Divergence of the Recent Trends in Coronary Mortality for the Four Major Race-Sex Groups in the United States

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Abstract: Since 1976 there has been a leveling off or slowdown in the rate of decline in coronary heart disease (CHD) mortality. The age-adjusted absolute annual rate of decline in CHD mortality rates during 1968–75 (Δ rate/100,000 population/year) was virtually identical for White males (−7.54), Black males (−7.85), and Black females (−7.20), and somewhat lower for White females (−4.25). During 1976–85, however, the secular trends diverged considerably. Age-adjusted rates continued to decline at the same annual rate for White males, while the decline was approximately half as steep for the other thre race-sex groups. During 1976–85 there was also a leveling off in the average annual per cent change in age-adjusted CHD mortality for Black males and females and White females when compared to 1968–75, while there was no change for White males. As a result, more than 40,000 White and Black females and Black males died of CHD in 1985 than would have died if CHD rates would have continued to decline at the 1968–75 trends. All comparisons were based on a reclassification of cause-of-death codes to maximize comparability between the 8th and 9th Revisions of the International Classification of Disease. These results suggest that the factors which have led to the continued decline in coronary heart disease may not have influenced all the demographic groups in this country equally over the last decade. (*Am J Public Health* 1988; 78:1422–1427.)

Introduction

Rapidly changing patterns of mortality from coronary heart disease (CHD) have been recognized in a wide range of countries over the last three decades.[1–3] Beginning in the mid-1960s, a tendency has been observed for countries with the highest rates to experience a rapid and consistent decline in mortality, most notably in the United States, Canada, Australia, New Zealand, and Finland, while Eastern Europe and the Soviet Union, which entered this period with lower rates, have seen a marked upturn in death rates from CHD.[3–6]

Although preventive campaigns and changes in the prevalence of risk factors for CHD may have contributed to the decline in the US, it has not been possible to provide precise estimates of all the factors affecting the downward trend in CHD mortality rates.[7–9] The prevalence and changes in the prevalence of the coronary risk factors have not been the same among the four major race-sex groups of the US[8,10–12]; it is therefore important to examine the secular trends in CHD mortality by sex and race to determine whether the changes are the same for the four groups.

Around 1980 it appeared that the decline in mortality for adults from all causes combined had slowed in the US, with a brief increase recorded for Blacks.[13] Since CHD is by far the most important single disease category determining adult mortality rates in the US, and it has been the primary component of significant secular trends in all-causes mortality, we examined trends in CHD mortality for the four major race-sex groups in the US with the hope of gaining insight into the two important questions: Has the decline in CHD mortality continued at the same rate in the 1980s? Has it continued at the same rate for each of the four largest race-sex groups?

Methods

Data Sources and Definitions

Age-adjusted and age-specific CHD mortality data for the four major race-sex groups were obtained from vital statistics data tabulated by the National Center for Health Statistics for the years 1968–85. Age-adjusted rates were computed by the direct method using the total US population of 1940 as the standard. During 1968–78 deaths were coded using the 8th revision of the International Classification of Diseases Adapted for Use in the United States (ICDA 8) and during 1979–85 they were coded using the 9th Revision of the ICD (ICD 9). We adjusted for the lack of comparability in coding rules between the two revisions by including in CHD for 1979–85 those ICD 9 categories that, for the most part, would have been coded in CHD categories in ICDA 8.[14] As a result, CHD during 1968–78 was defined using the category numbers for Ischemic Heart Disease (ICDA Nos. 410–413) and during 1979–1985 it was defined as the sum of Ischemic Heart Disease (ICD Nos. 410–414), Hypertensive Heart Disease (ICD No. 402), and Cardiovascular Disease Unspecified (ICD No. 429.2) (See Appendices Tables 1 and 2).

Because there was no break in comparability for Acute Myocardial Infarction (MI) and Diseases of Heart between the two revisions those two categories were used to confirm the trends for CHD.[14] Acute MI, a category within CHD, was coded using category No. 410 during both revisions. Diseases of Heart, a more general category which includes CHD, was defined during the 8th Revision as ICDA Nos. 390–398, 402, 404, 410–429 and during the 9th Revision as ICD Nos. 390–398, 402, 404–429.

Statistical Methods

Linear regression was used to compare the slopes for both the *absolute* and *relative* rates of change in CHD mortality.[15–17] The *absolute* rate of change in CHD mortality was calculated as the change in the age-adjusted mortality rate/100,000 population/year. A log-linear model, which assumes that there is a constant proportional or *relative* change, was used to calculate the average annual per cent change.[17] Data for Figure 1 and Tables 1, 2 and 4 were calculated using the entire age range, and for Table 3 they were calculated only for people ages 35–74.

Because of the prior work that found evidence for a slowdown in the decrease in all cause mortality,[13] we anticipated that the slope or rate of decline in CHD during 1976–85 would be less than during 1968–75, i.e., that mortality rates for CHD decreased at a slower rate during 1976–

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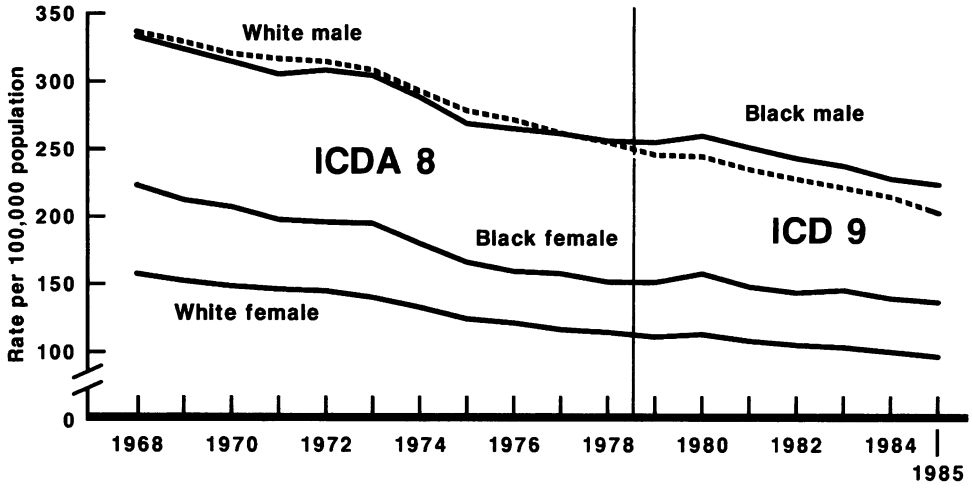
Editor's Note: See also related editorial p 1415 this issue.



NOTE: Coronary Heart Disease: 1968-78 (ICDA 8), ICDA Nos. 410-413; 1979-84 (ICD 9), ICD Nos. 410-414, 402, 429.2
SOURCE: Prepared by authors using data from NCHS, Division of Vital Statistics

FIGURE 1—Trends in age-adjusted Coronary Heart Disease for all ages, United States, 1968–84.

85 than during 1968–75. But, since it is important to monitor any change in mortality trends a two-sided t-test was used in comparing the slopes from the two periods. Statistical significance was set at the 0.05 level with a critical t-value (df = 14) of 2.145. To examine the effects of our reclassification of CHD during ICD 9, the same procedures were used to compare slopes for the periods 1968–78 and 1979–85. However, because we were examining trends in CHD mortality over a relatively short period of time, we emphasize consistency in the data more than statistical significance.

To investigate the impact of our recategorization of the mortality data coded under the 9th Revision on the analysis of CHD trends, comparisons were also made using first the original 9th ICD classification for Ischemic Heart Disease (ICD Nos. 410–414) and then adding incrementally Hypertensive Heart Disease (ICD No. 402) and Cardiovascular Disease Unspecified (ICD No. 429.2) (Table 1). The values for either absolute or relative rate of change in CHD mortality were not changed by including the other two categories. Addition of Hypertensive Heart Disease and Cardiovascular Disease Unspecified to Ischemic Heart Disease minimized the discontinuity between the two ICD periods without affecting the trends during 1979–85.

Projected age-adjusted CHD mortality rates for 1985 were determined using the race-sex specific regression equations for 1968–75. Excess CHD mortality associated with the slowing up in the rate of decline after 1975 was estimated by comparing the observed and the projected age-adjusted rates for 1985. The observed age-adjusted rate minus the projected one divided by the observed was used to define the percentage excess in age-adjusted mortality. The excess number of CHD deaths in 1985 was calculated by multiplying the percentage excess in the age-adjusted rates by the observed number of CHD deaths for the year 1985.

TABLE 1—Absolute and Relative Changes in Coronary Heart Disease Mortality During the Period of ICDA 8-1968–78 and the period of ICD 9-1979–85 by ICD Category Numbers, Race and Sex: United States, 1968–85

Periods	ICD Code Numbers	White		Black	
		Males	Females	Males	Females
		Absolute Rate of Change per 100,000 Population per Year			
1968–78	410–413	−8.45	−4.51	−8.02	−7.29
1979–85	410–414	−6.87	−2.37	−5.17	−2.18
	410–414,402	−6.95	−2.51	−5.49	−2.60
	410–414,402,429.2	−7.15	−2.65	−6.16	−2.96
		Average Annual Per Cent Change			
1968–78	410–413	−2.83	−3.30	−2.72	−3.89
1979–85	410–414	−3.37	−2.59	−2.84	−2.00
	410–414,402	−3.33	−2.63	−2.69	−2.07
	410–414,402,429.2	−3.12	−2.50	−2.53	−2.02

NOTES: All rates were age-adjusted by the direct method using the total US population of 1940 as the standard.
SOURCE: Prepared by authors using data from the NCHS, Division of Vital Statistics.

Results

CHD mortality rates (age-adjusted) have declined in the US for all four of the major race-sex groups throughout 1968–85 (Figure 1). A break or leveling off in the trend lines for White females, and for Black males and females appears around 1976, while there is no discernible break or leveling off for White males. (The rises in mortality discernible in 1972–73 and 1980 are related to increases in CHD mortality during influenza epidemics.)

With Black males and females and White females, both the absolute and the relative rates of decline after 1975 were slower than during the period 1968–75 (Table 2). Black females experienced the greatest leveling off in CHD mortality in both absolute and relative terms, followed by White females, and then by Black males. White males did not experience a slowdown; in fact there was evidence of an increase in their rate of decline.

We replicated the analysis shown in Table 2 for ages 35 through 74 years (Table 3). The age-adjusted data for this restricted age range support the hypothesis of a slowdown in the rate of decline in CHD mortality after 1975 for White and Black females and Black males, although, the results for Black males, were not "statistically significant". Furthermore, results consistent with Table 2 were found when

TABLE 2—Change in Age-adjusted Mortality Rates for Coronary Heart Disease for all Ages between 1968–75 and 1976–85: United States, 1968–85

Periods	White		Black	
	Males	Females	Males	Females
	Absolute Rate of Change per 100,000 Population per Year			
1968–75	−7.54	−4.25	−7.85	−7.20
1976–85	−7.16	−2.52	−4.57	−2.41
t	(0.53)	(4.40)	(3.05)	(6.47)
	Average Annual Per Cent Change			
1968–75	−2.42	−2.97	−2.57	−3.64
1976–85	−2.99	−2.30	−1.86	−1.62
t	(−2.24)	(2.07)	(1.76)	(4.56)

NOTES: All rates were age-adjusted by the direct method using the total US population of 1940 as the standard; Coronary Heart Disease: 1968–78 (ICDA 8) ICDA Nos. 410–413; 1979–85 (ICD 9) ICD Nos. 410–414, 402, 429.2; t—statistic for two-sided t-test on the difference between the two specified periods, $t_{0.05}$ (d.f. = 14) = 2.145.

SOURCE: Prepared by authors using data from the NCHS, Division of Vital Statistics.

age-adjusted trends for Acute MI and Disease of Heart were compared between 1968–75 and the 1976–85 (data available from authors).

Age-specific trends are also shown in Table 3. Black women experienced an absolute and relative slowdown across all age groups, while the slowdown among White women appeared to be present in only the older age groups. An absolute slowdown was present in all age groups for Black men, while the relative changes in CHD mortality do not follow a clear pattern.

The excess mortality associated with the slow down in CHD mortality rates is shown in Table 4. Black females had a mortality rate from CHD in 1985 that was 27 per cent higher than the rate projected from the 1968–75 trend; White females and Black males had rates that were approximately 10 per cent higher. Based on the percentage changes in age-adjusted mortality, there were an estimated 40,000 more CHD deaths for White and Black females and Black males in 1985 than there would have been had the 1968–75 trend continued. The majority of these deaths (30,000) were of White females.

Discussion

One of the more remarkable features of the decline in CHD mortality that began in the US in the mid-1960s was its virtually simultaneous onset and similar relative magnitude of decline in the four major race-sex groups, and across the entire age range where deaths from this disease occur.[1,2] The analysis presented here suggests that this pattern of decline began to change significantly in the mid-1970s and, although age-adjusted CHD mortality rates continued in a downward trend for each of the four demographic groups, the rapid rate of decline observed from 1968–75 has persisted only for White males.

Regardless of whether we classified deaths during 1979–85 to minimize the effect of changing from ICDA 8 to ICD 9, used 1979–85 or 1976–85 as the second time period, or used absolute or per cent changes, the results were the same. The rate of decline has not slowed for White males and has slowed for females of both races and to a lesser extent for Black males.

We do not believe that the divergence of CHD trends is a result of coding changes that were instituted in 1979 with the introduction of ICD 9. The divergence began around 1975–76, three years before the introduction of ICD9, and the trends for 1976–85 were very similar to those for 1979–85. Moreover, the results for all ages (Table 2) were similar to the results where the analysis was restricted to persons ages 35–74 years (Table 3). Finally, the same results were found for Acute MI and Diseases of Heart, two disease categories with no discontinuity between the two ICD periods.

The major difficulty in evaluating CHD trends in the US, in the absence of long-term community-based myocardial infarction registries, remains the validity of the death certificate.[19–23] We can find no evidence that secular trends over the last two decades have been influenced by significant changes in patterns of reporting cause of death by medical practitioners. More important is whether a systematic bias in reporting for the different race-sex groups[24] exists and has changed, or whether changes in the classification system alter the final code assigned. There is evidence, albeit less than satisfactory, that Blacks have a higher proportion of out-of-hospital deaths from CHD[25–28a] than Whites. Comparison of death certificate data and hospital admissions in at least three communities support this contention,[25–27] and findings from the pilot phase of the Community and Cohort Surveillance Project also suggest that a higher proportion of CHD deaths among Blacks occur out of the hospital.[29] It has also been demonstrated recently that the delay before receiving medical care during the acute phase of MI is longer among a group of Blacks seen at a large urban municipal hospital than previously reported for Whites.[30] None of these studies, addressed the issue of change over time in coding these deaths, however.

Why are the death rates from CHD no longer falling at the same rate for all the four race-sex groups? Any attempt to analyze the decline in CHD mortality must take into account changes in the incidence of the disease and case-fatality rates.[7] A variety of community-based studies have suggested that the major factor in the US CHD trends during 1968–80 has been the decrease in incidence.[20,22,31–33] However, recent reports have suggested that the incidence of MI, as estimated by hospital admissions, may have increased in recent years;[34,35] although this could be an artifact resulting from more people with acute MIs reaching the hospital alive. Conflicting evidence also exists about the improvement in acute case-fatality rates from MI and the long-term prognosis. Data from two community surveys in Minnesota[32,36,37] from the National Hospital Discharge Survey,[35] and from DuPont[31] suggest a fall in case-fatality rates, while summary data for hospitals in Boston[38] and the Health Insurance Plan of New York[39] suggest no change.

If the leveling off in CHD mortality which we have observed is a result of changes in the trends in incidence of CHD then this should be reflected in changes in the distributions of major CHD risk factors, such as serum cholesterol, overweight, hypertension, and cigarette smoking. The best sources of data on risk factor levels in the US population—the National Health and Nutrition Examination Survey (NHANES) and the National Health Interview Survey—are inconsistent.[8,10,40,41] Between the midpoints of NHANES I (1974) and NHANES II (1978), mean serum cholesterol levels were estimated to have decreased by approximately 3–4 mg/100 ml for White and Black men and Black women, and 1 mg/100 ml for White women.[10] During that same time period, the prevalence of overweight remained unchanged for Black and

TABLE 3—Change in Mortality Rates for Coronary Heart Disease† for Persons Ages 35–74 Years during 1968–75 and 1976–84: United States, 1968–85

	White Men		White Women		Black Men		Black Women	
Age Group	1968–75	1976–85	1968–75	1976–85	1968–75	1976–85	1968–75	1976–85
	Absolute Rate of Change per 100,000 Population per Year							
35–74*	−14.52	−14.11	−6.26	−3.39#	−14.96	−11.27	−13.36	−5.93#
35–44	−3.01	−2.40#	−0.48	−0.41	−6.43	−2.96#	−3.94	−1.45#
45–54	−8.21	−9.61	−1.69	−1.50	−9.27	−9.85	−8.68	−5.37#
55–64	−22.39	−22.11	−7.10	−4.50#	−26.17	−17.52	−24.06	−6.96#
65–74	−50.02	−45.42	−32.60	−14.73#	−34.68	−28.28	−34.07	−18.44#
	Average Annual Per Cent Change							
35–74*	−2.62	−3.41	−3.26	−2.36#	−2.48	−2.36	−3.65	−2.27#
35–44	−3.82	−4.57	−3.21	−4.13	−5.07	−3.33#	−6.45	−4.24#
45–54	−2.54	−4.08	−2.51	−2.90	−2.25	−3.00	−4.19	−3.72
55–64	−2.57	−3.42	−2.75	−2.25	−2.77	−2.28	−4.22	−1.70#
65–74	−2.55	−3.04	−3.64	−2.24#	−1.86	−1.91	−2.64	−1.93

*Rates were adjusted by the direct method using the total US population of 1940 as the standard.
†Coronary Heart Disease: 1968–78 (ICDA 8) ICDA Nos. 410–413; 1979–85 (ICD 9) ICD Nos. 410–414, 402, 429.2.
#$p < 0.05$, for two-sided t-test $t_{0.05}$ (d.f. = 14) = 2.145 between 1968–75 and 1976–85.
SOURCE: Prepared by authors using data from the NCHS, Division of Vital Statistics.

White women and increased somewhat for Black and White men.[41] The prevalence of definite hypertension (BP ≥160/95 mm Hg and/or currently taking antihypertensive medication) during the period from 1974 to 1978 increased slightly (1–2 per cent) for White males and females and decreased by approximately 3–4 per cent for Black males and females.[42] Finally, between 1965 and 1976 rates of current smoking have decreased by 10 per cent for both Black and White men while there have only been small changes for Black and White women.[41]

Considering simultaneous changes in serum cholesterol, smoking, and blood pressure between 1974 and 1978 yields a somewhat different picture, however.[40] In this case, the impact of the changes in these three risk factors for persons ages 35–74 years was assessed by comparing the percentage decrease in observed CHD mortality between midpoints of NHANES I (1974) and NHANES II (1978) with the expected percentage change in CHD. The expected change in CHD mortality was estimated based on each individuals' levels of the three risk factors in both surveys by using a multiple logistic model derived from the Framingham data. The changes in risk factors explained 50 per cent or more of the observed decrease in CHD mortality between the two surveys. Thus, on a national level, small simultaneous changes in multiple risk factors can have important effects.

TABLE 4—Comparison of Observed CHD Mortality for all Ages in 1985 with Mortality Projected from Trends during 1968–75

		Age-adjusted Rate (per 100,000 Population)		Difference in Mortality	
Race	Sex	Observed	Projected	Rate (%)	Number of deaths
White	Males	204.4	210.1	−2.8	−8,327
	Females	96.6	85.9	+11.1	+29,973
Black	Males	222.7	199.5	+10.4	+3,000
	Females	136.4	99.8	+26.8	+7,496

NOTES: All rates were age-adjusted by the direct method using the total US population of 1940 as the standard; Coronary Heart Disease: 1968–78 (ICDA 8) ICDA Nos. 410–413; 1979–85 (ICD 9) ICD Nos. 410–414, 402, 429.2; Difference in mortality: Rate (%) = (observed − projected/observed) × 100; Number of deaths = (observed − projected).
SOURCE: Prepared by authors using data from the NCHS, Division of Vital Statistics.

Other factors, such as competing cause effects and access to medical care, could alter these relationships. Additionally, such factors as economic trends and socioeconomic status or social class may also play a substantial role in changes in CHD mortality trends.[43–52]

Our purpose in this study was to document the divergence in CHD mortality trends and the slowing of the rate of decline for three of the four major race-sex groups in the United States. The public health importance of the slowing in rates of decline is evidenced by the approximately 40,000 excess CHD deaths of White females and Black males and females that would not have occurred if mortality rates had continued at the rates observed during 1968–75. The results emphasize the need for increased efforts aimed at primary and secondary prevention and access to appropriate treatment in Blacks and in White females, while maintaining and improving upon the gains already made in White males.

ACKNOWLEDGMENTS

It is a pleasure to thank Drs. Manning Feinleib, Richard Havlik, and Richard Gillum and Mr. Robert Israel for the many helpful comments and suggestions they made.

Data through 1983 were presented in part at the 59th Scientific Sessions of the American Heart Association, Dallas, Texas, November 17–20, 1986.

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(continued)

APPENDIX TABLE 1—Age-adjusted Mortality Rates per 100,000 Population for Ischemic Heart Disease: United States 1968–85

	White		Black	
Years	Males	Females	Males	Females
ICDA 8 Category Nos. 410–413				
1968	336.6	157.6	332.9	223.2
1969	329.1	152.4	323.6	212.3
1970	320.3	148.5	314.5	207.1
1971	316.4	146.2	305.1	197.6
1972	314.2	144.8	307.9	195.6
1973	308.1	140.1	303.9	194.7
1974	292.4	132.9	287.8	179.6
1975	277.9	124.3	268.4	165.8
1976	271.1	121.4	264.5	159.2
1977	261.2	116.5	260.8	157.5
1978	254.2	114.5	255.4	151.3
ICD 9 Category Nos. 410–414				
1979	219.8	96.0	190.5	111.0
1980	218.0	97.4	196.0	116.1
1981	209.1	93.2	188.8	110.1
1982	203.0	90.9	182.2	106.9
1983	195.7	89.0	175.8	106.8
1984	187.0	86.0	168.5	102.6
1985	180.8	82.9	164.9	100.8

NOTE: All rates were age-adjusted by the direct method using the total US population of 1940 as the standard.
SOURCE: NCHS, Division of Vital Statistics.

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APPENDIX TABLE 2—Age-adjusted Mortality Rates per 100,000 Population for Hypertensive Heart Disease and Cardiovascular Disease Unspecified, and their Sum with Ischemic Heart Disease by Race and Sex: United States, 1979–85

	White		Black		White		Black	
Year	Males	Females	Males	Females	Males	Females	Males	Females
	Hypertensive Heart Disease ICD No. 402				Cardiovascular Disease Unspecified ICD No. 429.2			
1979	5.0	4.2	22.6	18.1	20.1	11.0	41.1	21.9
1980	5.0	4.1	21.8	17.5	20.6	11.5	41.2	23.8
1981	5.0	3.9	21.9	16.5	20.0	11.0	39.6	21.1
1982	4.8	3.8	21.6	16.1	19.2	10.5	38.3	20.4
1983	4.8	3.6	21.6	16.0	20.0	10.8	39.0	22.3
1984	4.6	3.5	20.7	15.7	19.5	10.6	37.7	20.8
1985	4.6	3.4	20.5	15.5	19.0	10.3	37.3	20.1
	Ischemic Heart Disease + Hypertensive Heart Disease				Ischemic Heart Disease + Hypertensive Heart Disease + Cardiovascular Disease Unspecified			
1979	224.8	100.2	213.1	244.9	111.2	254.2	151.0	
1980	223.0	101.5	217.8	133.6	243.6	113.0	259.0	157.4
1981	214.1	97.1	210.7	126.6	234.1	108.1	250.3	147.7
1982	207.8	94.7	203.8	123.0	227.0	105.2	242.1	143.4
1983	200.5	92.6	197.4	122.8	220.5	103.4	236.4	145.1
1984	191.6	89.5	189.2	118.3	211.1	100.1	226.9	139.1
1985	185.4	86.3	185.4	116.3	204.4	96.6	222.7	136.4

NOTES: All rates were age-adjusted by the direct method using the total US population in 1940 as the standard; Ischemic Heart Disease; 1979–84 (ICD 9) ICD Nos. 410–414.
SOURCE: Prepared by authors using data from NCHS, Division of Vital Statistics.

Rural Hospital Closures May Harm the Elderly

The closure of rural hospitals may hold serious implications for the very old living in rural areas of the United States. According to a research study published in the July issue of the *Journal of Rural Health,* such closures could have a critical impact on the rural elderly. The study, sponsored by the National Center for Health Services Research (NCHSR), analyzed distances traveled for hospital care by rural area residents in New York State. Few residents in the 75+ age group traveled beyond the county line for care. Most were hospitalized locally. Only 18 per cent crossed a county line to get care, compared with 31 per cent of those younger than age 75. Overall, 29 per cent of the State's rural inhabitants went outside their home county for hospital care. Two-thirds of this group went to urban medical centers.

The study, entitled "Patterns of Travel for Rural Individuals Hospitalized in New York State: Relationships between Distance, Destination, and Casemix," was conducted by Christopher Hogan, PhD, a former researcher at NCHSR. Reprints of the study are available from NCHSR Publications and Information Branch, Parklawn Building, Room 18-12, Rockville, MD 20857. Tel: (301) 443-4100.