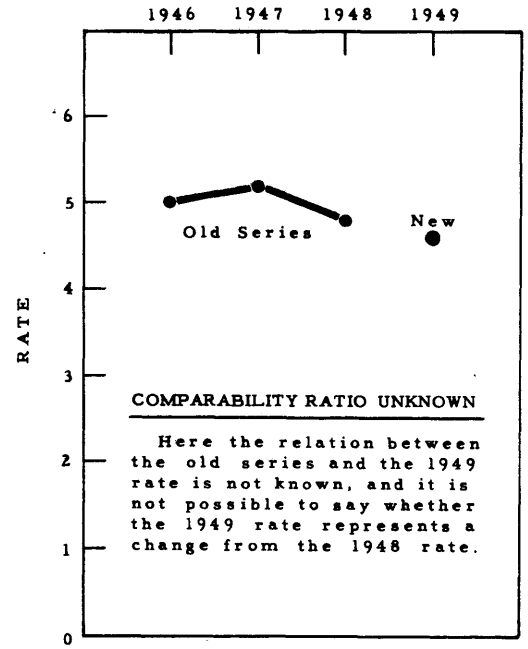
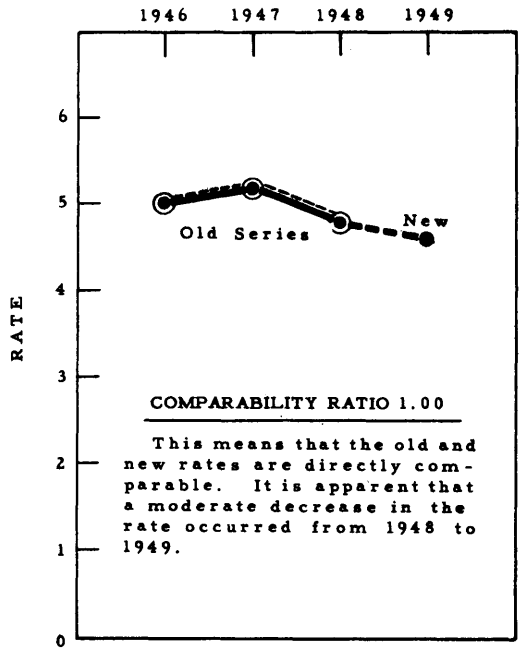
CHART A.– MEANING OF THE COMPARABILITY RATIO

Points marked O indicate rates in the "Old Series" multiplied by the comparability ratio.
The other four points are in same positions in all panels.



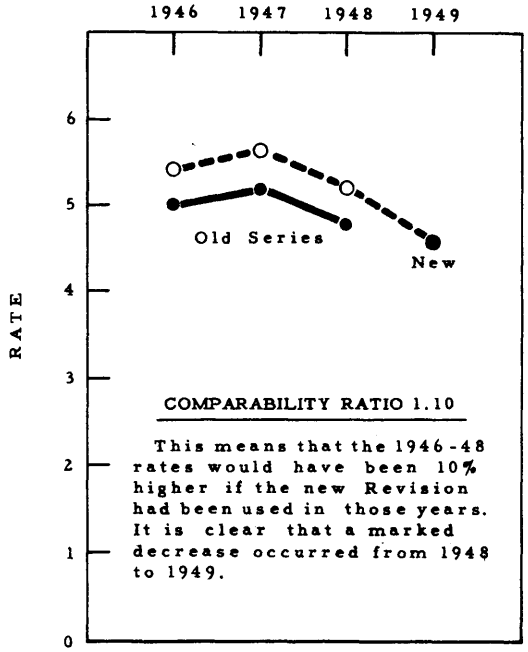
COMPARABILITY RATIO UNKNOWN

Here the relation between the old series and the 1949 rate is not known, and it is not possible to say whether the 1949 rate represents a change from the 1948 rate.



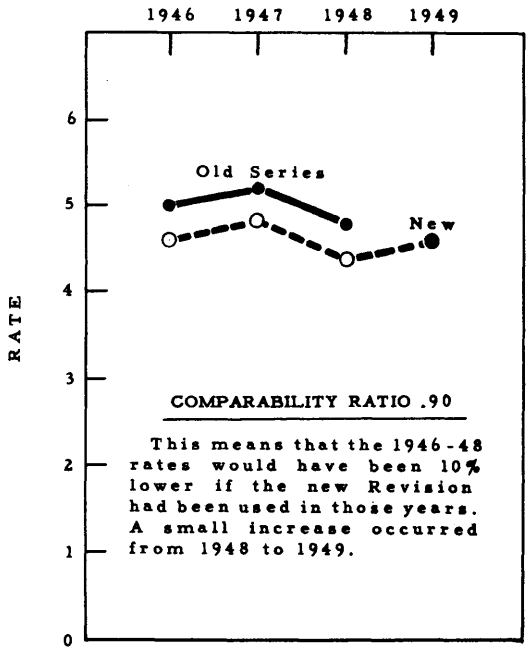
COMPARABILITY RATIO 1.00

This means that the old and new rates are directly comparable. It is apparent that a moderate decrease in the rate occurred from 1948 to 1949.



COMPARABILITY RATIO 1.10

This means that the 1946-48 rates would have been 10% higher if the new Revision had been used in those years. It is clear that a marked decrease occurred from 1948 to 1949.



COMPARABILITY RATIO .90

This means that the 1946-48 rates would have been 10% lower if the new Revision had been used in those years. A small increase occurred from 1948 to 1949.

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The comparability ratio for a particular cause is simply the factor by which the old mortality rate for that cause should be multiplied before it is compared with the corresponding new rate. The comparability ratio is obtained by taking the number of deaths coded to the given cause using the new Revision, and dividing it by the number of deaths coded to that cause or a similar cause with the old Revision.

Hypothetical data are used in chart A to show how the comparability ratio determines the relationship between an old series of rates for a particular cause and the new rate for a similar cause. In all four panels of this chart, the "old series" of rates and the "new" rate are plotted in exactly the same positions (since these rates, as such, would not be affected by the comparability ratio). If the comparability ratio is 1.00, it means that no adjustment of the old rates is necessary before comparison is made with the new rate. If the comparability ratio is larger or smaller than 1.00, the old rates are increased or decreased proportionately, as indicated in the two lower panels of chart A, before comparison with the new rate is attempted.

To obtain accurate comparability ratios it is necessary to code large numbers of death certificates by both the old and new Revisions. The National Office of Vital Statistics is planning to code all deaths of the year 1950 by both Revisions. The comparability ratios to be obtained from that project will be reliable, but they will not be available for at least a year.

In the interim, the National Office of Vital Statistics has coded 10% samples of 1949 and 1950 death certificates by both Revisions, and has obtained provisional comparability ratios from these samples. 4/

So far as main causes of infant, childhood and maternal mortality are concerned, the provisional comparability ratios may be considered fairly reliable. They are used in this report to estimate 1939 and 1948 rates in terms of the new Revision, and thus to permit comparison with the rates for 1949. However, it should be noted that the estimated rates for 1939 and 1948 (as well as the percentage changes between them and 1949 rates) are only estimates, and that some of them will need to be modified when more accurate comparability ratios become available.

The provisional comparability ratios which have been used in constructing charts 1-3 are shown in the corresponding tables. When more accurate ratios become available, they should be compared with the provisional ratios and allowances should be made as necessary in the

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4/ See: "The Effect of the Sixth Revision of the International Lists of Diseases and Causes of Death Upon Comparability of Mortality Trends", Vital Statistics - Special Reports, Vol. 36, No. 10, available on request to the National Office of Vital Statistics, Washington 25, D. C. Also: "Vital Statistics of the United States, 1949", Part I, pages XIV-XVIII; published by the Federal Security Agency and available in large libraries.

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rates estimated for 1939 and 1948. Suppose, for example, that the provisional ratio which has been used for a particular cause in this report is .91, and later information shows that .93 is a more accurate ratio. The estimated 1939 and 1948 rates shown herein for that cause should be divided by .91 and multiplied by .93. The revised estimates of 1939 and 1948 rates so obtained should then be used to recompute the percentage changes between those years and 1949.

The category numbers in the new and old International Lists are shown in the tables, for each cause or group of causes shown in the charts. The old category numbers will be needed in case the reader wishes to look up the names of the old causes which were used in setting up the comparability ratios. The reference for doing this is given in footnote 2. However, since the old names of the causes are not essential information and since all cause data in this report are given in the new terms, the old names of the causes are not included here.

Infant Mortality

Under the new procedure, certificates of infant death on which the physician has stated that immaturity (premature birth) is at least one cause of death are classified in the following manner:

1. If no other significant cause of death is given, the death is coded to "immaturity unqualified". This is one of the conditions included in the cause group "certain diseases of early infancy".

2. If the physician states that both immaturity and some additional condition were causes of death, the coding depends on whether or not the additional cause is also in the group "certain diseases of early infancy".

   a. If the additional cause is in that group, the certificate is coded to the additional cause, but count is kept of the number of cases in which immaturity is mentioned. In effect, this means coding certificates of this kind to the combination immaturity and the additional cause.

   b. If the additional cause is not in the group "certain diseases of early infancy", the certificate is coded to the additional cause, and no record is kept of the fact that immaturity is stated as one of the causes.

The last rule does not occasion much loss of information regarding immaturity as a cause of death, because the group "certain diseases of early infancy" includes most of the causes with which immaturity is

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Table 1. - INFANT MORTALITY RATES FOR MAIN CAUSES: U. S., 1939, 1948 and 1949

Rates are in terms of the Sixth Revision of the International Lists. Rates for 1939 and 1948 are estimates, and are subject to change when more accurate comparability ratios become available.

Cause (by 6th Rev.)	Category numbers		Provisional comparability ratio 1/	Rates/1,000 live births			Change (estimated)		
	6th Rev.	5th Rev.		1939 (est.)	1948 (est.)	1949 (final)	1939-48	1948-49	1939-49
All causes	---	---	---	48.0	32.0	31.3	-33%	-2%	-35%
Certain diseases of early infancy, total.....	760-76	158-61	1.05	23.7	18.4	18.0	-22%	-2%	-24%
Immaturity unqualified.....	776	159 pt.	.62	8.9	6.9	6.6	-22%	-4%	-26%
Postnatal asphyxia and atelectasis.....	762	---	---	4.5	3.9	3.7	-13%	-5%	-18%
With immaturity.....	.5	159 pt.	.22	---	---	2.3	---	---	---
Without immaturity.....	.0	161a	1.01	---	---	1.4	---	---	---
Birth injuries.....	760-1	160	.95	4.3	3.3	3.5	-23%	+6%	-19%
With immaturity.....	.5	---	---	---	---	1.6	---	---	---
Without immaturity.....	.0	---	---	---	---	1.9	---	---	---
Other conditions of early infancy	763-75	---	---	6.5	4.3	4.2	-34%	-2%	-35%
With immaturity.....	.5	---	---	---	---	2.0	---	---	---
Without immaturity.....	.0	---	---	---	---	2.2	---	---	---
Congenital malformations.....	750-9	157	.95	4.4	4.2	4.1	-5%	-2%	-7%
Influenza and pneumonia, except pneumonia of newborn...	480-93	33,107-9 pt.	.93	5.7	2.7	2.6	-53%	-4%	-54%
Gastritis, duodenitis, enteritis, and colitis, except diarrhea of newborn.....	543, 571-2	119 pt.	.88	3.1	1.3	1.6	-58%	+23%	-48%
All other causes.....	---	---	---	11.1	5.4	5.0	-51%	-7%	-55%

1/ Based on 10% sample of 1949 and 1950 deaths under 1 year of age.

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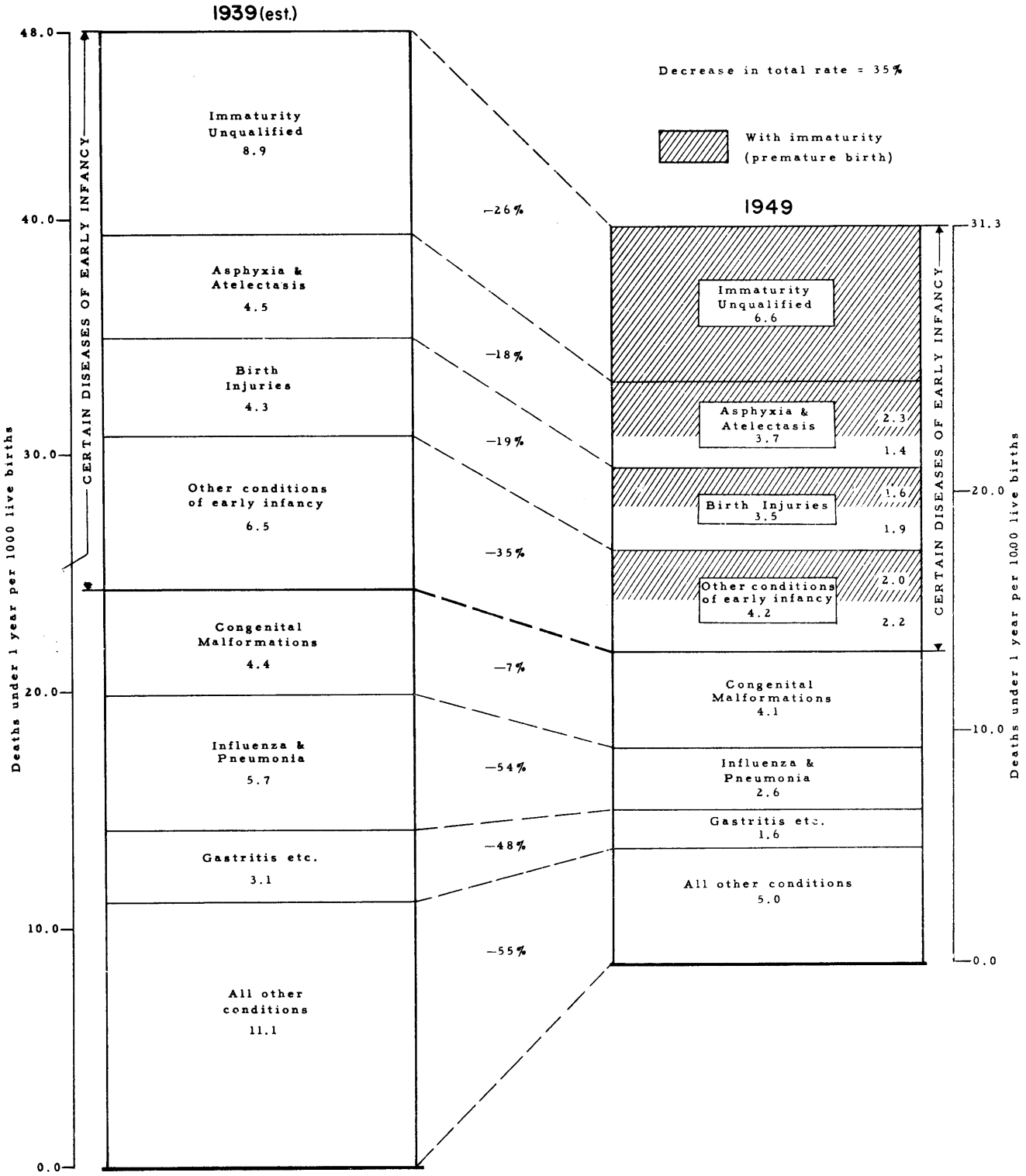
CHART I.- INFANT MORTALITY

MAIN CAUSES BY 6TH REVISION OF THE INTERNATIONAL LISTS

U.S., 1939 AND 1949



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associated. Indeed, it is known that more of the cases involving immaturity are counted under the new procedure than was true under the old procedure, when "premature birth" was given priority over some causes and not over others.

However, the new classification of infant deaths was not designed to improve the counting of certificates on which immaturity is stated as a cause of death. In fact, immaturity was considered to be, at most, a secondary cause of death.

The results of the new procedure are shown in the right-hand part of chart 1, which gives the final rates for main causes of infant mortality in 1949. The block shown there as "immaturity unqualified" means that no other cause was stated on the certificates of those infant deaths, but does not necessarily mean that no other cause of death existed. If more had been known about these deaths, the block for "immaturity unqualified" would have been smaller and the shaded parts of the other three blocks in the group "certain diseases of early infancy" would have been larger. Yet the total for "certain diseases of early infancy" would have remained practically unchanged.

The total rate for "certain diseases of early infancy" is a suitable rate for use in connection with programs of care for newborns; and indeed, this rate is at least as useful for that purpose as the old rate for mortality from "premature birth" ever was. For purposes of trend data, in lieu of attempting to continue the rate for premature birth into 1949 or later years, one need simply look up, for whatever area and pre-1949 year may be concerned, the mortality rate previously published for category numbers 158-61 of the old Revision; multiplying that rate by 1.05 (as done in table 1 for the United States) gives a rate comparable to the rate for "certain diseases of early infancy" in 1949 or any later year.

It is doubtful whether a rate based on the sum of the shaded parts of chart 1 should be used. This is because the meaning of immaturity, as reported on death certificates may be changing. The new classification encourages physicians to define an immature infant as one weighing $5\frac{1}{2}$ pounds (2,500 grams) or less at birth, or as one with a gestation period of less than 37 weeks. However, the extent to which this definition is being observed is not known, nor is it known how changes in the observance of the definition may be affecting the frequency of certificates with immaturity stated as a cause of death. Adequate statistics on the mortality of prematurely born infants must await the time when the mortality rates can be computed on the basis of birth weight.

The derivation and use of comparability ratios for causes within the group "certain diseases of early infancy" are complex problems. For details the reader should consult the pertinent reports of the National Office of Vital Statistics. It is sufficient to note here that although the rate for "immaturity unqualified" can be estimated for any year between 1939 and 1948 (by taking 62% of the rate for "premature birth" in the given year), it is not feasible to estimate the "with immaturity"

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components of other rates in the group "certain diseases of early infancy" for years before 1949. 5/

In table 1, it may be noted also that the 1939 rates for the four components of "certain diseases of early infancy" add to somewhat more than the total rate shown for that group. The same is true for the 1948 rates. This happens because the total rate for "certain diseases of early infancy" has been estimated independently of the component parts. Since adjustments to make the parts equal the total rate would increase rather than decrease the errors involved in the estimates, no adjustments have been made, and percent changes have been computed from the figures as they stand. However, for purposes of charting the 1939 rates in the left-hand part of chart 1, the four components of "certain diseases of early infancy" have been slightly reduced, though the rates stated in the chart are the same as the rates given in the table.

Childhood Mortality

Of the various percentage changes shown in the middle portion of chart 2, the most certain are those for accidents (-20%), influenza and pneumonia (-64%), and tuberculosis (-57%).

The meaning of the percentage increases shown for malignant neoplasms and congenital malformations is uncertain. Although a small part of these increases might be real, the greater part of the apparent rises is probably due to more frequent autopsies and improved diagnoses of these causes of death.

The large percentage increase shown in the rate for poliomyelitis arises from the fact that the year 1939 happened to be one of the "low" years for this rate, while in 1949 the rate reached a high point in the decade.

Although the chart shows separate rates for diseases of the heart and rheumatic fever, the differential diagnosis of these causes is known to be difficult in the childhood age range. Where possible, therefore,

5/ "Infant Mortality from 45 Selected Causes by Age, Race and Sex: United States, 1949," Vital Statistics--Special Reports, Vol. 36, No. 17, available from the National Office of Vital Statistics, Washington, D. C. This publication includes estimated infant mortality rates for detailed causes in each year between 1939 and 1948, as well as provisional comparability ratios for more detailed causes than those shown in the present report. Similar information is given on pages XVI-XVIII and XLVII-LII of "Vital Statistics of the United States, 1949," Part I, published by the Federal Security Agency.

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Table 2. - CHILDHOOD MORTALITY RATES FOR MAIN CAUSES: U. S., 1939, 1948 and 1949

Rates are in terms of the Sixth Revision of the International Lists. Rates for 1939 and 1948 are estimates, and are subject to change when more accurate comparability ratios become available.

Cause (by 6th Rev.)	Category numbers		Provisional comparability ratio 1/	Rates/100,000 children aged 1-14 years			Change (estimated)		
	6th Rev.	5th Rev.		1939 (est.)	1948 (est.)	1949 (final)	1939-48	1948-49	1939-49
All causes	---	---	---	165.9	97.1	92.6	-41%	-5%	-44%
Accidents.....	E800-962	169-95	1.00	34.5	30.1	27.7	-13%	-8%	-20%
Motor-vehicle accidents.....	E810-35	170	1.00	10.9	10.6	9.7	-3%	-9%	-11%
Other accidents.....	E800-2, E840-962	169,171-95	1.00	23.6	19.5	17.9	-17%	-8%	-24%
Influenza and pneumonia.....	480-93	33,107-9	0.89 2/	24.3	9.4	8.7	-61%	-7%	-64%
Malignant neoplasms.....	140-205	45-55,74	1.00	5.6	7.1	7.7	+27%	+8%	+38%
Leukemias.....	204	74	1.00	2.3	3.2	3.6	+39%	+13%	+57%
Other malignant neoplasms....	140-203,205	45-55	1.00	3.3	3.9	4.1	+18%	+5%	+24%
Congenital malformations.....	750-9	157	0.92 3/	3.9	5.4	5.6	+38%	+4%	+44%
Tuberculosis, all forms.....	001-19	13-22	1.00	8.1	3.7	3.5	-54%	-5%	-57%
Poliomyelitis.....	080	36	1.00	1.3	2.8	3.5	+115%	+25%	+169%
Diseases of the heart and rheumatic fever.....	400-2, 410-43	58,90-5	---	9.1	4.0	3.8	-56%	-5%	-58%
Diseases of the heart.....	410-43	90-5	0.77 4/	5.6	2.4	2.0	-57%	-17%	-64%
Rheumatic fever.....	400-2	58	1.60 4/	3.5	1.6	1.8	-54%	+13%	-49%
All other causes.....	---	---	---	79.1	34.6	32.1	-56%	-7%	-59%

1/ Ratios of 1.00 are based on 10% sample of 1949 and 1950 deaths of all ages; values falling between .97 and 1.03 have been taken as 1.00 because small departures from that value are not likely to be meaningful so far as the age range 1-14 years is concerned

2/ Based on 10% sample of 1950 deaths of all ages. 3/ Based on 10% sample of 1949 deaths of ages 1-14 years.

4/ Based on 10% sample of 1951 deaths of ages 1-14 years.

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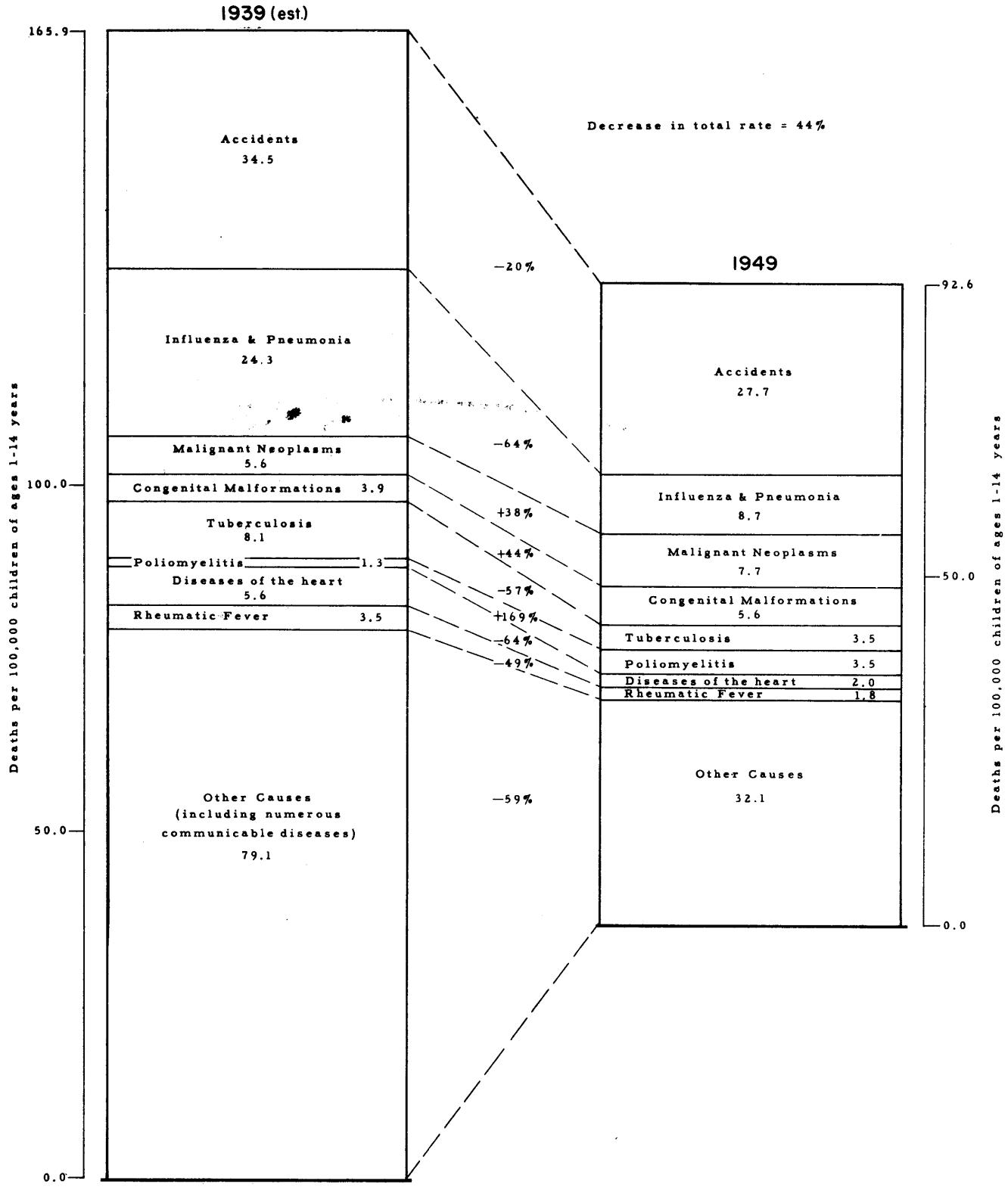
CHART 2.– CHILDHOOD MORTALITY

MAIN CAUSES BY 6TH REVISION OF THE INTERNATIONAL LISTS
U.S., 1939 AND 1949



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it is best to use the total rate for these two causes taken together. As shown in table 2, this total rate decreased 58% from 1939 to 1949.

The provisional comparability ratios available from the 10% sample are not accurate enough to complete chart 2 for further causes of childhood death, which include a large number of specific diseases. However, it may be said that the greater part of the decrease of 59% shown in the chart for "other causes" of childhood mortality is due to reductions in deaths from the more communicable diseases. These include measles, meningococal infections, diphtheria, dysentery, whooping cough and scarlet fever, in that order of importance in childhood deaths of the year 1949.

Maternal Mortality

Unlike the total infant or total childhood mortality rate, the total rate for maternal causes is not based on or limited to an age group. For that reason, not only the component parts of the maternal mortality rate, but also the total maternal rate, has been affected by the new Revision.

The provisional comparability ratio for the total maternal mortality rate is .91. In effect, this means that of all maternal deaths as coded by the rules of the old Revision, physicians now judge that a condition concerned with pregnancy, delivery or the puerperium was the underlying cause of death in 91% of the cases. In the other 9%, conditions associated with pregnancy, childbirth or the puerperium may have been contributing factors, but are not judged to be underlying causes of death.

When percentage changes are computed from data adjusted to the new Revision (chart 3 and table 3) it is found that the total maternal rate decreased 75% from 1939 to 1949, and 15% from 1948 to 1949.

The data available on trends of the component parts of the maternal mortality rate are much less certain than the data on trends of infant or childhood mortality components. (The total number of maternal deaths in 1949 was 3,216, as compared with 111,531 infant deaths and 34,404 childhood deaths; it is thus obvious that the provisional comparability ratios from the 10% sample are relatively unreliable for components of the maternal rate). However, from the provisional ratios so far available it appears that decreases over the past decade were greatest (80 to 85%) for maternal deaths from sepsis and abortion, and least (about 65%) for deaths from hemorrhage and ectopic pregnancy. This is about as much as can safely be said regarding trends in the components of the maternal mortality rate. Little reliance should be placed in the percentages shown in table 3 until the provisional comparability ratios can be checked against the ratios obtained from complete coding of 1950 deaths by both Revisions.

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CHART 3.- MATERNAL MORTALITY

MAIN CAUSES BY 6TH REVISION OF THE INTERNATIONAL LISTS
U.S., 1939 AND 1949

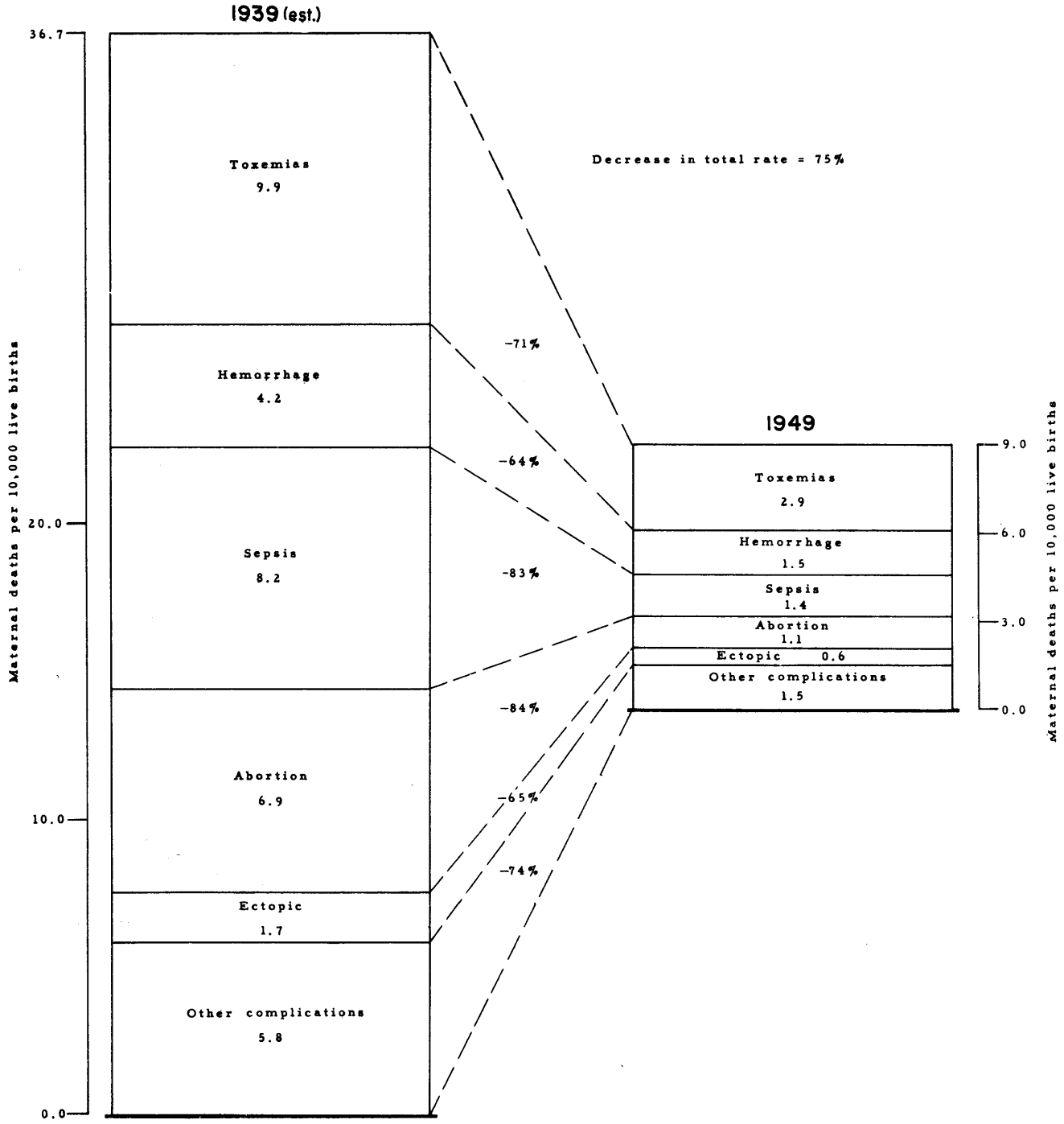

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Table 3. - MATERNAL MORTALITY RATES FOR MAIN CAUSES: U. S., 1939, 1948 and 1949

Rates are in terms of the Sixth Revision of the International Lists. Rates for 1939 and 1948 are estimates, and are subject to change when more accurate comparability ratios become available.

Cause (by 6th Rev.)	Category numbers		Provisional comparability ratio	Rates/10,000 live births			Change (estimated)		
	6th Rev.	5th Rev.		1939 (est.)	1948 (est.)	1949 (final)	1939-48	1948-49	1939-49
All maternal causes	640-89	140-50	.91 1/	36.7	10.6	9.0	-71%	-15%	-75%
Toxemias (except abortion with toxemia).....	642, 685-6	144,148	1.05	9.9	3.3	2.9	-67%	-12%	-71%
Hemorrhage.....	643-4, 670-2	143,146	.87	4.2	1.9	1.5	-55%	-21%	-64%
Sepsis (except abortion with sepsis).....	640-1, 681-2, 684	145a,147	.72	8.2	1.8	1.4	-78%	-22%	-83%
Abortion (including abortion with toxemia or sepsis)....	650-2	140-1	.87 1/	6.9	1.2	1.1	-83%	-8%	-84%
Ectopic pregnancy.....	645	142	1.00	1.7	0.7	0.6	-59%	-14%	-65%
Other complications.....	646-8, 660, 673-8, 680, 683, 687-9	145b, 149-50	---	5.8	1.7	1.5	-71%	-12%	-74%

1/ Based on 10% sample of 1949 and 1950 deaths; other comparability ratios are based on 10% sample of 1949 deaths.

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