Original Article

Mortality amenable to health care in the United States: The roles of demographics and health systems performance

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Abstract   This article examines associations of socio-demographic and health-care indicators, and the statistic 'mortality amenable to health care' (amenable mortality) across the US states. There is over two-fold variation in amenable mortality, strongly associated with the percentages of state populations that are poor or black. Controlling for poverty and race with bi- and multi-variate analyses, several indicators of health system performance, such as hospital readmission rates and preventive care for diabetics, are significantly associated with amenable mortality. A significant crude association of 'uninsurance' and amenable mortality rates is no longer statistically significant when poverty and race are controlled. Overall, there appear to be opportunities for states to focus on specific modifiable health system performance indicators. Comparative rates of amenable mortality should be useful for estimating potential gains in population health from delivering more timely and effective care and for tracking the health outcomes of efforts to improve health system performance.
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Introduction

'Mortality amenable to health care' is a specifically defined composite measure of deaths before age 75 from complications of conditions that might be avoided by timely effective care and prevention.[1] The concept originated in the 1970s when Rutstein *et al* 'selected conditions in which critical increases in rates of disease, disability, or untimely death could serve as indexes of the quality of care'.[2] Nolte and McKee, in developing the statistic 'mortality amenable to health care' or 'amenable mortality', have limited the data to deaths and updated the conditions included. They have used the statistic to assess the performance of health systems and track changes over time across advanced industrialized countries.[1,3] Their comparisons of amenable mortality among 19 Organization for Economic Cooperation and Development (OECD) countries over two time periods have found that the United States (US) failed to keep pace with rates of decline in amenable mortality rates in other countries – falling to last place as of 2002–2003.

Lagging rates of improvement in the US may reflect a variety of influences on the amenable mortality statistic. These could include demographic factors influencing the rates and also health system performance factors. One recent article has shown that there appear to be complex relationships between factors such as state political cultures and cultural differences and both the total and amenable mortality of African Americans and American Indians.[4] This adds to an already extensive literature on the relationship of total mortality in the US and factors such as race and income inequality. Another recent article has reviewed this subject and shown an interaction between race and income inequality that is modified in metropolitan areas by racial segregation.[5] Alternatively, or in addition, the amenable mortality statistic may have a relationship with some of the well-documented US health-care system performance deficits including a high rate of uninsured and a fragmented delivery system with relatively weak primary care and poor coordination of care between providers and sites. These types of relationships have not been explored in the past.

The Patient Protection and Affordable Care Act of 2010 (PPACA) importantly begins to address a number of US health system issues, particularly coverage for the uninsured, but differences in local health systems and state policies are likely to matter a great deal. In fact, variation in mortality amenable to health care across the US states

exceeds variation among OECD countries, several of which have universal coverage, underscoring that for states to address the interstate differences they will have to go beyond their roles in implementing the coverage provisions of the PPACA.

To provide insight to governments and all involved in providing health care to populations and individuals, this study examines variation of mortality amenable to health care across the US and assesses the extent to which variations in state rates are associated with two key socio-demographic characteristics, poverty and race, and then, controlling for those characteristics, with a variety of health-systems indicators.

Methods

Data

The composite rate of mortality amenable to health care per 100 000 consists of age-standardized rates of deaths that occur before age 75 from causes considered at least partially treatable or preventable with timely and appropriate health care.[1] The developers designed it to be 'conservative', excluding deaths due to lung cancer and including only 50 per cent of the deaths from ischemic heart disease. Deaths counted in the measure comprise approximately 27 per cent of deaths from all causes among persons under age 75 (see Appendix, Table A1).

We followed Nolte and McKee's methodology[1,3] to calculate rates for each US state and the District of Columbia using the 2004–2005 CDC Multiple Cause-of-Death data files. For each state, we pooled deaths for 2 years to allow for greater stability in those states with small populations. We age-standardized state rates using US Census Bureau population data. The median amenable mortality rate for all states in 2004–2005 was 89.9 deaths per 100 000 (range 63.9–158.3).

The variables in the analyses included each of the state-based rates of mortality amenable to health care; two socio-demographic measures – the per cent of each state population that is black and the per cent that is under 200 per cent of the federal poverty level; and 19 health care access and system performance indicators. The access and system performance indicators include measures of the non-elderly uninsured population, delays in care, routine physician visits among at-risk patients, having a usual source of care, use of recommended primary and secondary clinical preventive services, hospital delivery of recommended care, and

measures of preventable hospitalizations. The data were originally compiled for the Commonwealth Fund's 2009 state scorecard on health system performance[6] (see Appendix, Table A2).

Statistical analysis

Following methods commonly used in analyses of contributors to mortality rates, we converted all variables to their natural logarithms and then conducted tests of association to examine relationships of each with US state amenable mortality rates.[7,8] The transformation to logarithmic form has two significant advantages. First, in regression analyses using the double-log form (that is, dependent and independent variables) coefficients are expressed as elasticities, which are easily interpreted and compared across measures. Elasticities are interpreted as the per cent change in the dependent variable that is associated with a 1 per cent change in an independent variable. A regression of the state mortality amenable rate on the per cent residents receiving clinically recommended care, for example, resulting in an elasticity coefficient of −2.0 would indicate that a 1 per cent increase in the recommended care rate is associated with a 2 per cent decline in the mortality rate. Second, we fit regression models of population-based ratios on both sides of the equation. Regressions with untransformed ratios would yield very large spurious associations unrelated to the relationships of interest. The use of double-log transformations eliminates this serious statistical problem.[9]

Recognizing that income and race are related to insurance, where people receive care, and care experiences, we examined the correlations of the natural logarithms of socio-demographic variables with the health system variables. To determine the extent to which health system variables are significantly associated with variations in mortality amenable to health care, we performed a series of multivariate regression analyses for amenable mortality at the state level and each of the health care-related indicators, controlling for race and poverty.

Black rates of amenable mortality are higher than for whites in all states, and the black population is distributed unequally across states. To understand mortality variations not attributable to the racial composition of states, we also performed regressions using state white-only amenable mortality rates along with white-only poverty and uninsured rates. We employed the STATA version 9.2 statistical package for all analyses.

Results

In 2004–2005, age-standardized amenable mortality by state within the US ranged from a low of 63.9 deaths per 100 000 persons under age 75 in Minnesota to highs of 142.0 in Mississippi and 158.3 in the District of Columbia. Rates were highest in southern states and a band ranging from Texas to New York (Figure 1). The North Central, Mountain, and Pacific regions had lower rates. The variation in amenable mortality rates within the US is more extensive than that seen in 19 OECD countries in 2002–2003, which ranged from a low of 65 for France to a high of 110 for the US.[3]

The bivariate regressions (Table 1) show strong associations between state-level amenable mortality rates and poverty and race, as well as various health system-related indicators. Of the two socio-demographic variables, poverty had the stronger association. The bivariate coefficients, based on natural logarithm transformed data, can be interpreted as elasticities or comparative rates of change; for example, a 10 per cent
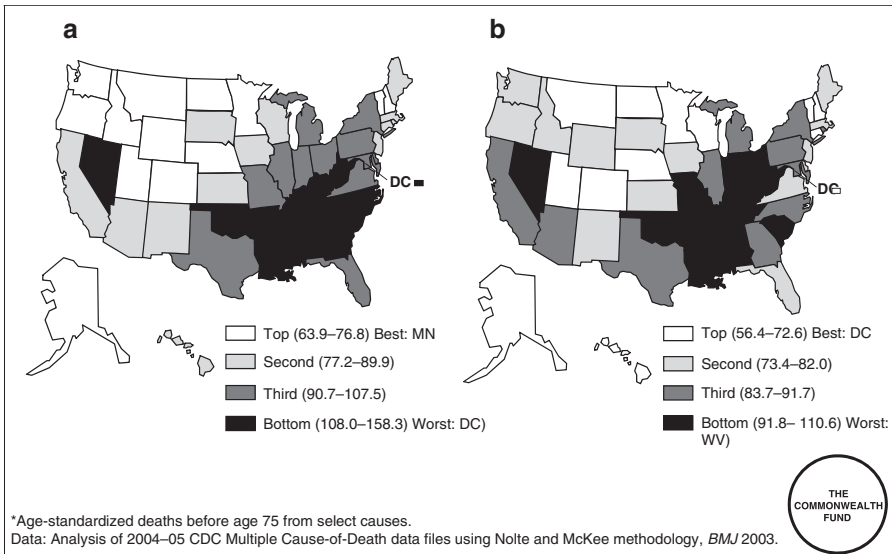
Figure 1: Mortality Amenable to Health Care by State.
Deaths* per 100 000 Population; 2004–2005 (**a**) left, Total population; (**b**) right, white-only population.
Source: Commonwealth Fund State Scorecard on Health System Performance, 2009.

Table 1: Association of state socio-demographic and health care-related indicators with state mortality amenable to health care rates (deaths per 100 000 total and white-only populations)

Indicator (independent variables)	Total population			White population		
	Bivariate elasticity	P-value	R^2	Bivariate elasticity	P-value	R^2
Socio-demographic indicators						
Percentage of state population that is black	0.144	<0.0001	0.66	0.067	0.0002	0.24
Percentage of state population under 200 per cent of the federal poverty level	0.925	<0.0001	0.44	0.540	<0.0001	0.37
Access and preventive care indicators						
Percentage uninsured, ages 0–64[a]	0.238	0.021	0.10	0.316	0.0001	0.28
Percentage of adults without a time in past year when they needed to see a doctor but could not because of cost	−3.233	<0.0001	0.33	−2.941	<0.0001	0.46
Percentage of at-risk adults who visited a doctor for routine checkup in past 2 years	0.878	0.119	0.05	−0.001	0.9983	0.00
Percentage of adults with a usual source of care	0.093	0.838	0.00	0.044	0.8998	0.00
Percentage of adults age 50 and older who received recommended screening and preventive care	−0.563	0.040	0.08	−0.540	0.0094	0.13
Percentage of adult diabetics who received recommended preventive care	−0.974	<0.0001	0.37	−0.771	<0.0001	0.39
Hospital indicators: Recommended care						
Percentage of surgical patients who received appropriate care to prevent complications	−2.396	0.0003	0.23	−1.451	0.0057	0.15
Percentage of hospitalized patients who received recommended care for heart attack	−8.433	<0.0001	0.43	−4.676	0.0004	0.23
Percentage of hospitalized patients who received recommended care for heart failure	−0.826	0.127	0.05	−0.485	0.2447	0.03
Percentage of hospitalized patients who received recommended care for pneumonia	−3.757	0.0009	0.20	−0.341	0.7105	0.00

Percentage of hospitalized patients who received recommended care for heart attack, heart failure, and pneumonia	−4.368	0.0003	0.24	−0.877	0.3737	0.02
Percentage of heart failure patients given written instructions at discharge	−0.363	0.215	0.03	−0.028	0.9006	0.00
Potentially preventable hospital use indicators						
Percentage of adult asthmatics with an ER or urgent care visit in past year	0.740	<0.0001	0.71	0.337	0.0011	0.27
Hospital admissions for pediatric asthma per 100 000 children (ages 2–17)	0.296	0.0003	0.33	0.205	0.0031	0.24
Medicare hospital admissions for ambulatory care sensitive conditions, per 100 000 beneficiaries	0.636	<0.0001	0.44	0.434	<0.0001	0.35
Medicare 30-day hospital readmissions as a percentage of admissions	1.167	<0.0001	0.54	0.726	<0.0001	0.36
Nursing home and home health: Hospital use indicators						
Percentage of long-stay nursing home residents with a hospital admission	0.484	<0.0001	0.67	0.337	<0.0001	0.56
Percentage of short-stay nursing home residents with a hospital readmission within 30 days	0.952	<0.0001	0.64	0.706	<0.0001	0.60
Percentage of home health patients with a hospital admission	0.582	0.0004	0.23	0.510	<0.0001	0.30

[a]The first three data columns for this indicator include total population uninsured by state; the last three include white population uninsured by state.

increase in poverty rate is associated with an average 9.3 per cent higher state amenable mortality rate.

Health care-related variables most strongly associated with mortality amenable to health care in the bivariate analyses include ones related to asthma and other ambulatory care such as preventive care for diabetics, access to a source of care when needed, hospital readmissions, and publicly reported hospital quality measures (Table 1). The percentage of the population that is uninsured was significantly but less strongly associated with amenable mortality compared with other health system variables, income, or race.

As Table 2 illustrates, many of the health system variables are also significantly correlated with poverty and black race. These include the expected strong associations of rates of poverty and uninsurance with rates of persons reporting going without care because of costs. There is also a striking correlation between state poverty rates and the per cent of adults age 50 and older who received recommended screening and preventive care and the per cent of diabetics receiving recommended care.

The multivariate analyses of mortality amenable to health care control for state-level rates of poverty and black race (Table 3) and include only health-system indicators that were significant initially at $P<0.05$ in the bivariate analyses. The multivariate coefficients of several health care-related variables that remain statistically significant after controlling for poverty and race include: per cent of adult diabetics who received recommended preventive care; adult asthmatics with an emergency department or urgent care visit in the past year; hospital admissions of Medicare beneficiaries for ambulatory care sensitive conditions; hospital readmissions of Medicare patients and of short-stay nursing home patients; and hospital admissions of long-stay nursing home patients – many of whom would be covered both by Medicaid and Medicare.

Given the associations between each of these health care-associated indicators and poverty and black race (Table 2), when one compares results in Tables 1 and 3, one finds a smaller multivariate than bivariate regression coefficient for each of these indicators in relation to amenable mortality. Nonetheless, the associations remain significant with relatively high coefficients. The results in Table 3, for example, can be interpreted as showing that a 10 per cent increase in a state's Medicare hospital readmission rate is associated with a 5.1 per cent

higher rate of mortality amenable to health care, controlling for poverty and black race.

Because of the large black–white difference in rates of mortality amenable to health care, it is worth considering variation in race-specific rates. The highest rate of amenable mortality calculated for just the white population of each state is in West Virginia (110.6) and the lowest rates are in the District of Columbia (56.4) and Minnesota (61.1) – Figure 1. The pattern of highest state-based rates of amenable mortality among whites still clusters in the south and the band of states from Texas to New York; but relatively high rates are also seen in the west-southwestern states.

The association of mortality amenable to health care and the per cent uninsured is stronger when restricted to white mortality rates (Table 1). Other patterns were similar. In the multivariate analysis for whites, controlling for poverty (Table 3), the same health care-related indicators remained significant as in the initial analysis. Several other variables not significant in the all-race analysis were significantly associated with rates of mortality amenable to health care for whites (Table 3). These include: the per cent of adults without a cost-related problem accessing a doctor in the past year; hospital quality indicators for surgical patients who received appropriate care to prevent complications; and the combined group of patients who received recommended care for heart attack, heart failure, and pneumonia.

Finally, multivariate analyses show that state rates of mortality amenable to health care are associated with underlying population conditions (not illustrated in tables): These include the state percentages of adult smokers, overweight children, and adult diabetics. For adult smokers, the multivariate coefficient controlling for poverty and black race is 0.39 ($R^2 = 0.84$, $P < 0.001$); for overweight children the coefficient is 0.51 ($R^2 = 0.82$, $P < 0.01$); and for adult diabetics the coefficient is 0.49 ($R^2 = 0.84$, $P < 0.001$).

Discussion

The results indicate that multiple factors are associated with state variations in mortality amenable to health care. These, as has been suggested,[10] include socio-demographic variables, in particular, as shown in the present analysis, the percentage of the population that is black and the percentage that is below 200 per cent of poverty.

Table 2: Bivariate elasticities and correlations of state socio-demographic and health care-related indicators with percentage of population under 200 per cent of federal poverty level, black or uninsured

Indicator (independent variables)	Dependent variables		
	Percentage under 200% poverty: Bivariate elasticity (R^2)	Percentage black: Bivariate elasticity (R^2)	Percentage uninsured: Bivariate elasticity (R^2)
Socio-demographic indicators			
Percentage of state population that is black	0.051 (0.16)**	—	0.043 (0.03)
Percentage of state population under 200 per cent of poverty	—	3.103 (0.16)**	1.090 (0.33)***
Access and preventive care indicators			
Percentage uninsured, ages 0–64	0.307 (0.33)***	0.734 (0.03)	—
Percentage of adults without a time in past year when they needed to see a doctor but could not because of cost	−2.936 (0.52)***	−11.307 (0.13)*	−6.158 (0.64)***
Percentage of at-risk adults who visited a doctor for routine checkup in past 2 years	−0.236 (0.01)	9.043 (0.16)**	−2.237 (0.17)**
Percentage of adults with a usual source of care	−0.641 (0.08)*	3.390 (0.04)	−2.898 (0.46)***
Percentage of adults age 50 and older who received recommended screening and preventive care	−0.779 (0.31)***	0.307 (0.00)	−1.432 (0.29)***
Percentage of adult diabetics who received recommended preventive care	−0.653 (0.32)***	−3.552 (0.15)**	−1.236 (0.39)***
Hospital indicators: Recommended care			
Percentage of surgical patients who received appropriate care to prevent complications	−2.211 (0.38)***	−8.601 (0.09)*	−3.770 (0.31)***
Percentage of hospitalized patients who received recommended care for heart attack	−6.241 (0.46)***	−38.536 (0.28)**	−7.109 (0.17)**
Percentage of hospitalized patients who received recommended care for heart failure	−1.223 (0.20)**	−1.491 (0.00)	−1.742 (0.11)*

Percentage of hospitalized patients who received recommended care for pneumonia	−2.744 (0.21)**	−15.931 (0.11)*	−2.450 (0.05)
Percentage of hospitalized patients who received recommended care for heart attack, heart failure, and pneumonia	−2.875 (0.20)**	−22.953 (0.20)**	−2.279 (0.03)
Percentage of heart failure patients given written instructions at discharge	−0.426 (0.08)*	−1.557 (0.02)	−0.947 (0.12)*
Potentially preventable hospital use indicators			
Percentage of adult asthmatics with an ER or urgent care visit in past year	0.360 (0.28)**	3.922 (0.63)***	0.399 (0.10)
Hospital admissions for pediatric asthma per 100 000 children (ages 2–17)	0.163 (0.15)*	1.959 (0.56)***	0.194 (0.06)
Medicare hospital admissions for ambulatory care sensitive conditions, per 100 000 beneficiaries	0.271 (0.15)**	2.912 (0.29)***	0.040 (0.00)
Medicare 30-day hospital readmissions as a percentage of admissions	0.359 (0.10)*	5.855 (0.43)***	0.165 (0.01)
Nursing home and home health: Hospital use indicators			
Percentage of long-stay nursing home residents with a hospital admission	0.232 (0.27)**	2.403 (0.48)***	0.264, (0.10)*
Percentage of short-stay nursing home residents with a hospital readmission within 30 days	0.406 (0.20)**	5.560 (0.63)***	0.526 (0.10)*
Percentage of home health patients with a hospital admission	0.313 (0.13)**	3.282 (0.23)**	0.141 (0.01)

$*P < 0.05; **P < 0.01; ***P < 0.0001.$

Table 3: Multivariate analyses of state mortality amenable to health care and state health care-related indicators: Total amenable mortality, controlling for poverty and black race; and white-only amenable mortality, controlling for white-only poverty

Indicator (independent variables)	Total population		White population	
	Partial elasticities, controlling for poverty and race	R² of full model	Partial elasticities, controlling for poverty among whites	R² of full model
Access and preventive care indicators				
Percentage uninsured (total and white uninsured), ages 0–64	−0.031	0.80	0.146	0.41
Percentage of adults without a time in past year when they needed to see a doctor but could not because of cost	−0.555	0.80	−2.154***	0.56
Percentage of adults age 50 and older who received recommended screening and preventive care	−0.250	0.81	−0.247	0.40
Percentage of adult diabetics who received recommended preventive care	−0.316*	0.83	−0.604***	0.62
Hospital indicators: Recommended care				
Percentage of surgical patients who received appropriate care to prevent complications	−0.247	0.80	−1.198**	0.47
Percentage of hospitalized patients who received recommended care for heart attack	−0.997	0.80	−3.812***	0.52
Percentage of hospitalized patients who received recommended care for pneumonia	−0.482	0.80	−1.231	0.41
Percentage of hospitalized patients who received recommended care for heart attack, heart failure, and pneumonia	−0.138	0.80	−1.744*	0.43
Potentially preventable hospital use indicators				
Percentage of adult asthmatics with an ER or urgent care visit in past year	0.256*	0.84	0.323***	0.65
Hospital admissions for pediatric asthma per 100 000 children (ages 2–17)	−0.040	0.74	0.170**	0.49

Medicare hospital admissions for ambulatory care sensitive conditions, per 100 000 beneficiaries	0.219**	0.83	0.344***	0.58
Medicare 30-day hospital readmissions as a percentage of admissions	0.511***	0.86	0.741***	0.74
Nursing home and home health: Hospital use indicators				
Percentage of long-stay nursing home residents with a hospital admission	0.210***	0.85	0.294***	0.65
Percentage of short-stay nursing home residents with a hospital readmission within 30 days	0.356**	0.8	0.665***	0.79
Percentage of home health patients with a hospital admission	0.037	0.80	0.401***	0.55

*$P<0.05$; **$P<0.01$; ***$P<0.0001$.

In addition, multiple health care-related variables are associated with amenable mortality. These indicators, selected to broadly represent important dimensions of health system performance, potentially can be improved with appropriate interventions. Despite the associations, there is as yet no evidence that improving performance on these indicators will improve amenable mortality, but this is worth testing. In addition, improvement in variables such as readmission rates or care for asthmatics and diabetics are objectives worth attaining in their own right.

The health care-related variables in this analysis may be only the tip of the iceberg of factors that can be changed and could potentially lead to lower rates of mortality amenable to health care. Indeed, one could argue that the variables included in this analysis, which were chosen because they are ones that are currently available across the states, are simply proxies for other variables that may be a better reflection of the care that patients should experience to reduce their probability of amenable mortality. One could speculate, for example, that if there were data to link individual patient experiences over time to mortality rates, there might prove to be a relationship between the effectiveness of smoking cessation programs and/or obesity management programs and lower rates of amenable mortality. Similarly, it is possible that if one had data on drug and alcohol use and the effectiveness of substance use programs, one might find a relationship with amenable mortality.

Given the strong correlation between state rates of uninsured and lower rates of preventive care, we would expect to find that chronically uninsured or unstably insured children and adults [11] would lack basic access to care for extended periods of time, putting them at higher risk of morbidity and mortality over time. It is not possible, however, to examine such person-level experiences at the state level with currently available insurance and care data. With implementation of the PPACA and its enhanced coverage, we anticipate that there will be improvements in care and amenable mortality data.

Some have suggested that the poor performance of the US on various health outcomes relative to other developed countries, for example, life expectancy, is primarily related to population differences and in no way or only a small way related to health system performance, others disagree. Recently, Muennig and Glied, in a study in which comparative national life expectancies were examined over time in relation to population risk, have found that 'the risk profiles of

Americans generally improved relative to those for citizens of many other nations, but Americans' fifteen-year survival has nevertheless been declining'.[12] They comment that 'the findings undercut critics who might argue that the US health-care system is not in need of major changes, or that changes would not play an important role in improving US health outcomes'.

Limitations of the current study include the use of state averages and cross-sectional data that preclude direct inference of causality from the observed associations. Another limitation is that with only 51 data points for each indicator it is difficult to control for multiple variables simultaneously in examining the independent association of health-system indicators. It is also possible that other socio-demographic factors, for example, educational attainment, which is known to have an association with poverty and race, might still have some independent association with the amenable mortality statistic.

Just as it is important in examining health-system indicators to control for independently associated socio-demographic variables, it is also important to avoid over-controlling in the analyses, both with multiple socio-demographic and health-system indicators. Various health-system indicators are related to each other and interact; for example, lack of timely access to primary care is related to hospital admissions, and lack of timely follow-up care is related to hospital readmissions. Similarly, high rates of hospital readmissions of Medicare beneficiaries and readmissions of short-stay nursing home patients are likely to be related.

This study is also limited by the paucity of comparable data across and within states regarding health outcomes and health-system indicators. It would be desirable, for example, to examine indicators such as diabetics in control, or hypertensives in control. Or, rather than looking at readmission rates of Medicare beneficiaries, it would be preferable to analyze hospital readmission rates limited to persons under age 75. Currently, however, state-based rates of such indicators do not exist. Efforts to identify and develop additional health-outcome indicators that are sensitive to variations in performance as well as sentinel health care-related factors related to outcomes would enable local, state, and national public and private initiatives to target further efforts to improve. It will require national initiatives to assure that additional indicators are measured uniformly across states and available in sub-state regions and metropolitan areas. The above

notwithstanding, it may be possible within some states to examine variation by area within the state. For example, in a state with several million people, it may be possible to obtain sufficient data for each of several metropolitan statistical areas to enable some comparison between them.

Relationships between black race, lower income, higher rates of uninsurance, and poorer health outcomes have been examined in a number of studies.[13] In this study, state uninsured rates are strongly related to black race and poverty and are not statistically significant in the multivariate analysis of the relationship with amenable mortality after controlling for poverty and race. Yet, persistent lack of access to affordable care undermines health and puts children and adults at risk of complications that could have been prevented.[14] Reducing, ideally eliminating, the percentage of the population that is uninsured is thus central to comprehensive health reform and could yield a societal payback in many ways. Efforts to improve performance and over time reduce death rates from conditions amenable to health care also will require a comprehensive approach. For example, the close association of per cent black population with Medicare hospital readmission rates ($R^2 = 0.43$) and readmission rates among short-stay nursing home residents ($R^2 = 0.63$) may indicate that the states with a high proportion of black residents have weaker care systems and lower quality hospital and transitional care. Efforts to reduce readmissions ideally involve changes and improvements at all levels of the care process following the patient's journey – including factors leading to the initial admission, care delivered while hospitalized, care and information flow during transitions, and follow-up care. This spans care provided in ambulatory, hospital, rehabilitation, and nursing home settings.

Despite the limitations, overall the results of our study indicate that examining associations with mortality amenable to health care could be useful as a guide to developing approaches to improve population health – for example, delivering more timely, effective, and safe preventive and therapeutic care. The indicators thus far associated with amenable mortality may just be sentinel indicators of overall health system performance rather than causally related to amenable mortality. Nonetheless, improving some of the indicators associated with amenable mortality might lead to reduced amenable mortality rates and should be tested. Given the importance of the modifiable indicators

associated with amenable mortality, it is worth improving performance on each whether or not such improvement is associated with a detectable reduction in amenable mortality.

Each of the factors associated with mortality amenable to health care merits attention in the context of a comprehensive, systemic approach to improving the way care is organized and delivered, starting with access. In addition, each state and health system within it should consider immediately how it might improve its performance, improve the health and productivity of the population, and potentially reduce mortality. Although across the US states, there is a wide range of performance on a variety of health care and health-system indicators, not just amenable mortality,[6] and although there are several state-level 'market, politicial, and cultural characteristics that can help or hinder health system improvement', a study of high and low performers by Silow-Carroll and Moody[15] suggests that all states, 'regardless of starting point', can work to improve and that there are common lessons that can be applied. These include developing incentives for consumers, providers, and health plans; 'framing health in terms of economic development to gain public and political support'; and engaging purchasers and payers to adopt methods of value-based purchasing. Perhaps most importantly, Silow-Carroll and Moody emphasize 'bringing stakeholders together to develop goals and build trust'. States, even poor states, can convene stakeholders and encourage joint action. Prior measurements of health indicators across states over time have demonstrated that when improvement goals are set, improvement actually occurs.[6] Accordingly, we encourage states, regardless of their individual demographic characteristics, and the nation as a whole to adopt goals of improving the health-system indicators associated with amenable mortality.

Acknowledgements

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Appendix

Table A1: Deaths counted in the measure of mortality amenable to health care

Causes of death	Age
Intestinal infections	0–14
Tuberculosis	0–74
Other infections (diphtheria, tetanus, septicaemia, poliomyelitis)	0–74
Whooping cough	0–14
Measles	1–14
Malignant neoplasm of colon and rectum	0–74
Malignant neoplasm of skin	0–74
Malignant neoplasm of breast	0–74
Malignant neoplasm of cervix uteri	0–74
Malignant neoplasm of cervix uteri and body of uterus	0–44
Malignant neoplasm of testis	0–74
Hodgkin's disease	0–74
Leukemia	0–44
Diseases of the thyroid	0–74
Diabetes mellitus	0–49
Epilepsy	0–74
Chronic rheumatic heart disease	0–74
Hypertensive disease	0–74
Cerebrovascular disease	0–74
All respiratory diseases (excluding pneumonia and influenza)	1–14
Influenza	0–74
Pneumonia	0–74
Peptic ulcer	0–74
Appendicitis	0–74
Abdominal hernia	0–74
Cholelithiasis and cholecystitis	0–74
Nephritis and nephrosis	0–74
Benign prostatic hyperplasia	0–74
Maternal death	All
Congenital cardiovascular anomalies	0–74
Perinatal deaths, all causes, excluding stillbirths	All
Misadventures to patients during surgical and medical care	All
Ischaemic heart disease (NOTE, only 50 per cent of deaths included)	0–74

Source: Nolte and McKee.[1]

Table A2: Indicator descriptions and data used in analyses

	Data description, source, and year
Access and preventive care indicators	
Percentage uninsured, ages 0–64	Data from annual social and economic supplement to the current population survey for years 2007–2008
Percentage of adults without a time in past year when they needed to see a doctor but could not because of cost	Data from Behavioral Risk Factor Surveillance System for years 2006–2007
Percentage of at-risk adults who visited a doctor for routine checkup in past 2 years	Percentage of adults age 50 and older, or in fair or poor health, or ever told they have diabetes or pre-diabetes, acute myocardial infarction, heart disease, stroke, or asthma who visited a doctor in the past 2 years. Data from Behavioral Risk Factor Surveillance System for years 2006–2007
Percentage of adults with a usual source of care	Percentage of adults age 18 and older who have one (or more) person they think of as their personal doctor or health-care provider. Data from Behavioral Risk Factor Surveillance System for years 2006–2007
Percentage of adults age 50 and older who received recommended screening and preventive care	Percentage of adults age 50 and older who have received: sigmoidoscopy or colonoscopy in the past 10 years or a fecal occult blood test in the past 2 years; a mammogram in the past 2 years (women only); a pap smear in the past 3 years (women only); and a flu shot in the past year and a pneumonia vaccine ever (age 65 and older only). Data from Behavioral Risk Factor Surveillance System for years 2006–2007
Percentage of adult diabetics who received recommended preventive care	Percentage of adults age 18 and older who were told by a doctor that they had diabetes and have received: hemoglobin A1c test, dilated eye exam, and foot exam in the past year. Data from Behavioral Risk Factor Surveillance System for years 2006–2007
Hospital: Recommended care	
Percentage of surgical patients who received appropriate care to prevent complications	Proportion of cases where hospitals provided five recommended processes of care for surgical patients to prevent complications: prophylactic antibiotics within 1 hour before surgery and discontinued within 24 hours after surgery; prophylactic antibiotic selection for surgical patients; surgery patients with recommended venous thromboembolism prophylaxis ordered and received within 24 hours before surgery to 24 hours after surgery. Data from CMS Hospital Compare for year 2007

Table A2 *continued*

	Data description, source, and year
Percentage of hospitalized patients who received recommended care for heart attack	Proportion of cases where hospitals provided eight recommended processes of care for patients with heart attack: aspirin at arrival and at discharge; beta-blocker at arrival and at discharge; angiotensin-converting enzyme (ACE) inhibitor for left ventricular systolic dysfunction; smoking cessation advice/counseling; thrombolytic agent received within 30 min of hospital arrival; and PCI within 90 min of hospital arrival. Data from CMS Hospital Compare for year 2007
Percentage of hospitalized patients who received recommended care for heart failure	Proportion of cases where hospitals provided four recommended processes of care for patients with heart failure: assessment of left ventricular function; use of an ACE inhibitor for left ventricular dysfunction; smoking cessation advice; and discharge instructions. Data from CMS Hospital Compare for year 2007
Percentage of hospitalized patients who received recommended care for pneumonia	Proportion of cases where hospitals provided seven recommended processes of care for patients with pneumonia: initial antibiotic within 4 hours of hospital arrival; pneumococcal vaccination; assessment of oxygenation; smoking cessation advice/counseling; blood cultures performed in emergency department before initial antibiotic received in hospital; appropriate initial antibiotic selection; and influenza vaccination. Data from CMS Hospital Compare for 2007
Percentage of hospitalized patients who received recommended care for heart attack, heart failure, and pneumonia	Proportion of cases where hospitals provided all 19 recommended processes of care for patients with heart attack, heart failure, and pneumonia as defined above. Data from CMS Hospital Compare for year 2007
Percentage of heart failure patients given written instructions at discharge	Heart failure patients with documentation that they or their caregivers were given written instructions or other educational materials at discharge. Data from CMS Hospital Compare for year 2007

Potentially preventable hospital use

Percentage of adult asthmatics with an emergency room (ER) or urgent care visit in past year	Percentage of adults age 18 and older who were told by a doctor that they had asthma and had an ER or urgent care visit in the past 12 months. Data from Behavioral Risk Factor Surveillance System for years 2001–2004

Table A2 *continued*

	Data description, source, and year
Hospital admissions for pediatric asthma per 100 000 children (ages 2–17)	Excludes patients with cystic fibrosis or anomalies of the respiratory system, and transfers from other institutions. Data from Health care Cost and Utilization Project State Inpatient Databases for year 2005
Medicare hospital admissions for ambulatory care sensitive conditions, per 100 000 beneficiaries	Hospital admissions of fee-for-service Medicare beneficiaries age 65 and older for 1 of 11 ambulatory care sensitive conditions (AHRQ PQI Indicators): short-term diabetes complications, long-term diabetes complications, lower extremity amputation among patients with diabetes, asthma, chronic obstructive pulmonary disease, hypertension, congestive heart failure, angina (without a procedure), dehydration, bacterial pneumonia, and urinary tract infection. Results calculated using AHRQ Prevention Quality Indicators, Version 3.0. Data from Medicare Standard Analytical Files (SAF) 5 per cent Data for years 2006–2007
Medicare 30-day hospital readmissions as a percentage of admissions	Fee-for-service Medicare beneficiaries age 65 and older with initial admissions due to 1 of 31 select conditions who are readmitted within 30 days following discharge for the initial admission. Data from Medicare SAF 5 per cent Data for years 2006–2007
Nursing home/home health	
Percentage of long-stay nursing home residents with a hospital admission	Percentage of long-stay residents (residing in a nursing home for at least 90 consecutive days) who were ever hospitalized within 6 months of baseline assessment. Data from Medicare enrollment data and MEDPAR File for 2006
Percentage of short-stay nursing home residents with a hospital readmission within 30 days	Percentage of newly admitted nursing home residents (never been in a facility before) who are rehospitalized within 30 days of being discharged to nursing home. Data from Medicare enrollment data and MEDPAR File for 2006
Percentage of home health patients with a hospital admission	Percentage of acute care hospitalization for home health episodes. Data from Outcome and Assessment Information Set for 2007

Source: Commonwealth Fund State Scorecard on Health System Performance, 2009, Appendix B.