CHAPTER 4 CORRELATION OF HEALTHCARE COST, COVERAGE, AND ACESS (HCCA) INDEX with HEALTH STATUS, ECONOMY AND PERSISTENT POVERTY

4.1 APPALACHIA

This chapter explores the relationship of economic disparity to the HCCA, and the relationship of both to the outcome measure, Years of Productive Life Lost under age 75 per 100,000 population. It also looks at the variation in HCCA when data are filtered for persistent poverty. As noted in Chapter 3, one or more of the health access components register low for counties in every Appalachian state. Although both Appalachian South Carolina and Appalachian Maryland rank average to above average on the HCCA, some Appalachian counties in both states rank below average on health insurance coverage (HIC). ARC counties that rank lowest on the HCCA concentrate in rural areas:

- Northern West Virginia

- Western Appalachian Kentucky

- Western-most Appalachian North Carolina

- Western Appalachian Tennessee

- Northern Georgia

- Appalachian Mississippi

- Appalachian Alabama outside the Birmingham metro area

In nine states, Appalachian counties fall below average on healthcare cost (HCC); and in four states, Maryland, North and South Carolina and Ohio, Appalachian counties fall in the average or higher percentiles on the HCC. This component describes the most dramatic of the disparities, and one that becomes self-perpetuating. Low payment limits provider capacity to pay wages, and low wages cause low payment rates.

Figure 14 in Chapter 3 shows the pervasive low wage rates from the CMS Geographic Wage Index in most of the Appalachian Region.

4.2 RURAL AND ECONOMICALLY DISTRESSED AREAS

Other parts of the U.S. have patterns similar to the Appalachian Region, or worse. Low health insurance coverage (HIC) in Texas, Louisiana and Florida are consistent with high concentrations of undocumented migrants in those states. Non-citizens rarely qualify for federal assistance programs. Lower HCC scores are primarily in the rural south.

The HCRA component indicates that basic health resources are distributed in a consistent pattern across the country. The HCRA component does not measure intensity of the resources. So, a small rural hospital in a small population county could score a percentile ranking as high as a tertiary medical center in a high population metropolitan county.

4.3 RELATIONSHIPS BETWEEN HEALTHCARE COST, COVERAGE, AND ACCESS (HCCA) INDEX AND COUNTY SOCIOECONOMICS

4.3.1. ANALYTIC APPROACH

In a first test of the extent to which the HCCA variance is explained by a county's economic and/ or health status, we examined the characteristics of the proposed HCCA Index by comparing its performance to three external characteristics that served as validating concepts:

1. Years of Potential Life Lost before age 75 due to preventable causes per 100,000 population (YPLL_75).

2. The ARC Economic Distress Index (ARC_EDI), which served as a generalized proxy for the overall socio-economic status of a community.

3. Enrollment in Medicare Disability, because it is so pervasive in the Appalachian Region.

To accomplish this objective, we calculated correlation coefficients that describe the statistical relationships between the YPLL_75 rate, the ARC_EDI, and our new composite index, HCCA. The logic we employed to assess the sturdiness of the HCCA Index is as follows.

- First, YPLL_75 rate represents a reasonable summary health measure that could be used to assess overall health status of a community.

- Second, we expect to observe a significant positive relationship between YPLL_75 rates and the ARC_EDI. Such a finding would be consistent with the well-established positive relationship among community level socioeconomic factors, general health status, and lower premature mortality of populations. Such relationships have been observed consistently and repeatedly with county-level data in the United States.

- Third, we expect to see a positive relationship between the ARC_EDI and the HCCA Index, as well as a positive relationship between the HCCA Index and the YPLL_75 rate.

- Because of the pervasive nature of disability in the Appalachian Region, we included in the correlation analysis a measure of the relationship of cost and access disability at the county level.

- Finally, we filtered the HCCA, the ARC_EDI and the YPLL_75 rate for persistent poverty to determine the extent to which that factor explained variations.

Details of the construction and mathematical transformations of these indices are described in Appendix M and summarized below. We employed multivariate linear regression to describe the combined effects on community health status of ARC_EDI, persistent poverty, the HCCA Index, and designation as an Appalachian county.

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4.3.2 CORRELATIONS OF HEALTHCARE COST, COVERAGE, AND ACCESS (HCCA) INDEX AND ITS COMPONENTS WITH YPLL_75, THE ARC ECONOMIC DISTRESS INDEX, AND PREVALENCE OF DISABILITY

Tables 19 through Table 21 display the key variables in this analysis. Means and standard deviations are displayed in the first column, while the pattern of relationships between the variables is displayed in the form of correlation coefficients in subsequent columns. These three tables have the same format, but describe different sets of counties. Table 19 describes all counties in the United States; Table 20 describes all 1,070 counties in the 13 Appalachian states; and Table 21 describes the 420 counties within the ARC region.

In these tables, Years of Preventable Life Lost under age 75 per 100,000 population, as a result of preventable causes, ratio of Medicare Disabled in the population and the ARC Economic Development Index, are tested for correlation with one another and with the new HCCA Index and its three components. All data are centered on the year 2007. All variables have been scaled so that <u>higher values</u> whether numerical, percentiles or ranks <u>represent less desirable situations</u>. Most of the correlations are significant. For ease of reading, we have used blue shading to highlight correlation values above 0.25.

The health insurance coverage (HIC) component is the least correlated in all three geographies. The healthcare cost (HCC) component also behaves independently of health insurance coverage (HIC) in these geographies.

We chose YPLL_75, which was obtained from Wisconsin's County Health Rankings, to represent a reasonable summary global health measure that could be used to assess overall health status and preventable premature mortality of a community. The first two measures of community health transformed the YPLL_75 in two distinct ways. First, the quantity was ranked and converted to a percentile in such a way that a lower percentile would reflect less premature mortality. This transformation enables the reader to understand where a given county would rank in terms of its premature mortality experience when compared with all the other counties in the nation. However, in order to statistically examine the relationships between health status and the ARC Economic Distress Index (ARC_EDI), as well as our proposed index and its components, we also performed another mathematical transformation on the YPLL_75 rate. Because values of these data were highly skewed, we transformed the variable by taking the natural logarithm. Further, we rescaled this value by multiplying it by 100,000, so that the regression coefficients would be more easily interpreted. Details of these transformations are in Appendix M.

A third measure of health status, disability, is included in the tables for comparative purposes. This measure consists of the ratio of the number of disabled persons on Medicare to the estimated population for the same year (2007). The next column contains the correlation to the individually ranked ARC_EDI, in which higher values represented better status. The remaining four columns contain the correlations for the summary HCCA index and its three components. All four health index measures are treated as percentiles. For purposes of making values in this regression analysis consistent, <u>HCCA and component percentiles were re-ordered</u>, such that lower values reflect more favorable conditions and <u>higher values reflect less desirable situations</u>.

In Table 19, the national county average and standard deviations of the counties ranked on the ARC_EDI are consistent with what would be expected in a national ranking, in the range of 1500. Similarly, the average YPLL_75 rate percentile, the HCCA, and its three component indices typically average around 50, with a standard deviation around 29. These values are consistent with expectations, given the mathematical transformations performed on the data. Not surprisingly, comparative examination of the values for the ARC states (Table 20) and ARC counties (Table 21) suggest that these counties have poorer health status and more distressed economic conditions than U.S. counties as a whole. The percentile of YPLL_75 rate in ARC

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counties is 63.9, well above the national mean ranking. Similarly, the disability index in Appalachian counties (76.2) reflects the fact that the typical Appalachian county has a relatively high proportion of its population on Medicare Disability. The composite HCCA Index in Appalachian counties also suggests that ARC counties face a somewhat more challenging healthcare access situation than U.S. counties as a whole.

In the aggregate, healthcare resource availability (HCRA) in ARC states and counties is comparable to U.S. counties, at 51.3, and health insurance coverage is also comparable (48.1 percentile), due in part to extensive Medicaid coverage. However, ARC counties experience a widespread pattern of lower insurance reimbursement, the healthcare cost (HCC) component. At the value 69.1, the HCC is markedly below the average of all U.S. counties.

An examination of the relationships between these various indices reveals the expected positive inter-relationship between the community health status variables (YPLL_75), the ARC_EDI, and our proposed HCCA Index and its components. However, the individual components of the HCCA, especially measures of health insurance coverage (HIC) and levels of reimbursement HCC, do not always exhibit consistent patterns of correlation with each other or with measures of community health status.

Key to abbreviations in Tables 19 to 21

- YPLL_75: Years of Potential Life Lost under age 75 per 100,000 Population, averaged over 2005-2007 and expressed as a percentile

- Disabled: Ratio of Disabled (on Medicare SMI and HI) to Total Population in 2007, expressed as a percentile

- ARC_EDI: ARC Economic Distress Index Value Rank (1 = Best; 3,110 = Worst)

- HCCA: Healthcare Cost, Coverage and Access Index, expressed as a percentile (1 = Best; 100 = Worst)

- HCRA: Health Care Resource Availability, component expressed as a percentile (1 = Best; 100 = Worst)

- HIC: Health Insurance Coverage, component expressed as a percentile (1 = Best; 100 = Worst)

- HCC: Health Care Cost, component expressed as a percentile (1 = Best; 100 = worst)

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TABLE 19 - CORRELATIONS BETWEEN MEASURES OF HEALTH STATUS, ECONOMIC DISTRESS, AND PROPOSED HCCA AND ITS COMPONENTS, FOR ALL COUNTIES IN THE U.S. (N=3110 COUNTIES)*

Variable	Mean (std. dev.)	Community Health Status		Economic Distress	Proposed Index and components			
		YPLL_75	Disabled	EDI	HCCA	HCRA	HIC	HCC
YPLL_75	49.5 (28.9)	1.000	.669	.669	.490	.288	.284	.465
Disabled	50.5 (28.9)		1.000	.672	.275	.183	-.031 [NS]	.426
EDI	1552.0 (895.9)			1.000	.487	.360	.257	.424
HCCA	50.5 (28.9)				1.000	.710	.702	.703
HCRA	50.5 (28.9)					1.000	.264	.254
HIC	50.5 (28.9)						1.000	.244
HCC	50.5 (28.9)							1.000

*Numbers of counties employed in above correlations range from 3008 to 3110, depending on availability of YPLL_75 estimates for the counties. Estimates for YPLL_75 were missing in 95 cases, and judged to be unreliable in an additional 196 cases. All correlations are significant at the p <. 01 level, except for those marked "NS"

TABLE 20 - CORRELATIONS BETWEEN MEASURES OF HEALTH STATUS, ECONOMIC DISTRESS, AND PROPOSED HCCA INDEX AND ITS COMPONENTS, FOR ALL COUNTIES IN THE 13 APPALACHIAN STATES (N=1070 COUNTIES)*

Variable	Mean (std. dev.)	Community Health Status		Economic Distress	Proposed Index and components			
		YPLL_75	Disabled	EDI	HCCA	HCRA	HIC	HCC
YPLL_75	60.74 (26.8)	1.000	.755	.735	.487	.301	.188	.492
Disabled	65.9 (26.4)		1.000	.785	.515	.308	.088	.619
EDI	1842.7 (880.1)			1.000	.611	.394	.223	.612
HCCA	53.9 26.9				1.000	.731	.635	.688
HCRA	51.3 (29.5)					1.000	.262	.193
HIC	48.1 (23.1)						1.000	.190
HCC	59.5 (28.8)							1.000

*Number of counties employed in above correlations is 1070. Only 10 counties in ARC states were judged to have unreliable estimates of YPLL_75. All correlations are significant at the p < .01 level.

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TABLE 21 - CORRELATIONS BETWEEN MEASURES OF HEALTH STATUS, ECONOMIC DISTRESS, AND PROPOSED HCCA INDEX AND ITS COMPONENTS, FOR ALL COUNTIES IN THE APPALACHIAN REGION (N=420COUNTIES)*

Variable	Mean (std. dev.)	Community Health Status		Economic Distress	Proposed Index and components			
		YPLL_75	Disabled	EDI	HCCA	HCRA	HIC	HCC
YPLL_75	63.9 (21.0)	1.000	.728	.560	.301	-.209	-.040 NS	.368
Disabled	76.2 (21.0)		1.000	.688	.337	.203	-.140	-0.548
EDI	2035 (730.3)			1.000	.503	.359	-.032 NS	.534
HCCA	57.1 (28.7)				1.000	.713	.598	.564
HCRA	51.9 (23.4)					1.000	.172	.072 NS
HIC	44.9 (23.4)						1.000	.036 NS
HCC	69.1 (24.3)							1.000

*Number of counties employed in above correlations is 420. Only 3 counties within the ARC region were judged to have unreliable estimates of YPLL_75. All correlations are significant at the p <. 01 level, except for those marked "NS"

4.3.3 CONTROLLING FOR THE ECONOMIC DISTRESS INDEX

We tested the hypothesis that the HCCA and its components have a direct, independent relationship to the rate of premature mortality (YPLL_75). Multiple regression models were employed to examine the joint relationships of YPLL_75 rates with the socio-economic variable (ARC_EDI), as well as health system variables reflected by the new HCCA index. In addition, at the national level, we included a variable reflecting whether or not a county was in the ARC region. Appendix M contains these results for all counties in the nation, the 13 Appalachian states and the Appalachian Region. In all three analyses, the socioeconomic status of counties, as reflected in the ARC_EDI, seems to have a substantial relationship to premature mortality rates. However, at the national level, the HCCA Index exhibits an independent relationship to premature mortality rates, as well.

Relationships between the HCCA, ARC_EDI and the YPLL_75 rates are significant nationally, but not in Appalachian states or counties. This suggests that something other than economic distress could be affecting the Appalachian states' premature mortality rates. Further, Appalachian counties' rates of premature mortality (YPLL_75) were higher than would be predicted on the basis of their scores on ARC_EDI and HCCA alone, suggesting that there may also be an unmeasured factor at work in counties located in the Appalachian Region, over and beyond the combined impact of socioeconomic status and health system characteristics. All of these relationships were highly statistically significant (p < .001) at the national level. Please see Appendix M, Tables 45 through 47, for the complete statistical analysis and commentary.

4.3.4 TESTING THE RELATIONSHIPS OF COMPONENTS OF HEALTHCARE COST, COVERAGE, AND ACCESS (HCCA) INDEX TO HEALTH STATUS AND ECONOMIC DISTRESS

Tables 48 through 50 in Appendix M show linear regressions of the components of the HCCA and the ARC_EDI against YPLL_75 rates for United States, Appalachian states and Appalachian counties. Blue shading shows highly significant relationships.

The county ARC_EDI has the strongest relationship with premature mortality rates of any of the variables in the equations at all levels: United States, Appalachian states and Appalachian Region. Even though the healthcare resource component (HCRA) has a relatively high correlation with county health status (YPLL_75 rate), HCRA has little relationship to county YPLL_75 rates, once the ARC_EDI has been statistically controlled. This is true at the national, Appalachian state and Appalachian Region levels. The other two components of the HCCA index have complex relationships with health status depending on the geographic focus of the analysis:

- At the national level, with ARC_EDI controlled, less health insurance coverage and lower reimbursements continue to be significantly correlated with health status. Similarly, being an ARC county has a small, but still statistically significant, relationship with poorer YPLL_75 rate, the measure of health status ($p < .05$). Please see Table 48 in Appendix M.

- At the 13-state level, with ARC _EDI controlled, less health insurance coverage is not related to health status, but lower reimbursements continue to be significantly correlated with poorer health status. Similarly, being an ARC county has a statistically significant relationship with health status ($p < .001$). Please see Table 49 in Appendix M.

- When examining only the Appalachian counties, with ARC_EDI controlled, more health insurance coverage and lower payments for health services are associated with poorer health status, but these relationships do not achieve the same level of statistical significance (i.e., $p < .05$). This phenomenon may be related to intersection of a relatively high proportion of insurance coverage consisting of Medicaid and Medicare Disability, along with a relatively low level of reimbursement to providers by these programs in Appalachian counties. Please see Table 50 in Appendix M.

4.3.5 CONTROLLING FOR PERSISTENT POVERTY

The U.S. Department of Agriculture tracks persistent poverty in non-metropolitan counties. Among the list of 388 counties, those in the Appalachian Region are predominantly in Kentucky, West Virginia and Mississippi. A few are in Tennessee and Alabama. The pattern in Figure 40 shows some relationship between persistent poverty designation and a county's HCCA's, but the relationship is not consistent. In the Appalachian Region, eastern Kentucky and Mississippi counties that have high persistent poverty also rank low on the HCCA and high on YPLL_75 rates.

Tables 51 through 56, in Appendix M, explore the extent to which a filter for persistent poverty explains the variations in HCCA and YPLL_75 rates, nationally and in the Appalachian Region. A test of the hypothesis that persistent poverty is highly correlated with the HCCA showed less relationship between the HCCA and persistent poverty than between the ARC Economic Distress Index and HCCA.

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FIGURE 40 – PERSISTENT POVERTY COUNTIES, 1970-2000
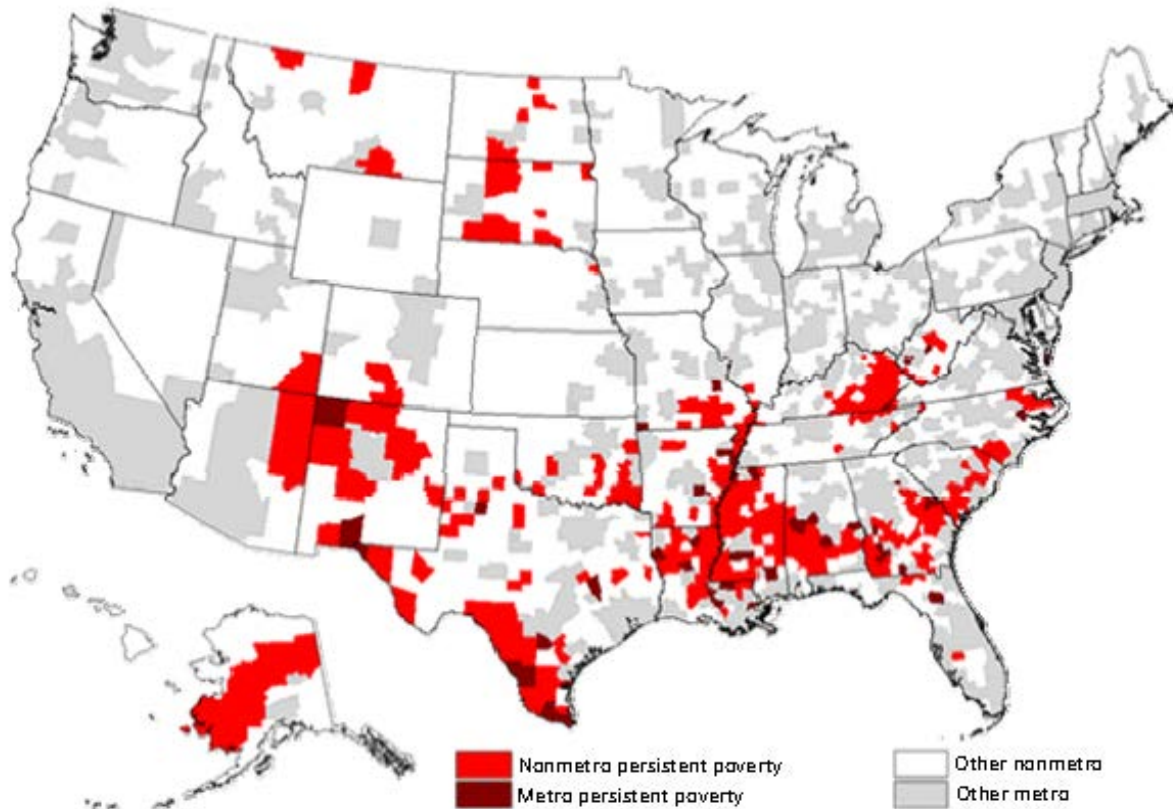
Persistent poverty counties - 20 percent or more residents were poor as measured by each of the last four censuses. 1970, 1980, 1990 and 2000.
Source: Economic Research Service, USDA. (http://www.ers.usda.gov/briefing/rurality/typology/maps/poverty.htm)

- In general, these six models do not explain as much variance in health status as do the corresponding models involving the ARC_EDI. Not surprisingly, persistent poverty is a consistent predictor of poor health status in all six models, whether using the combined HCCA index or the separate components of the combined index.

- The HCCA index is consistently statistically significantly related to health status at the national, 13-state and ARC region (Table 51, Table 52 and Table 53 in Appendix M).

- Further, when all three components of the HCCA index are put in the equation as individual variables, their relationships to health status are significant at the national level, as is designation as an ARC county (Table 54 in Appendix M).

- The situation is less clear at the 13-state level where resources (HCRA) and cost (HCC) are related to health status, but coverage (HIC) is not (Table 55 in Appendix M).

- Finally, at the Appalachian Region level, all three components of the HCCA index are significantly related to health status, with higher levels of health insurance coverage being associated with poorer health status (Table 56 in Appendix M), as was the case in the national comparison (Table 54 in Appendix M). Though counter intuitive, this may reflect national policy that provides coverage for poor, aged and disabled persons.

4.4 SUMMARY OF STATISTICAL CORRELATIONS: ACCESS AND HEALTH STATUS

In summary, the proposed Healthcare Cost, Coverage and Access Index (HCCA) performs reasonably well in explaining variation in a surrogate indicator of community health status, preventable premature mortality rates. Furthermore, the HCCA is associated with overall community economic status and with preventable premature mortality rates in the expected positive manner.

We tested the hypothesis that there would be a positive relationship between the HCCA and preventable mortality, after we controlled for the relationship of economic distress to premature mortality rates. A multivariate linear regression statistical model of the relationship between the HCCA and preventable premature mortality showed a positive statistical relationship between premature mortality rates and socioeconomic status of counties, as reflected in the ARC_EDI. However, our proposed HCCA index also exhibited an independent relationship to premature mortality rates. Further, rates of premature mortality in Appalachian counties exceeded what would be predicted on the basis of their combined predicted scores on ARC_EDI and HCCA alone (p < .01). This suggests that factors other than socioeconomic status and healthcare cost, coverage and access are related to premature mortality.

Although the HCCA did not perform as well as a predictor of YPLL_75 rates at the regional level, where sample sizes were smaller, we can conclude the proposed HCCA Index is a useful measure for comparing the performance of community healthcare systems in Appalachian counties in relation to national patterns of healthcare.

ARC Economic Distress (ARC_EDI) status and persistent poverty scores are so highly correlated that either one swamps the relationship with the other, a problem of multi-co linearity. However, a comparison of the scatter plots at the national level shows that the ARC_EDI status is a better predictor of poor health outcomes than is persistent poverty. Scatter plots and supporting statistics are contained in Appendix M of this report.

In the regression analysis, the insurance coverage component, HIC, had no significant relationship to preventable mortality rates and had a weak relationship to the resource component, HCRA. Contextually, this suggests that health reform initiatives to increase the number of people who have healthcare coverage may not result in improved health status. Without other complementary interventions, coverage costs may increase without an offsetting improvement in access or health outcomes.

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