6-1971

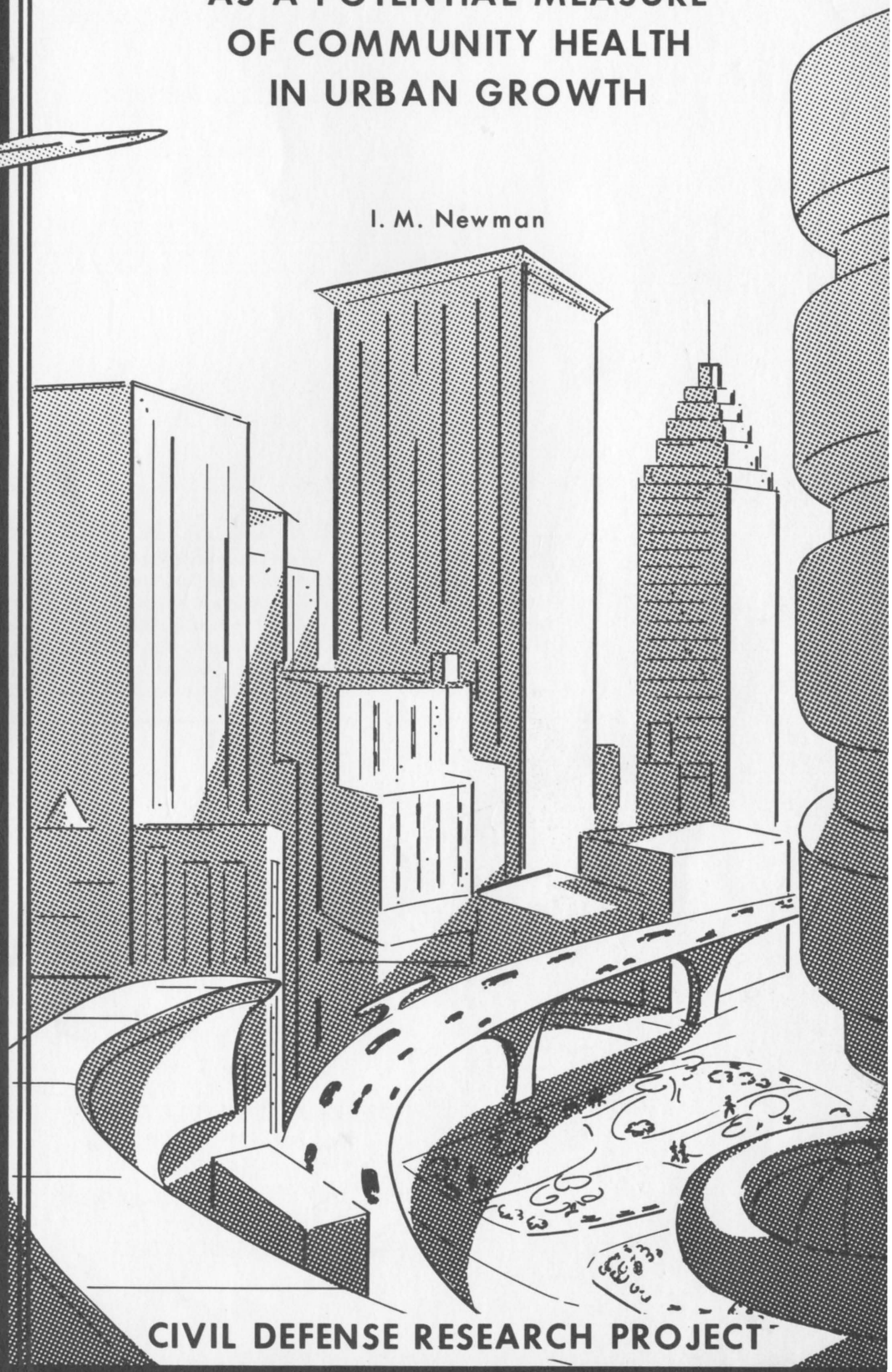
Infant Mortality as a Potential Measure of Community Health in Urban Growth

Ian Newman
University of Nebraska-Lincoln, inewman1@unl.edu

ORNL-HUD-10

INFANT MORTALITY AS A POTENTIAL MEASURE OF COMMUNITY HEALTH IN URBAN GROWTH

I. M. Newman



CIVIL DEFENSE RESEARCH PROJECT

OAK RIDGE NATIONAL LABORATORY • OPERATED BY UNION CARBIDE CORPORATION FOR THE U.S. ATOMIC ENERGY COMMISSION

ORNL-HUD-10

Contract No. W-7405-eng-26

DIRECTOR'S DIVISION

Civil Defense Research Project

INFANT MORTALITY AS A POTENTIAL MEASURE OF COMMUNITY HEALTH IN URBAN GROWTH

by

I. M. Newman

Work supported by the Department of Housing and Urban Development and the U.S. Atomic Energy Commission under Interagency Agreement No. IAA-H-28-69 AEC 40-192-69.

JUNE 1971

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
operated by
UNION CARBIDE CORPORATION
for the
U. S. ATOMIC ENERGY COMMISSION

PREFACE

This document is one of a series which contains the results of research carried out during a 1969 Summer Study of Urban Decentralization at the Oak Ridge National Laboratory, sponsored by the Department of Housing and Urban Development and the U.S. Atomic Energy Commission. The summary of the Summer Study is contained in "An Introduction to Urban Decentralization Research," ORNL-HUD-3.

CONTENTS

INFANT MORTALITY AS A POTENTIAL MEASURE OF COMMUNITY HEALTH FOR URBAN GROWTH PLANNING

Ian M. Newman*

ABSTRACT

Infant mortality rates were examined as a possible guide to the quality of general community health. Findings indicated that infant mortality rates were sensitive and potentially useful indicators of social conditions and the availability of health services. Infant mortality rates varied greatly between geographic regions and on smaller aggregated units, within geographic regions. Both white and nonwhite infant mortality rates have declined in recent years with present day nonwhite rates being significantly higher than white rates.

Infant mortality was negatively correlated with migration, income and education. Northern counties showed a significant relationship between white and nonwhite infant mortality, but this trend was not evident among Southern counties. There appeared to be no relationship between nonwhite infant mortality and the percentage of people in the community who were nonwhite. Distance of residence from cities of 100,000 or more population was not related to infant mortality. Similarly, population per square mile was not related to infant mortality.

It was concluded that infant mortality data gathered on smaller area aggregates and subdivided into white and additional nonwhite categories (e.g., Negro, Indian, Oriental, etc.) would be useful in future urban growth planning.

*Associate Professor of Public Health Education, University Health Center, University of Nebraska, Lincoln, Nebraska.

INFANT MORTALITY AS A POTENTIAL MEASURE OF COMMUNITY HEALTH FOR URBAN GROWTH PLANNING

Ian M. Newman

I. INTRODUCTION

Health is highly valued in our society and the improvement of health status is an accepted goal of communities and the nation. As such, health and the improvement of health status is a significant variable to be considered in any future policy that pertains to patterns of urban decentralization.

However, the utilization of measures of health status as decision making tools is complicated by the fact that no suitable measure of positive health currently exists. Attempts to formulate indices of health such as those by Saunders[1] and Chiang[2] have not met with widespread acceptance. As a result, we are forced to turn to negative measures such as morbidity and mortality statistics to measure the status of community health.

For purposes of this initial exploration of public health concerns related to the problems of urban decentralization, infant mortality was selected as a guide to health status. Defined as the number of deaths under the age of one year per 1,000 live births, infant mortality rates provide a useful indicator of the overall health of the mother and the infant. Undue stresses on the fetal host, the mother, during the prenatal period, or directly on the infant during the first year of life influence the youngster's viability. Therefore, the infant mortality rate is a sensitive index to overall socio-economic conditions and can rise and fall rapidly with the improvement or deterioration of these conditions. Thus rates have fallen rapidly in Japan and in East Germany as their economies have improved, and in each of these countries it was very high in the disorganized conditions immediately following the war.

II. INFANT MORTALITY IN THE UNITED STATES- A GENERAL REVIEW

At least 17 other nations have lower infant mortality rates than the United States.[3] This means that approximately 40,000 babies in the United States die each year who would have lived if our infant mortality rate was as low as Sweden's.[4] However, discrepancies between nations in the definition of a live birth and in reporting procedures make international comparisons subject to some question. Examination of the U.S. rate over a period of time indicated that the U.S. was actually declining in its ability to keep up with the world's lowest rates. In 1954, the USA ranked 8th in the world, in 1959, 10th,[5] and in 1964, 18th.[6]

Recent trends in migration to the cities from the farms and to the "suburbs" or outlying urban areas, from the core of large cities is reflected in the changing birth patterns. In 1950, 55 percent of births, live and still, were to mothers living in metropolitan counties.* In 1963, this had increased to 64.2 percent. For white mothers in the population, the increase was mainly confined to the rural parts of metropolitan counties where, in 1950, 11.5 percent of these mothers lived. This had increased to 16.9 percent by 1963. In contrast, in 1950, 44.5 percent of nonwhite mothers lived in the urban parts of metropolitan counties and by 1963 this proportion had increased up to 58.8 percent. In addition to this migratory trend the contribution of nonwhites to the total birth rate for the country increased. In 1950, the births to nonwhite mothers made up 14 percent of the total birth rate. This had increased to 15.8 percent by 1963.[7]

Fertility information based on the number of women aged 15-44 who had ever married indicated that those living in metropolitan areas had borne an average of 2.4 children by June 1964 and those living in nonmetropolitan areas had borne 2.7. This indicator of lower fertility in metropolitan counties was also shown by examining the percentage of women who have borne 5 or more children. In the age group 35-44, 14.4 percent of the metropolitan mothers had borne 5 children or more while the comparable figure for nonmetropolitan mothers was 23.1 percent.[8]

---

*Metropolitan counties are defined as having a city of 50,000 or more.

A. Current Status of Infant Mortality

In 1964, the infant mortality rate for the United States was 24.8 per 1,000 live births.[9] Approximately 41 percent of all deaths occurred in the first 24 hours of life, and 24 percent of the deaths occurred during the balance of the first week.[10] A close examination of this declining phenomenon indicated that a sharp drop in the loss rate occurred after the first three days of life. Death occurring in the first 24 hours following birth indicated a color differential of approximately 50 percent. This dropped to 30 percent at 3 days and increased through each successive day until the sixth day when the nonwhite mortality rate was more than twice the rate among whites. This differential continued to increase and at age eight months was three times as great for nonwhites; it then narrowed slightly for the balance of the first year (Table 1).

The significance of early loss of life is evident when one realizes that when deaths occurring in the first week of life are combined with fetal loss, after 20 weeks of gestation, the result equals all deaths occurring in the subsequent four decades of life.[11]

B. Geographic Distribution

In 1963, infant mortality rates ranged from a low of 18.6 per 1,000 live births in Utah to 41.3 in Mississippi. Dividing the United States into four regions, the Northeast, North Central, West, and South, illustrates the nature of the regional differences. Infant mortality for both whites and nonwhites was higher in the South than any other region. Also, the differential between the death rates of white and nonwhite infants was slightly greater in the South. In 1963, the ratios of nonwhite infant mortality rates to those of the whites were as follows:[12]

United States	1.87
Northeast	1.85
North Central	1.78
South	1.91
West	1.52

TABLE I

INFANT MORTALITY RATES BY AGE, COLOR, SEX: UNITED STATES, 1962

Age	Rates per 100,000 live births								
	Total			White			Nonwhite		
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
Under 1 year	2,531.1	2,857.7	2,188.8	2,233.7	2,543.7	1,907.3	4,135.9	4,568.5	3,693.0
Under 1 day	1,035.9	1,170.7	894.2	959.1	1,084.1	827.6	1,434.1	1,616.9	1,247.0
1 day	262.0	301.6	220.6	247.4	291.3	201.2	337.8	358.0	317.0
2 days	173.1	206.9	137.7	165.2	200.9	127.6	215.4	242.8	187.4
3 days	77.4	92.1	62.1	73.3	87.7	58.2	100.8	119.2	82.0
4 days	43.6	51.2	35.7	39.3	47.7	30.5	66.1	69.3	62.8
5 days	31.2	35.4	26.8	27.7	31.5	23.6	50.2	57.0	43.2
6 days	22.8	24.7	20.8	19.4	21.2	17.5	41.6	44.1	39.1

SOURCE: Annual volume Vital Statistics of the United States, National Center for Health Statistics, Public Health Service, Washington, U.S. Government Printing Office, as reported in Infant and Perinatal Mortality in the United States. National Center for Health Statistics. PHS Publication No. 1000 - Series 3, No. 4, p. 15.

Examination of urban and rural areas in metropolitan and nonmetropolitan counties showed that the lowest rates, for the period 1960 to 1963, were found in the rural areas of metropolitan counties (Table II).

TABLE II

INFANT MORTALITY RATES, BY COLOR: URBAN AND RURAL AREAS IN METROPOLITAN AND NONMETROPOLITAN COUNTIES IN THE UNITED STATES, 1960-63.

AREA	1963[1]	1962[1]	1961[1]
WHITE			
Metropolitan counties	Rates per 1000 live births		
Urban	21.7	22.2	22.2
Rural (urban fringe)	20.4	20.6	20.9
Nonmetropolitan counties			
Urban	24.3	24.1	24.3
Rural	23.1	22.8	23.0
NONWHITE			
Metropolitan counties			
Urban	37.4	38.2	37.6
Rural	40.1	39.6	38.4
Nonmetropolitan counties			
Urban	47.2	46.7	46.6
Rural	49.6	47.2	46.5

[1]Figures exclude data for residents of New Jersey.

SOURCE: Natality Statistics Analysis. National Center for Health Statistics. PHS Publication No. 1000-Series 21 No. 11, February 1967.

For the whites the rural areas of metropolitan counties, roughly equated as the urban finge, had the lowest rates, followed by the urban areas of metropolitan counties, the urban areas of nonmetropolitan counties, the rural areas of metropolitan counties and finally the rural areas of nonmetropolitan counties. This is most likely explained by the relative wealth of whites in the urban fringe and also their ready access to health facilities.

For nonwhites, infant death rates were lowest in the urban areas of metropolitan counties followed by the metropolitan rural areas. The pattern in nonmetropolitan counties showed an increasing difference between the rural and nonrural areas with the rural areas recording the highest rates.

Examination of data compiled by the Operational and Demographic Analysis for Material and Child Health Project of the George Washington University indicated a similar but not identical trend.[13] Based on infant mortality data by county, this project divided the United States population into areas defined as (1) Greater Metropolitan, (2) Lesser Metropolitan, (3) Adjacent, (4) Isolated Semi-Rural, (5) Rural, and (6) Isolated Rural, and showed that for both whites and nonwhites the rate of infant mortality increased as one moved from the greater metropolitan areas to the isolated rural areas. Table III shows the relative contribution of each of these areas to the total mortality rate.

Infant mortality rates were lowest in areas of over one million population and were highest in the most rural areas. Among whites the rate was five percent lower than the national average for the largest metropolitan counties and ten percent above the national average in isolated rural counties. Among nonwhites the variation was greater, from eight percent below in the largest metropolitan areas to twenty percent above in isolated rural areas.

Data on infant mortality for cities of various sizes are available only around census years, at which time special analyses are usually attempted. Table IV indicates infant mortality rates for 1960-61 and for 1950-51 for cities of over 250,000 population in 1960. In 1960-61 the highest infant mortality rate was for Newark, New Jersey and the

TABLE III

INFANT MORTALITY RATES BY COLOR AND PLACE OF BIRTH

County Group	Infant Mortality Rate, United States, 1961-65[1] (Rate is per 1,000 live births)					
	Total		White		Nonwhite	
	Rate	Ratio	Rate	Ratio	Rate	Ratio
United States	25.1	1.00	21.9	1.00	41.0	1.00
Greater Metropolitan	24.0	.96	20.9	.95	37.7	.92
Lesser Metropolitan	24.2	.97	21.7	.99	38.8	.95
Adjacent	25.4	1.02	22.6	1.03	44.9	1.10
Isolated Semi-Rural	27.9	1.11	23.6	1.08	47.8	1.17
Isolated Rural	29.1	1.16	24.1	1.10	49.4	1.20

[1]Items may not add to total due to rounding. County groupings are based on population and geographic contiguity. Greater metropolitan includes counties with 1 million or more population, 1960. Lesser metropolitan includes those with 50,000 or less than 1 million. Adjacent counties have no city (1960) of 50,000 or more but are contiguous to one or more metropolitan counties. Isolated counties are noncontiguous without urban places as large as 50,000. The semi-rural have places 10,000 to less than 50,000; the isolated rural, urban places under 10,000 and farm areas.

SOURCE: Infant and Perinatal Mortality Rates by Age and Color 1956-60; 1961-65. Operational and Demographic Analysis for Maternal and Child Health Project, The George Washington University, 1968.

lowest rate was for Seattle, Washington. At 37.1 Newark's rate for 1960-61 was roughly 21 percent higher than it had been in 1950-51 when it was 31.1. The rate had fallen over the decade in only 17 of the 36 cities, the most impressive decrease being in Phoenix, Arizona, where it plummeted from 41.6 to 27.0. In 1950-51, there had been a slight increase in rate as size of city decreased but by 1960-61 there was no longer a regular pattern.

While state groupings showed regional differences, such as higher infant mortality rate in the South, large cities were sufficiently varied in their rates to show little regional conformity (Table IV). For example, Newark, New Jersey, reported a higher rate than Memphis, Tennessee, or New Orleans. Border cities, like St. Louis, Washington, D.C., and Baltimore reported rates higher than New York, Dallas, or Memphis. Detroit reported the highest rate for cities with over 1 million in population; Washington, D.C., reported the highest rates for cities 500,000 to one million and Newark ranked highest in cities with 250,000-500,000 population.

Similar variations were noted when one examined the rates in contiguous counties. For example, in the state of Georgia, where counties are uniformally small in size, rates for infant mortality varied greatly. Telfair County for 1961-1965 recorded a nonwhite rate of 28.3 while Dodge County, immediately adjacent reported 54.9, and Laurens County 73.7. Counties within easy commuting distance from Columbus indicate similar variations. Marion County reported a nonwhite rate of 38.3 and Taylor County immediately adjacent reported 79.7.

Variations among the white rates were not as extreme but were still significant. Wheeler County, for example, reported a white rate of 29.6 while adjacent Telfair reported a rate of 11.0.

The variation within a single city is even more striking than the variation among cities. Perhaps the best examination of intracity variation was made by Donabedian and his associates in Boston, using data for 1950-54.[14] Although they were writing in 1965, the best data available for their purposes was more than 10 years old, an interesting commentary on the state of demographic and health studies in urban areas.

TABLE IV

AVERAGE ANNUAL INFANT MORTALITY RATES BY AGE AT DEATH AND COLOR: UNITED STATES, METROPOLITAN AND NONMETROPOLITAN COUNTIES AND CITIES OVER 250,000 POPULATION

Area	Total			
	Under 1 year		Under 28 days	
	1960-61	1950-51	1960-61	1950-51
	Rates per 1,000 live births			
United States	25.7	28.8	18.6	20.3
Individual cities by size 1,000,000 or more				
New York, N. Y.	26.0	24.9	19.4	19.2
Chicago, Ill.	28.4	25.4	19.8	18.9
Los Angeles, Calif.	24.1	24.8	18.3	20.1
Philadelphia, Pa.	30.7	31.1	23.4	23.4
Detroit, Mich.	29.4	26.9	22.6	20.2
500,000 - 1,000,000				
Baltimore, Md.	32.6	24.8	24.3	18.6
Houston, Tex.	27.2	28.7	19.0	23.6
Cleveland, Ohio	29.5	25.6	23.4	19.5
Washington, D.C.	36.0	30.4	27.3	24.5
St. Louis, Mo.	32.0	25.7	23.8	19.2
Milwaukee, Wis.	24.8	25.4	19.4	20.0
San Francisco, Calif.	23.8	21.7	17.8	17.2
Boston, Mass.	24.5	25.2	18.5	20.1
Dallas, Tex.	27.6	26.9	21.1	21.3
New Orleans, La.	32.4	30.1	23.7	23.3
Pittsburgh, Pa.	29.1	26.4	23.4	22.4
San Antonio, Tex.	30.3	38.0	21.0	22.4
San Diego, Calif.	25.7	29.3	19.3	21.1
Seattle, Wash.	23.6	25.2	17.1	19.8
Buffalo, N. Y.	25.9	25.6	20.1	20.1
Cincinnati, Ohio	24.2	26.4	18.3	19.0

(Continued)

TABLE IV (Continued)

15 largest cities of population 250,000 - 500,000				
Memphis, Tenn.	30.3	33.6	22.7	24.1
Denver, Col.	27.2	28.7	21.7	22.8
Atlanta, Ga.	34.0	31.1	24.3	23.7
Minneapolis, Minn.	24.6	24.4	18.9	20.1
Indianapolis, Ind.	27.8	27.5	20.4	18.9
Kansas City, Mo.	26.2	30.7	18.8	24.2
Columbus, Ohio	24.3	25.4	18.4	18.6
Phoenix, Ariz.	27.0	41.6	19.1	31.2
Newark, N. J.	37.4	31.1	25.9	24.5
Louisville, Ky.	27.9	30.3	21.8	24.5
Portland, Oregon	24.9	20.0	18.3	16.7
Oakland, California	26.9	24.5	20.3	19.2
Fort Worth, Tex.	27.5	31.5	18.8	25.0
Long Beach, Calif.	25.6	23.3	19.0	18.5
Birmingham, Alabama	29.6	31.2	21.4	23.5

Census tracts were assigned scores of socio-economic status on the basis of three characteristics determined from the 1950 census: median income, percent who had completed high school, and proportion of professionals, technical workers, managers and proprietors in the labor force. Various measures of infant mortality were used, including perinatal mortality in which late fetal deaths are combined with infant deaths in the first month of life.

For perinatal mortality the range was from 13.9 to 75.4 per thousand births (live and still) in the 90 census tracts, more than five-fold difference. Commenting on this finding the authors remarked that in the worst areas there was "a pattern similar to that for the United States as a whole in 1915, and comparable with the current pattern in partially developed countries. With respect to infant mortality, some areas of a modern American metropolis appear to be four decades behind the times.[15]

When tracts were ranked by socio-economic status, there was a sharply negative relationship between status and still births, deaths

within the first week of life, prenatal deaths, and postneonatal deaths (deaths after one month but before one year of age). Still births were twice as frequent in the poorest tracts as in those with the highest indexes of socio-economic status, and postneonatal deaths were three times as frequent. In discussing the causes of the poor showing of the larger cities, the authors remarked that...

> ...in many of our larger cities demographic, social and economic changes have occurred which have increased the need and demand for personal health services to be provided by public health departments and reduced the financial capacity of the city to provide such services. Lesser recently presented a sobering summary of the situation. The following is only one of the many examples he gave. "From various parts of the country we learn that in Atlanta 23 percent of women delivered at the Grady Hospital had no prenatal care; in Dallas approximately one-third of low-income patients received no prenatal care, at the Los Angeles County Hospital in 1958, it was 20 percent, at the D.C. General Hospital in Washington, it is 45 percent, and in the Bedford-Stuyvesant section of Brooklyn, it is 41 percent with no or little prenatal care.[16]

III. INFANT MORTALITY IN NEW YORK AN URBAN EXAMPLE

Through the courtesy of Carl L. Erhardt, Director of the Office of Planning for Health Intelligence for New York City, we were able to obtain rates of infant mortality for health districts in New York City. Data for this city were among the best in the country because they could be related to confidential medical reports which included questions bearing on the course of pregnancy and delivery. For New York City, the rate of infant mortality was reduced by a half between 1900 and 1930 and again by a half between 1930 and 1945. The low point was reached in 1951 after which it has varied between 24 and 27 per 1,000 live births.

The rate in New York City, however, varied considerably by race. For whites the rate has averaged about 20 in recent years, as against 40 for nonwhites and 30 for Puerto Ricans. For all of these groups

there has been a notable decline in the last three or four years, with the rate for whites falling to 18.2 in 1967 as against 36.2 for non-whites. Puerto Ricans experienced the sharpest decline with the rate falling to 24.3 in 1967.

By health district the range of the infant mortality rate in 1966-67 was from 13.0 in Maspeth-Forest Hills to 41.5 in Central Harlem. In the former, the proportion of births to nonwhite mothers was less than three percent; in the latter it was 94 percent and almost all of the remainder were Puerto Rican. In Maspeth-Forest Hills, less than two percent of the births were out of wedlock; in Central Harlem, the proportion was 51 percent. Seven percent of the mothers in Maspeth-Forest Hills had received no prenatal care or had received it late as against 36 percent of the mothers in Central Harlem. Seven percent of the births in Maspeth-Forest Hills were premature as against 17 percent of those in Central Harlem.

For New York City as a whole, nearly one out of six births was illegitimate and more than one in five had received no prenatal care or had received it late. One in ten births were premature, one in four were to nonwhite mothers, and one in six to Puerto Rican mothers. All of these factors are linked to each other and all act to determine an overall high rate of infant mortality.

Of the five counties in New York, Manhattan had the worst record. One fourth of the births were illegitimate, one fourth had received late or no prenatal care and one eighth were premature. In Richmond, on the other hand, the proportion of illegitimate births was four percent. There eleven percent had received late or no prenatal care, and eight percent of the births were premature. Throughout the city, wherever there were concentrations of Puerto Ricans or nonwhites, the toll of infant deaths was high---in Mott Haven in the Bronx, where Puerto Ricans were congregated, in Bedford, in Brooklyn, where the black proportion was large, for example.

The effect of income on the characteristics of live born infants is shown below where high income districts are separated from low income districts (Table V).

TABLE V

INCOME AND BIRTH CHARACTERISTICS

	Percent of Infants	
	High income districts	Low income districts
Premature (less than 2500 grams)	7.7	13.8
With late or no prenatal care	9.6	32.1
Illegitimate	3.7	31.5

The effect of illegitimacy on infant mortality is indicated below where rates of infant mortality are given separately for whites, nonwhites, and Puerto Ricans (Table VI).

TABLE VI

LEGITIMACY AND INFANT MORTALITY

	Infant Deaths Per 1,000 Live Births	
	Legitimate	Illegitimate
White	15.4	28.4
Nonwhite	30.7	41.1
Puerto Rican	22.3	32.7

It is interesting to note that the excess in infant deaths for illegitimate births is more pronounced among whites than among nonwhites or Puerto Ricans. If whites had the same rate of illegitimacy

as nonwhites or Puerto Ricans, the overall differences in infant mortality would diminish greatly.

Finally, the effect of prenatal care on infant mortality shows an interesting relationship. In all cases, some care, no matter when it was begun, was better than no care. The seeming anomaly that care begun in the third trimester is more effective than care begun earlier is probably related to the tendency of mothers who anticipate difficulty to seek care early (Table VII).

TABLE VII

PRENATAL CARE AND INFANT MORTALITY

Infant Deaths Per 1,000 Live Births
Trimester When Care Began

	First or Second	Third	No Care
White	14.0	15.0	56.2
Nonwhite	26.9	19.6	112.3
Puerto Rican	21.2	15.7	61.5

In a paper read before the Section of Preventive Medicine at the Annual Meeting of the American Medical Association in New York City on July 16, 1969, Erhardt commented on ways of reducing the rate of infant mortality as follows:

> It would seem evident that education of minority groups in the biology of living, improvement of minimal levels of income, and improvement of housing and of schools, would have better effect on the health of families, mothers, and offspring than the best of care after damage has been done. . .it is important to find out how we can best reach the hard core of women who are negligent or indifferent in obtaining modern medical and obstetrical supervision. Unsolved social rather than purely medical components may well be responsible

> for the current stagnation in the high rates of infant mortality in the United States.
>
> . . .it is evident that biomedical technologies have by far outstripped social technologies. . .If it is hoped to achieve gratifying benefit from the newer biomedical technologies in lowering infant mortality, then it is urgently necessary now to assign primary effective priorities and procedures to solve basic and highly important underlying and uncorrected social and economic problems that exist today.[17]

IV. THE SUMMER STUDY

A. Availability of Medical Services

Basic to the topic of infant mortality is the question of the availability of medical services. For the total United States in 1967, medical services appeared to be available in direct relationship to the population size of any given place. Where large numbers of people were found the highest incidence of essential medical services were also found. Table VIII shows that the ratio of population to physicians was most favorable in SMSA's with a population of 250,000 or more. This trend also held true for dentists. Not as clear but still of interest was the ratio of hospital beds to population. While little difference occurred within SMSA's of various sizes, hospital beds in non-SMSA areas were found to be less available. The lower ratio of population per hospital in non-SMSA's represents the variance in hospital sizes. Large hospitals were characteristic of large cities and small hospitals characteristic of rural areas.

Examination of the utilization of medical services further illustrated regional differences. Defining a physician as a doctor of medicine or an osteopathic physician the number of physician visits (July 66 - June 67) was highest among residents of standard metropolitan statistical areas and lowest among persons living on farms outside metropolitan areas. Persons 65 years, and younger, living on non-farm areas outside SMSA's were more similar, in physician utilization patterns, to those persons living in SMSA's, than to the farm population. Beyond 65 years of age the rates for farm and non-farm persons living

outside SMSA's were almost identical (Table VIII).

TABLE VIII

AVAILABILITY OF SELECTED HEALTH SERVICES

	Ratio of persons per service resource				
	Total Population	Physicians	Dentists	Hospital Beds	Hospitals
10 largest SMSA's	47,105,000	485	1372	234	54,082
SMSA's with 250,000 population and not the 10 largest	65,149,000	620	1670	241	50,115
SMSA's with population less than 250,000	17,599,000	740	2020	237	36,400
Non-SMSA's	66,037,000	1291	2896	284	20,400

SOURCE: Statistical Abstracts for the United States, 1967: (88th Edition) U.S. Bureau of the Census, Washington, D.C., 1967.

The rate of physician visits was highest in the 22 largest metropolitan areas, ranging from 6.2 physician visits per person per year in Philadelphia to 3.5 physician visits per person per year in Detroit. It is conceivable that these variations were due to sampling variability (Table IX).

The number of physician visits per person was highest in the West and lowest in the South. It is possible this regional difference was accounted for, in part, by differences in the level of insurance coverage paying the cost of medical consultation.[18]

TABLE IX

NUMBER OF PHYSICIAN VISITS AND NUMBER OF PHYSICIAN VISITS PER PERSON PER YEAR, BY RESIDENCE AND AGE; UNITED STATES, JULY 1966 - JUNE 1967

Sex and Age	Residence							
	All Areas	All SMSA's	Outside SMSA's		All Areas	All SMSA's	Outside SMSA's	
			Nonfarm	Farm			Nonfarm	Farm
Both sexes	Number of physician visits in thousands				Number of physician visits per person per year			
All ages----------	831,077	561,835	234,823	34,419	4.3	4.5	4.1	3.3
Under 5 years----------	112,561	76,457	32,925	3,179	5.7	6.1	5.4	3.7
5-14 years----------	110,557	76,913	30,425	3,218	2.7	3.0	2.5	1.4
15-24 years----------	120,770	80,290	36,672	3,808	4.0	4.1	4.0	2.5
25-34 years----------	96,209	66,387	26,339	3,483	4.4	4.6	4.1	4.1
35-44 years----------	100,773	70,863	26,086	3,824	4.3	4.5	4.0	3.4
45-54 years----------	95,999	65,150	25,242	5,608	4.3	4.4	4.2	4.0
55-64 years----------	86,972	57,656	24,508	4,808	5.1	5.3	4.9	4.0
65-74 years----------	68,109	43,901	20,057	4,151	6.0	6.3	5.5	5.6
75 years and over-------	39,127	24,219	12,569	2,340	6.0	6.5	5.4	5.5

SOURCE: Physician Visits, July 1967-June 1968, National Center for Health Statistics, P.H.S. Publication No. 1000 - Series 10, No. 49, p. 15.

It was significant to note that a lower percentage of physician visits in large SMSA's occurred in the physician's office than in small SMSA's or non-SMSA areas. Conversely the utilization of hospital clinics and emergency rooms was lowest in farm areas and highest in large SMSA's (Table X).

Whether or not the general public consciously recognized the greater supply of medical manpower that existed in larger urban areas and whether or not this was a major factor in determining migration patterns is not known. However, it is speculated that there is a consciousness of "better amenities" in urban areas. As such medical facilities may not be a specific element basic to patterns of in-migration but it can be hypothesized that one of the basic prequisites of steming the urban flow, or encouraging out-migration, or "recentralization" would be to provide, at least equal, medical care in rural areas.

The summer study sought to further study the variation of infant mortality among counties in relation to a number of geographic, socio-economic, and demographic factors. The infant mortality rates by county, for the 302 SMSA's outside New England for the period 1961-65 were entered onto city county data book tapes. With these data a series of correlational analyses were attempted and are summarized below.

B. Distance from Large Cities and Infant Mortality

It was evident that the pattern of infant mortality rates by broad area of the country is only roughly generalizable. Rates of infant mortality are high, as they were in New York City, wherever there are large numbers of blacks, but when black and white rates are considered separately the pattern is no longer clear. Counties with high rates are found next to counties with rather low rates and northern cities may have higher rates for blacks than do southern cities. The observation made earlier that Newark, New Jersey, had a higher rate for total population than any of the southern cities in 1960-61, can be repeated in North-South comparisons of black rates many times. In short, the black situation in this regard is not necessarily better in the North than in the South.

TABLE X

NUMBER AND PERCENT DISTRIBUTION OF PHYSICIAN VISITS, BY PLACE OF VISIT ACCORDING TO GEOGRAPHIC DISTRIBUTION: UNITED STATES, JULY 1966 - JUNE 1967

Geographic distribution	Place of visit				
	Total	Office (including prepaid group)	Hospital, clinic, or emergency room	Other and unknown	Total
	Number of physician visits in thousands	Percent distribution			
All areas---	831,077	71.8	9.3	15.6	100.0
Residence					
All SMSA's--	561,835	69.6	9.7	17.1	100.0
Large SMSA's------	322,006	68.3	10.3	16.8	100.0
New York-------	70,453	62.4	12.1	16.0	100.0
Los Angeles----	40,089	79.3	4.8	14.2	100.0
Chicago--------	33,445	70.7	8.5	19.7	100.0
Philadelphia---	28,316	64.7	10.3	19.7	100.0
Detroit--------	14,385	79.2	12.6	*	100.0
San Francisco--	17,144	67.5	16.7	14.0	100.0
Boston---------	11,043	53.8	17.5	20.1	100.0
Washington-----	13,196	59.5	9.7	20.1	100.0
Pittsburgh-----	10,452	66.8	*	21.2	100.0
St. Louis------	9,965	66.5	14.8	15.5	100.0
Cleveland------	9,433	73.1	*	14.7	100.0
Minneapolis----	6,507	65.5	*	23.1	100.0
Baltimore------	7,291	61.5	*	21.8	100.0
Houston--------	6,795	70.5	*	*	100.0

(Continued)

TABLE X (Continued)

NUMBER AND PERCENT DISTRIBUTION OF PHYSICIAN VISITS, BY PLACE OF VISIT ACCORDING TO GEOGRAPHIC DISTRIBUTION: UNITED STATES, JULY 1966 - JUNE 1967

Buffalo---------	5,432	63.2	*	20.4	100.0
Atlanta---------	5,211	78.2	*	*	100.0
Seattle---------	5,602	77.8	*	*	100.0
Cincinnati------	5,007	84.4	*	*	100.0
Dallas----------	5,196	77.3	*	*	100.0
Milwaukee-------	5,498	58.5	*	26.8	100.0
San Diego-------	6,299	67.0	*	*	100.0
Kansas City-----	5,247	72.8	*	*	100.0
Other SMSA's-------	239,829	71.3	8.9	17.5	100.0
Outside SMSA's					
Nonfarm------	234,823	75.5	8.5	13.2	100.0
Farm---------	34,419	82.9	7.7	7.1	100.0

SOURCE: Physician Visits, July 1967 - June 1968, National Center for Health Statistics, PHS Publication No. 1000 - Series 10, No. 49, p. 32.

Because isolated rural areas have the highest rates of infant mortality, transverses were drawn between large cities and infant mortality in the intervening counties examined to see if it was highest somewhere midway between the cities where presumably urban influence was least. Counties were then grouped in terms of distance from a metropolitan area and, though rates were highest for the most isolated areas, there was no systematic relationship with distance and presumably

with urban influence for either whites or blacks. Counties with infant mortality rates above 80 were found both near and far from cities.

C. White and Nonwhite Infant Mortality Rates

For the 302 SMSA counties the correlation between white and nonwhite infant mortality rates was computed on the assumption that as white rates increased, so would black rates, both responding to social and economic conditions and the level of medical care. A correlation coefficient of .18 was obtained, significant on the .01 level. While this result was statistically significant, it accounted for such a small proportion of the variance as to raise numerous questions. Visual examination of the plot of observed and predicted values indicated that perhaps two sets of data were actually present in this statistic. Accordingly, states classified by the Inter-University Consortium on Political Research Coding System as "solid south" were separated from those classified as non-southern. "Border states" were omitted from the sample. Separation of southern and non-southern states (less the border states) showed two distinct patterns. For the non-southern states, the relationship between white and nonwhite infant death rates produced a correlation coefficient of .32, significant at the .01 level. For the southern states, however, the correlation coefficient was .17, not significant.

White and nonwhite neonatal mortality rates showed similar relationships when treated separately as northern and southern states. The relationship between white and nonwhite deaths in northern states (excluding the border states) was significant at the .01 level with a correlation coefficient of .32, while for southern states the correlation coefficient was .18, not significant.

Further examination of the plot illustrated the range that existed between white and nonwhite rates within counties. Table XII gives examples of SMSA counties, both northern and southern, which deviated considerably from the regression line. Examination of these data illustrates further the variation in white and nonwhite rates.

TABLE XI

WHITE AND NONWHITE INFANT MORTALITY RATES AND PREDICTED NONWHITE RATES FOR SELECTED COUNTIES

County		White Rate	Nonwhite Rate	Predicted Non-white Rate	Residual
Rensselaer	N. Y.	21.6	20.8	37.2	-16.4
St. Louis	Minn.	21.4	27.5	37.0	- 9.5
Lehigh	Penn.	16.9	19.5	31.8	-12.3
Greene	Ohio	20.6	22.4	36.1	-13.7
Sacramento	Calif.	20.5	23.9	36.0	-12.1
York	Penn.	19.2	52.0	34.5	17.5
Macon	Ill.	21.3	54.7	36.9	17.8
Allen	Ohio	24.3	61.3	40.3	21.0
Brown	Wis.	21.1	54.8	36.7	18.1
Onodage	N. Y.	21.8	64.0	37.5	26.5
Miller	Ark.	25.0	28.5	43.9	-15.4
Taylor	Tex.	22.2	24.5	42.6	-18.1
Hanover	Va.	21.8	26.0	42.4	-16.4
Denton	Tex.	18.9	24.4	41.0	-16.6
Walker	Ga.	22.6	31.5	42.8	-11.3
Fort Bend	Tex.	29.0	73.4	45.8	27.6
Union	N. C.	24.3	66.7	43.6	23.1
Gwinnett	Ga.	22.4	75.6	42.7	32.9
Lafayette	La.	20.5	54.2	41.8	12.4
Campbell	Va.	18.9	56.4	41.0	15.4

D. Percentage of Nonwhite Population and Infant Mortality Rates

It was hypothesized that a larger percentage of nonwhites in the population would indicate greater probability of a lower socio-economic class, usually associated with poorer standards of health, reflected in higher infant mortality rates. This was not the case. No significant relationships were found between the percentage of nonwhites and the

nonwhite infant mortality in either northern or southern states.

E. Migration and Infant Mortality Rates

Inasmuch as migration alters the composition of population in many ways the rate of infant mortality was correlated with the rate of net migration. For nonwhites the correlation coefficient was not significant while for whites there was a negative correlation of -.17, significant at the .01 level, but hardly indicative of a strong relationship.

Despite the small nature of the correlation coefficient, it is significant to note that the nature of the population in places receiving considerable in-migration may differ significantly from other places. Their problems may be unique pointing out the fallacy of generalizing about urban places to too great an extent.

F. Income and Education and Infant Mortality Rates

For both whites and nonwhites there was a significant inverse relationship between median income for the counties and the rate of infant mortality, -.28 for whites and -.18 for nonwhites. Similar results were obtained with median number of years of school completed, -.23 for whites and -.22 for nonwhites. Again, while significant, the correlations are surprisingly low.

G. Population Density and Infant Mortality Rates

Inasmuch as infant mortality is known to vary with overcrowding in homes, a correlation was computed with the density of population in the counties. However, there was no systematic relationship with density at the county level. For both whites and nonwhites the coefficient of correlation was .06. It seemed that infant mortality may be especially high where density is very high, as in Harlem, or where it is very low, as in isolated rural areas.

V. SUMMARY

1. Infant mortality was negatively correlated with migration, income, and education.

2. Northern counties had a significant relationship between white and nonwhite infant mortality but this was not found in the southern counties.

3. There appeared to be no relationship between the nonwhite infant mortality rate and the percentage of people who were nonwhite.

4. Distance of residence from cities of 100,000 or more was not correlated with infant mortality.

5. Population per square mile was not correlated with infant mortality.

VI. DISCUSSION

While all of the significant correlations reported here show that there was less than one chance in a hundred of these results occurring by chance alone, they do not explain an appreciable degree of the variance in the actual mortality rates. In fact, in all cases the proportion of unexplained variance is large. No successful attempt was made to explain this as additional, more complex analysis is needed. It is sufficient to report that infant mortality as an ecologic resultant is complex in nature. Just what extent of the causes of infant deaths relate directly to environmental forces, which in turn are related to modes of living, are yet to be determined. Some of the needed data and suggested analysis that may prove invaluable to policy questions concerning urban decentralization are discussed in the final section of this report.

It should be noted that one of the major learnings of this effort was of the amount of data that is available in this general area. Actual data do not limit the scope of potential work. The critical element in conducting an intensive investigation into the dynamics of infant mortality is the availability of computer resources and trained and competant manpower who can devote uninterrupted attention to the problem. It

appears safe to say that Oak Ridge National Laboratory could well support such a research effort.

VII. SOME SUGGESTIONS FOR FUTURE RESEARCH

Economic and medical advances in the last decade have not been equalled by decreases in infant mortality rates. Reduction of the proportion of the population in the low socioeconomic classes and the increased migration from rural areas with poor amenities, to large urban centers with extensive health facilities, have not produced the expected infant mortality reductions.

The reasons for these phenomena, and others, equally as unclear, make infant mortality a critical guide to understanding environmental forces and their effects on human health.

The following suggestions are made as possible alternatives for future work to provide added insight into the health considerations of urban policy.

1. Data must be made available on smaller aggregated units than counties or SMSA's. Based on the experiences of Gabrielson, Siker, Sohler, and Stockwell, [19] these aggregates should be at least quarter-tracts for urban parts of SMSA's and be at the tract level for the balance of the SMSA's. Analytical units in non-SMSA's and rural areas would need to be developed in relationship to the population.

2. The white - nonwhite dichotomy into which most public health data are divided is no longer meaningful. This point can be illustrated in California, which has exceptionally low non-white infant mortality rates and a great many nonwhites who are also non-Negroes. The nonwhite category should be broken down into Negro and other nonwhite groups, at the very least.

3. How do community services respond to migration patterns? Inmigration of whites to central cities might be expected to reduce infant mortality rates in these areas. This is not the case. Just how new migrants find out about available services, (i.e., the inner city communication network) is an important, and largely unexplored variable

in the utilization of these services. How do such factors as size, homogeneity, and density influence communications?

4. A significant attempt should be made to determine the actual underreporting that occurs in infant mortality statistics. Any data that could be used to prompt a revision of the current methods of reporting infant deaths (i.e., through registrars) would be valuable. The suggestion that hospitals be responsible for vital event reporting has considerable merit.

5. The 1968 revision of the vital events certificates especially the certificates for fetal death, live birth, and infant death, should be considered as a possible data source. For example, information on previous deliveries, education, prenatal visits, and legitimacy could be used to gain insight into the infant mortality question.

6. Infant mortality data, when adequately collected could be a sensitive indicator of living conditions. Examination of data from the so called new cities, public housing projects, or urban redevelopment areas may be especially revealing.

7. As Shapiro, Schlesinger, and Nesbitt[20] have pointed out, the attainment of an infant mortality rate of 18-20 per 1000 is a realistic short term goal for the nation. The attainment of this goal, however, should be obtained in the most efficient manner possible. This process could provide much information on the elements involved in the mortality problem. Specifically, prospective epidemiological studies need to be conducted to isolate important contributing variables which could then become the focal point of preventive programs.

8. While education, income and the nature and extent of prenatal care are probably significantly correlated, few investigators have taken groups of factors, and attempted to relate (or control), these while examining other variables.

9. Retrospective studies will continue to provide a great deal of information concerning health problems but the consideration of carefully designed long term prospective studies may have considerably more payoff.

10. While aspects of the physical environment might provide initial and more easily conducted explorations of high infant mortality rates, it is equally important that aspects of the socio-cultural environment be given careful consideration.

Not only is infant mortality the product of both the physical and socio-cultural environment but the physical environment affects the socio-cultural environment and vise versa. Factors such as allergenic air pollutants, zoonoses, noise, controlled environments, heat, nutrition, and forms of social control and leadership, marital relationships, institutional behavior, specific attitudes and practices, all need to be considered. The real problem is that many of the factors that might be most critical can not yet be effectively measured. Until techniques of measurement are perfected, their significance can never be determined.

11. There is a need to establish a record of all work being done in this general area to avoid duplicated effort and also to pool learnings.

12. The initial use of mapping techniques such as those described by Gabrielson et al.,[21] and Donahedian et. al.,[22] need to be duplicated in other areas and used more extensively.

13. Infant mortality data are only one source of measuring the status of health within a community. Other indexes, or new indexes should be explored and developed in an attempt to better equate health status.

REFERENCES

1. B. S. Saunders, "Measuring Community Health Levels," American Journal of Public Health, 54, 1963-1070, 1964.

2. C. L. Chiang, In Index of Health, Mathematical Models, Vital and Health Statistics, PHS Publication No. 1000 - Series 2, No. 5, National Center for Health Statistics, Public Health Service, Washington, D. C., U.S. Government Printing Office, May, 1965.

3. Helen C. Chase, International Comparison of Prenatal and Infant Mortality, Vital and Health Statistics, PHS Publication No. 1000 - Series 2, No. 5, National Center for Health Statistics, Public Health Service, Washington, D. C., U.S. Government Printing Office, March, 1967, p. 2.

4. "President Johnson's Special Message to Congress on Children and Youth," New York Times, February 9, 1967.

5. Mary A. McCarthy, Infant, Fetal and Maternal Mortality, Vital and Health Statistics, PHS Publication No. 1000 - Series 20, No. 3, National Center for Health Statistics, Public Health Services, Washington, D. C., U. S. Government Printing Office, September, 1966, p. 29.

6. Infant,Fetal and Maternal Mortality, p. 2.

7. Eleanor P. Hunt, Recent Trends and Their Effects on Maternal and Child Health Needs and Services, Welfare Administration, Children Bureau, U. S. Department of Helath, Education and Welfare, Washington, D. C., U. S. Government Printing Office, 1966, p. 5.

8. Natality Statistics Analysis, p. 20-22.

9. International Comparison of Perinatal and Infant Mortality, p. 2.

10. Infant and Perinatal Mortality in the United States, p. 14.

11. Avedis Donabedian, Leonard S. Rosenfeld, and Edward M. Southern, "Infant Mortality and Socioeconomic Statis in a Metropolitan Community," Public Health Reports, 80, 1083-1094, 1965.

12. Infant, Fetal and Maternal Mortality, p. 2.

13. Infant and Perinatal Mortality Rates by Age and Color, 1956 - 1960; 1961 - 1965, U. S. Department of Health, Education and Welfare, Children's Bureau and George Washington University, Operational and Demographic Analysis for Maternal and Child Health Project, Washington, D. C., The Children's Bureau, 1968.

14. Donabedian, Rosenfeld, and Southern, 1083-1094.

15. Donabedian, Rosenfeld, and Southern, 1086.

16. Donabedian, Rosenfeld, and Southern, 1092.

17. Carl L. Erhardt, Harold Abramson, Jean Pakter, and Frieds Nelson, "An Epidemiological Approach to Infant Mortality," Archives of Environmental Health, 20, 743-757, 1970.

18. Charles S. Wilder, Physician Visits, July, 1966 - July, 1967, Vital and Helath Statistics, PHS Publication No. 1000 - Series 10, No. 49, National Center for Health Statistics, Public Health Service, Washington, D. C., U. S. Government Printing Office, November, 1968, p. 5-6.

19. Ira W. Gabrielson, Estelle Siker, Katherine B. Sohler, and Edward G. Stockwell, "Relating Health and Census Information for Health Planning." American Journal of Public Health, 59, 1169-1176, 1969.

20. Sam Shapiro, Edward L. Schlesinger, and Robert Nesbitt, Infant, Perinatal Maternal, and Childhood Mortability in the United States, Cambridge, Harvard University Press, 1968, p. 138.

21. Gabrielson, et al., 1169 - 1176.

22. Donabedian, et al., 1084-1087.

INTERNAL DISTRIBUTION

1. Biology Library
2-4. Central Research Library
5-104. Civil Defense Project Library
105. MIT Practice School
106-107. ORNL, Y-12 Technology Library Document Reference Section
108-158. Laboratory Records Department
159. Laboratory Records, ORNL-RC
160. J. A. Barker
161. C. Blake
162. W. J. Boegly
163. R. A. Bohm
164. J. C. Bresee
165. V. R. Cain
166. D. Chapman
167. J. Curlin
168. M. M. Clarke
169. J. H. Gibbons
170. M. L. Levin
171. J. L. Liverman
172. K. P. Nelson
173. N. M. Newman
174. D. A. Patterson
175. W. W. Pendleton
176. P. D. Postma
177. W. A. Thomas
178. D. B. Trauger
179. D. G. Rose
180. E. P. Wigner
181. A. M. Weinberg
182. H. A. Wright

EXTERNAL DISTRIBUTION

183. Thomas H. Atkinson, University of Toronto, Toronto, Canada
184. Calvin Beale, Director of Population Research, Department of Agriculture, Washington, D. C. 20250
185. Brian Berry, Center for Urban Studies, University of Chicago, 5848 University Avenue, Chicago, Illinois 60637
186. M. D. Betz, Dept. of Sociology, University of Tennessee, Knoxville, Tennessee 37916
187. D. B. Birch, Professor of Economics, Harvard Business School, Soldier's Field, Mass. 02163
188. Tasso Christie, Supervising Psychologist, Board of Education, 644 Albert St. East, Sault Ste. Marie, Ontario, Canada
189. James Cliatt, Office of Economic Opportunity, Atlanta, Georgia
190. T. H. Clarke, Jr., 1824 Hearst, Berkeley, California 94703
191-215. Wyndhan Clarke, Director, Research on Planning for Urban Growth Division, Dept. of Housing and Urban Development, Washington, D. C.
216. William H. Creswell, Jr., Dept. of Health and Safety, Huff Gymnasium, University of Illinois, Champaign, Illinois 61820
217. M. Coveyou, 400 Kendrick Road, Apt. 170, Rochester, N. Y. 14620
218. Louise Cureton, 2008 Velmetta Circle, Knoxville, Tennessee
219. Ted Dappen, Nebraska Dept. of Public Health, Capitol Building, Lincoln, Nebraska 68509
220. Henry David, Executive Secretary, Division of Behavioral Sciences, National Academy of Sciences, 2101 Constitution Avenue, Washington, D. C.
221-230. L. J. Deal, Chief, Civil Effects Branch, Div. of Biology and Medicine, USAEC, Washington, D. C.

EXTERNAL DISTRIBUTION (cont'd.)

231. Marvin Dunn, Educational Psychologist, University of Tennessee, Knoxville, Tennessee
232. G. Franklin Edwards, Professor of Sociology, Howard University, Washington, D. C.
233. Carl Feiss, Architect and Planning Consultant, 1250 Connecticut Avenue, N. W., Washington, D. C.
234. H. B. Finger, Assistant Secretary, Research and Technology, Housing and Urban Development, Washington, D. C.
235. Samuel Fuenning, Medical Director, University Health Center, University of Nebraska, Lincoln, Nebraska 68508
236. James Gober, Regional Planning Staff, 202 Mall Building, TVA, Knoxville, Tennessee
237. A. J. Gray, 5th Floor, Ironstone Building, TVA, Knoxville, Tennessee
238. Richard Hammer, University Health Center, University of Nebraska, Lincoln, Nebraska 38508
239. Howard Harrenstien, Associate Dean, College of Engineering, 2565 The Mall, University of Hawaii, Honolulu, Hawaii 96822
240. P. K. Howard, Ford Foundation, New York, N. Y.
241. Jonathon Howes, Director of Urban Policy, Urban America, Inc., 1717 Massachusetts Ave., N. W., Washington, D. C. 20036
242. Howard Hoyman, Dept. of Health and Safety, Huff Gymnasium, University of Illinois, Champaign, Illinois 61820
243. Mrs. Calista Hughes, Comprehensive Health Planning, Office of Planning and Programming, State Capitol Building, Lincoln, Nebraska 68509
244. Robert Irwin, Hamilton Teachers College, Hamilton, New Zealand
245. K. B. Kenny, Graduate School of Planning, University of Tennessee, 1515 W. Cumberland Avenue, Knoxville, Tenn. 37916
246. F. R. Kirby, Kansas City Department of City Planning, Kansas City, Missouri
247. Robert Kirk, Chairman of Health and Safety, University of Tennessee, Knoxville, Tennessee 37916
248. Miss Celeste Knipmeyer, University of Nebraska, University Health Center, Lincoln, Nebraska 68508
249. E. S. Lee, Institute for Behavioral Research, University of Georgia, Athens, Ga. 30601
250. Charles Levin, Professor of Economics, Washington University, St. Louis, Missouri
251. C. M. Lockhart, 256 Hill Street, Athens, Georgia 30601
252. Professor James Lotz, Canadian Research Center for Anthropology, St. Paul University, 223 Main Street, Ottawa, Ontario, Canada
253. Daniel Mandelker, Professor of Law, Washington University, St. Louis, Missouri
254. Gary Martin, University Health Center, University of Nebraska, Lincoln, Nebraska 68508
255. Mrs. Mary Martin, University Health Center, University of Nebraska, Lincoln, Nebraska 68508

EXTERNAL DISTRIBUTION (Cont'd.)

256. Cyrus Mayshark, Associate Dean, College of Education, University of Tennessee, Knoxville, Tennessee 37916
257. W. G. McMillan, Professor of Chemistry, Department of Chemistry, University of California, Los Angeles, California 90024
258. J. T. McComas, College of Education, University of Tennessee, Knoxville, Tennessee 37916
259. Donald J. Merki, Associate Professor, Texas Women's University, Denton, Texas 76201
260. Gerald Moeller, Director, Evaluation and Research, Board of Education, 1517 South Theresa Street, St. Louis, Missouri 63104
261. J. R. Moore, Dept. of Economics, University of Tennessee, Knoxville, Tennessee 37916
262. J. L. Neufeld, 207 Mosely Street, Apt. 6, Ann Arbor, Michigan 48103
263-282. Ian Newman, University Health Center, University of Nebraska, Lincoln, Nebraska 60508
283. Hoyt Oliver, Department of Health and Safety, University of Tennessee, Knoxville, Tennessee 37916
284. Oscar A. Ornati, Graduate School of Business Administration, 100 Trinity Place, New York University, New York, N. Y. 10006
285. C. E. Patterson, Jr., Department of Political Science, University of Tennessee, Knoxville, Tennessee 37916
286. D. A. Patterson, Department of Economics, University of Tennessee, Knoxville, Tennessee 37916
287. Joseph Patterson, Associate Professor of Health Education, University of Washington, Seattle, Washington 89105
288. W. W. Pendleton, Ford Foundation, New York, N.Y.
289. John Peper, Director, Evaluation and Research, Board of Education, 21st Street, South of Parkway, Philadelphia, Pennsylvania 19103
290. J. L. Ramsey, 97 Orange Lane, Oak Ridge, Tennessee 37830
291. Demitri Shimkin, Professor of Anthropology and Geography, University of Illinois, Urbana, Illinois
292-296. A. R. Siegel, Director, Division of Environmental Factors and Public Utilities, Housing and Urban Development, Washington, D. C.
297. Frances Silver, 107 Lehigh Avenue, Oak Ridge, Tennessee 37830
298. A. W. Stuart, University of North Carolina, Chapel Hill, N. C.
299. Gordon Sutton, University of Massachusetts, Department of Sociology, Amherst, Mass.
300. Dorothy Stulberg, 104 Woodridge Lane, Oak Ridge, Tennessee 37830
301. Richard Sturgis, Department of Sociology, 920 McClung Tower, University of Tennessee, Knoxville, Tennessee 37916
302. James Tarver, Professor of Sociology, Population Studies Center, University of Georgia, Athens, Georgia
303. Edward Teller, Associate Director, Lawrence Radiation Laboratory, Livermore, California 94550

EXTERNAL DISTRIBUTION (Cont'd.)

304. Wilbur Thompson, Department of Economics, Wayne State University, Detroit, Michigan 48202
305. S. F. Weiss, Center for Urban and Regional Studies, University of North Carolina, Chapel Hill, North Carolina
306. Helen Westerberg, Health Education Division, George Williams College, Downers Grove, Illinois 61515
307. Carol Zigelopher, c/o Lista De Correos, Ibdza Baleares, Spain
308-309. Division of Technical Information Extension, USAEC, Oak Ridge, Tennessee
310. Laboratory and University Division, ORO