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Does Payer Status Impact Clinical Outcomes after Cardiac Surgery? A Propensity Analysis

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ABSTRACT

Background: Medicaid patients bear proportionately greater financial responsibility for the cost of outpatient care and medication than non-Medicaid patients. We hypothesized that this difference in provision of continuing care would be associated with adverse clinical outcomes after cardiac surgery.

Materials and Methods: In a retrospective cohort analysis, 5056 consecutive adult patients undergoing cardiac surgery at a single institution between 2005 and 2010 were divided according to payer status. Propensity scores were calculated using 16 preoperative and demographic variables for each patient, and 461 1:1 propensity score–matched pairs were analyzed. Patient socioeconomic position was determined using aggregate data derived from zip codes. The main outcome measures were early mortality, postoperative complications, and patient survival.

Results: In multivariate analysis, Medicaid was found to be an independent predictor of worse survival after cardiac surgery (hazard ratio [HR], 2.1; 95% confidence interval [CI], 1.2-3.7; P = .01). No significant difference was observed in operative mortality in the 2 groups. After propensity score matching and controlling for socioeconomic position, the only independent predictors of worse midterm survival were an ejection fraction ≤ 30% (HR, 1.7; 95% CI, 1.1-2.7; P = .02) and a higher logistic EuroSCORE (HR, 1.03; 95% CI, 1.0-1.1; P = .02).

Conclusions: Comorbidity and lower socioeconomic status appear to be more important predictors of late mortality after cardiac surgery than payer status, which does not have a significant impact on survival.

INTRODUCTION

Medicaid is a joint federal–state health insurance program that covers disabled individuals, families, and others who cannot afford medical care [Centers for Medicare and Medicaid Services 2011], covering up to 10% of the US population (50 million people) [US Census Bureau 2011]. Recent healthcare reforms aim to significantly increase the number of people receiving Medicaid [Patient Protection and Affordable Care Act 2010; The Kaiser Commission on Medicaid and the Uninsured 2011]. Among other reductions in the scope of cover, the Deficit Reduction Act of 2005 reduced Medicaid reimbursement for post-hospital discharge medication and outpatient specialty care in comparison to non-Medicaid insurance [The Kaiser Commission on Medicaid and the Uninsured 2006]. Though previous studies have shown that Medicaid is associated with adverse outcomes after surgery [Higgins 1998; Zacharias 2005; Lemaire 2008; Kwok 2010; Allen 2011; Lapar 2011], most have not adjusted for socioeconomic status or were performed on cohorts of patients prior to the reduction in Medicaid coverage. This study was therefore designed to assess the impact of current Medicaid provision on postoperative outcomes in cardiac surgery in a cohort of patients matched for socioeconomic status and comorbidity.

MATERIALS AND METHODS

We retrospectively analyzed 5056 consecutive patients who underwent cardiac surgery at Mount Sinai Medical Center (New York, NY) between January 2005 and January 2010. The research protocol was approved by the Mount Sinai School of Medicine Institutional Review Board and compliant with Health Insurance Portability and Accountability Act regulations and the ethical guidelines of the 1975 Declaration of Helsinki. The approval included a waiver of informed consent and request to access data of decedents.

In order to reduce heterogeneity of the comparison groups, patients undergoing concomitant valve and coronary procedures, aortic surgery, or treatment of congenital abnormalities were excluded, leaving 3053 consecutive patients who underwent coronary bypass (n = 1412, 46.2%) or isolated and multiple valve surgery (n = 1641, 53.8%). The mean age of patients was 63.1 ± 13.6 years, 37.4% (n = 1143) of patients were female, and 17.2% (n = 526) of patients were on Medicaid. Patient demographics are summarized in Table 1. Medicaid patients were defined as those for whom Medicaid provided payment for any portion of the hospital stay. Preoperative comorbidities and adverse postoperative outcomes

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Table 1. Preoperative Patient Characteristics According to Medicaid Status

Variable	Non-Medicaid (n = 2527, 82.8%), n (%)	Medicaid (n = 526, 17.2%), n (%)	*P*
Age ≥ 60 years	1621 (64.1)	233 (44.3)	< .001
Female sex	942 (37.3)	201 (38.2)	.687
Ejection fraction ≤ 30%	176 (7.0)	62 (11.8)	< .001
Previous myocardial infarction	473 (18.7)	129 (24.5)	.002
Body mass index > 30, kg/m^2	640 (25.3)	130 (24.7)	.769
Cerebrovascular disease	254 (10.1)	65 (12.4)	.116
Diabetes	640 (25.3)	211 (40.1)	< .001
Peripheral vascular disease	236 (9.3)	37 (7.0)	.092
Chronic obstructive pulmonary disease	145 (5.7)	27 (5.1)	.584
Active endocarditis	62 (2.5)	18 (3.4)	.228
Dialysis	98 (3.9)	21 (4.0)	.902
Urgent surgery	750 (29.7)	245 (46.6)	< .001
Current coronary artery surgery	1092 (43.2)	320 (60.8)	< .001
Calcified aorta	117 (4.6)	18 (3.4)	.220
New York Heart Association function class III/IV	1406 (55.6)	298 (56.7)	.670
Multiple valve surgery	448 (17.7)	68 (12.9)	.008
Logisitc EuroSCORE [interquartile range]	4.1 [2.1 to 8.9]	2.4 [2.1 to 7.1]	< .001
Socioeconomic position [interquartile range]	−0.41 [−3.12 to 4.18]	−2.92 [−4.91 to −1.61]	< .001
Race			< .001
White	2040 (80.7)	268 (51)	
Black	286 (11.3)	88 (16.7)	
Asian	181 (7.2)	166 (31.6)	

were defined according to the definitions used in the New York State Department of Health Division of Primary & Acute Care Services Cardiac Surgery Report [New York State Department of Health 2008]. Clinical variables including patient demographics and Medicaid status, risk factors, operative information, and in-hospital postoperative outcomes were prospectively entered into the database. Follow-up survival information for documented US patients was obtained by cross matching each patient's Social Security number with the web-based Social Security death index (http://ssdi.rootsweb.ancestry.com/) between December 2010 and March 2011. The logistic EuroSCORE [Nashef 1999] was used for risk stratification: this is a weighted risk prediction tool made up of 17 clinical and demographic variables.

Socioeconomic Position

All patient charts were retrospectively analyzed, and each patient zip code was recorded. Zip code data from the 2000 US Census Bureau [US Census Bureau 2000] were used to calculate a score estimating the individual patient's socioeconomic position. Six variables were recorded for each patient's zip code: median household income; median value of a housing unit; proportion of households receiving interest, dividends, or net rental income; proportion of adults 25 years of age and older who have graduated from college; proportion of adults 25 years of age and older who have graduated from high school; and proportion of persons 16 years of age and older who were employed in a managerial or professional occupation. The mean and standard deviation of each variable were calculated. Using these values, each variable was transformed into a Z-score by subtracting its mean and dividing by its standard deviation. Each Z-score was weighted equally, and the individual scores were summed to create a composite score, which was used to quantify each patient's socioeconomic position [Diez Roux 2001]. The US Census Bureau was unable to provide relevant socioeconomic data on 70 patients; 6 of these patients lived outside of the United States.

Data Analysis

Continuous variables are expressed as medians and interquartile ranges. Categorical variables are presented as proportions. Differences between groups were detected using the ^{2} test or Fischer's exact test for categorical variables and the Mann–Whitney *U* test for continuous variables. All tests were 2-tailed. Midterm survival was evaluated using Kaplan–Meier survival analysis and log-rank test. Logistic and Cox proportional hazards regression were performed to determine independent predictors of mortality and survival, respectively. A *P* value < .05 was considered to be statistically significant.

Table 2. Preoperative Patient Characteristics According to Medicaid Status in the Propensity-Matched Cohort

Variable	Non-Medicaid (n = 461, 50%), n (%)	Medicaid (n = 461, 50%), n (%)	*P*
Age ≥ 60 years	212 (46.0)	217 (47.1)	.741
Female sex	172 (37.3)	176 (38.2)	.786
Ejection fraction ≤ 30%	55 (11.9)	49 (10.6)	.532
Previous myocardial infarction	112 (24.3)	107 (23.2)	.699
Body mass index > 30, kg/m^2	121 (26.2)	117 (25.4)	.763
Cerebrovascular disease	60 (13.0)	56 (12.1)	.691
Diabetes	174 (37.7)	178 (38.6)	.786
Peripheral vascular disease	39 (8.5)	33 (7.2)	.461
Chronic obstructive pulmonary disease	28 (6.1)	25 (5.4)	.671
Active endocarditis	18 (3.9)	14 (3.0)	.472
Dialysis	20 (4.3)	18 (3.9)	.741
Urgent surgery	199 (43.2)	201 (43.6)	.894
Current coronary artery surgery	276 (59.9)	274 (59.4)	.893
Calcified aorta	19 (4.1)	16 (3.5)	.605
New York Heart Association function class III/IV	256 (55.5)	262 (56.8)	.690
Multiple valve surgery	49 (10.6)	62 (13.4)	.188
Logistic EuroSCORE [interquartile range]	3.37 [1.93 to 6.81]	2.91 [1.72 to 6.78]	.214
Socioeconomic position [interquartile range]	−2.97 [−5.03 to 1.20]	−2.92 [−4.91 to −1.60]	.970
Race			.034
White	246 (53.4)	260 (56.4)	
Black	110 (23.9)	75 (16.3)	
Asian	105 (22.8)	126 (27.3)	

For comparative purposes, socioeconomic position was not included in this analysis.

In a separate analysis, the propensity for all patients in our cohort to be covered by Medicaid was calculated using multivariate logistic regression. The model provided good predictive power as validated by the Hosmer and Lemeshow goodness-of-fit test ($P = .89$) and C-statistic (0.80). In order to reduce selection bias, 461 1:1 matched pairs were generated based on individual propensity score; a difference of 0.01 in propensity score was used as a cutoff to match patients. After propensity score matching, there were no significant differences between the 2 groups for any variable except for race. In order to account for the potential confounding of race after matching, the race variable was forced into all multivariable models to insure that any independent determinants of outcomes of interest were significant independent of race.

Univariate logistic regression was used to identify predictors of a combined endpoint, which included 30-day mortality or any postoperative complication. Variables with a P value ≤ .25 on univariate analysis were included into a stepwise logistic regression model. Inclusion in the stepwise model was set to a P value of .25. A sensitivity analysis was performed in order to reduce bias in the regression models by repeating the regression and lowering the threshold for inclusion to 0.10 and 0.05. Identical models were produced for all 3 thresholds, thereby ensuring a stable multivariable model. Lastly, a Cox proportional hazards regression analysis was used to identify independent predictors of poorer midterm survival. The multivariable model was built in the same fashion as the previously discussed multivariate logistic regression model. Results are presented as hazards ratios (HR) or odds ratios (OR) with corresponding 95% confidence intervals. The statistical analysis was performed using IBM SPSS Statistics for Windows, version 19.0 (SPSS, Inc., IBM Corporation, Armonk, NY, USA).

RESULTS

Unadjusted Analysis

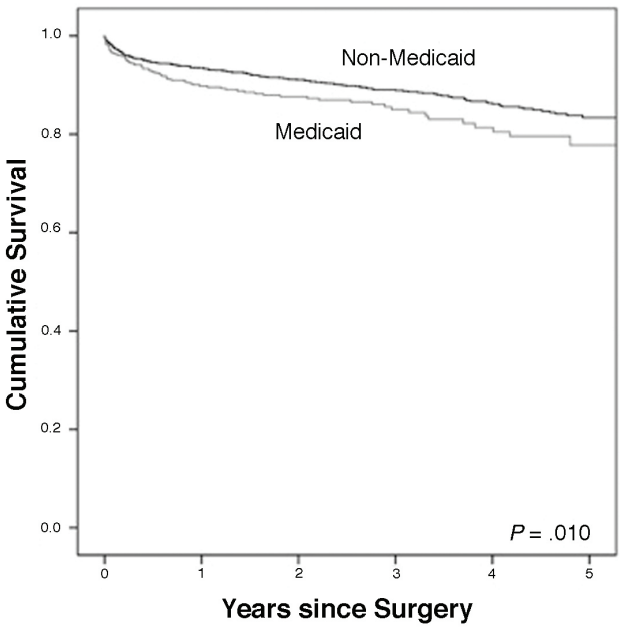
The overall differences between groups are shown in Table 1. Overall operative mortality was 2.3%, and 17.0% of patients had a major postoperative complication. No significant differences in postoperative complications were detected according to payer status (Table 2). Independent predictors of mortality are shown in Table 3. Kaplan–Meier analysis with log-rank comparison factor demonstrated a significant difference in survival between the 2 groups, 78% ± 3% versus 83% ± 1%, $P = .010$ (Figure 1), with Medicaid patients having poorer survival.

Table 3. Early Morbidity and Mortality According to Medicaid Status

	Entire Study Sample			Propensity-Matched Pairs		
	Non-Medicaid (n = 2527, 82.8%), n (%)	Medicaid (n = 526, 17.2%), n (%)	*P*	Non-Medicaid (n = 461, 50%), n (%)	Medicaid (n = 461, 50%), n (%)	*P*
Any morbidity or mortality	542 (21.4)	123 (23.4)	.328	94 (20.4)	112 (24.3)	.155
30-day mortality	52 (2.1)	18 (3.4)	.057	13 (2.8)	16 (3.5)	.571
Stroke	31 (1.2)	4 (0.8)	.500	8 (1.7)	3 (0.7)	.129
Deep sternal wound infection	39 (1.5)	4 (0.8)	.221	11 (2.4)	4 (0.9)	.075
Bleeding requiring reoperation	42 (1.7)	13 (2.5)	.204	6 (1.3)	12 (2.6)	.153
Sepsis	55 (2.2)	9 (1.7)	.498	7 (1.5)	8 (1.7)	.795
Gastrointestinal complications	26 (1.0)	3 (0.6)	.459	5 (1.1)	2 (0.4)	.451
Renal failure	53 (2.1)	12 (2.3)	.790	5 (1.1)	11 (2.4)	.206
Respiratory failure	173 (6.8)	35 (6.7)	.874	28 (6.1)	33 (7.2)	.508
Unplanned reoperation	33 (1.3)	8 (1.5)	.697	6 (1.3)	8 (1.7)	.590
Length of stay ≥ 15 days	293 (11.6)	65 (12.4)	.621	50 (10.8)	61 (13.2)	.266

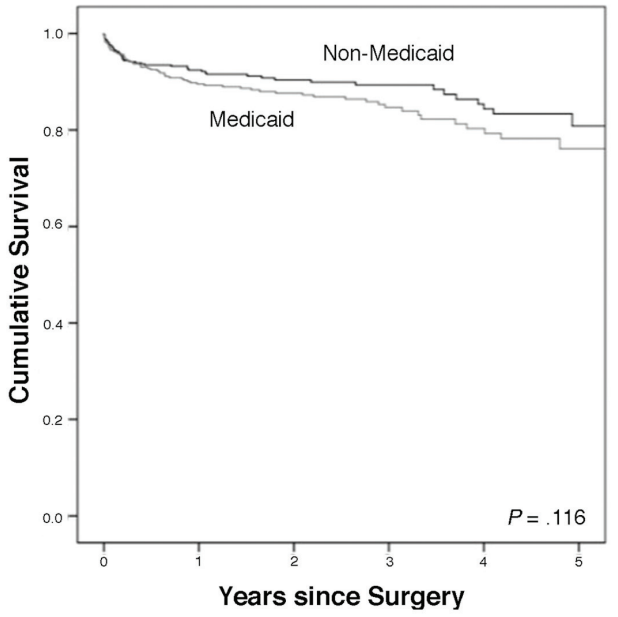
Propensity Score–Matched Analysis

Socioeconomic position was significantly lower for the Medicaid group before matching. Though socioeconomic position correlated with a handful of preoperative risk factors, including Medicaid status, none of these correlations were significant enough to indicate multi co-linearity. Patients on Medicaid were more likely to be African American, urgent, female, have ejection fraction ≤ 30%, and have cerebrovascular disease. Operative mortality in the propensity score–matched cohort was 3.1%. Multivariate predictors of early mortality and morbidity and poor survival are summarized in Tables 4 and 5. No significant differences in postoperative complications were identified during this analysis. Kaplan–Meier analysis with log-rank comparison factor demonstrated no difference in survival



Number of Remaining Cases						
Years since Surgery	0	1	2	3	4	5
Medicaid	526	380	269	156	97	25
Non-Medicaid	2527	1871	1177	707	469	169

Figure 1. Unadjusted Kaplan-Meier actuarial survival curve for all patients according to Medicaid status.



Number of Remaining Cases						
Years since Surgery	0	1	2	3	4	5
Medicaid	461	333	239	133	81	19
Non-Medicaid	461	329	200	134	85	28

Figure 2. Propensity score-adjusted Kaplan-Meier actuarial survival curve for matched patients according to Medicaid status.

Table 4. Multivariate Logistic Regression Analysis for Independent Determinants of Any Morbidity or Mortality

Variable	*P*	Odds Ratio	95% Confidence Interval
Ejection fraction ≤ 30%	.002	2.11	1.30 to 3.40
Multiple valve surgery	.004	2.03	1.26 to 3.27
Logistic EuroSCORE	< .001	1.05	1.02 to 1.08
Diabetes	.002	1.77	1.24 to 2.55
Active endocarditis	.023	2.61	1.14 to 5.97

between the 2 groups, $P = .116$, 81% 3% versus 76% ± 4% (Figure 2). Neither Medicaid status nor socioeconomic position was shown to be a predictor of postoperative morbidity, early mortality, or poor survival in either univariate or multivariate analysis in the propensity score–matched analysis.

DISCUSSION

Early Outcomes

Medicaid status was not associated with adverse early outcomes in this cohort. Two national registry studies examining patients undergoing valve [Lapar 2011] and endovascular abdominal aortic aneurysm surgery [Lemaire 2008] reported an association between patients receiving Medicaid and early adverse outcomes, which persisted after adjusting for socioeconomic status. Though large sample sizes increase their ability to identify small differences, both of these studies only used median income quartile as a surrogate for socioeconomic status in their analyses, whereas this study employed 6 well-validated parameters [Diez Roux 2001] to give what is more likely to be an accurate representation of the socioeconomic status for a given patient.

Midterm Survival

In the unadjusted analysis, Medicaid patients were found to have significantly poorer survival after surgery; this pattern became worse early in the postoperative period, and the trend continued to worsen with time compared to non-Medicaid patients (Figure 1). Zacharias et al reported a similar adverse association between survival after coronary bypass grafting and payer status but did not adjust for socioeconomic status [Zacharias 2005], and Kwok et al analyzed the impact of payer status on long-term outcomes after surgery for head and neck cancer and found that the adverse impact of Medicaid observed in these patients did persist after adjusting for socioeconomic status [Kwok 2010]. This may, however, reflect major differences between the diseases analyzed: revascularization and valve reconstruction lead to early functional improvement in many patients, whereas resection of head and neck cancers may rely on strict compliance with debilitating and costly additional treatments such as chemotherapy and radiotherapy for long-term success, which may be more likely to be affected by payer status. Controlling for several socioeconomic parameters eliminated any survival advantage for non-Medicaid patients (Figure 2) suggesting that payer status (and by extension, access to outpatient care and medication) may not be as influential in predicting poor outcomes as major comorbidities and socioeconomic factors.

Table 5. Cox Proportional Hazard Regression Analysis for Independent Determinants of Poor Survival

Variable	*P*	Hazard Ratio	95% Confidence Interval
Logistic EuroSCORE	.017	1.03	1.01 to 1.05
Ejection fraction ≤ 30%	.024	1.71	1.07 to 2.73

Socioeconomic Position and Reforms

In 2005, federal budgetary reforms left Medicaid patients with more financial responsibility for outpatient care and medications. The US federal government has recently increased the number of patients eligible for Medicaid, while gearing provision toward preventative medicine, children, and the elderly. Although these reforms have been criticized for failing to address the specific ongoing care needs of surgical patients [The Henry J. Kaiser Family Foundation Focus on Health Reform 2011], this study indicates that several preventable comorbidities and socioeconomic status are strongly predictive of adverse outcomes. The current focus on increasing education and access to primary and secondary preventative medicine [US Congressional Budget Office 2009] may therefore be a reasonable part of a strategy aimed at reducing adverse outcomes in this patient population.

Strengths and Limitations

The present study provides the most current representation of the care received by Medicaid patients undergoing cardiac surgery and its impact on postoperative outcomes and midterm survival. To the best of our knowledge, it is the first study to control for comorbidity and socioeconomic status in this patient group. However, this study is retrospective and observational, and thus its conclusions are limited in their application. Though we used several measures to calculate socioeconomic position, we only had access to patient zip codes and thus could not gather Census data on the block or tract level, which may provide a more accurate estimation of an individual's socioeconomic position. We employed multiple statistical methods, including conventional risk adjustment and propensity score matching in order to minimize bias in our study. Despite the use of these methods, other potential key confounders may not have been included in the model. Measured clinical outcomes were limited to major postoperative morbidity and mortality, with no data on late complications, late measures of health, or cause of death. Additionally, patients may move in and out of Medicaid coverage; only Medicaid status at the time of surgery was available in this study.

CONCLUSION

The association between payer status and adverse outcomes after cardiac surgery reported in several previous studies appears to be primarily due to the confounding variables of socioeconomic status and comorbidity. It remains to be seen whether the redirection of Medicaid provision from outpatient care toward health education and primary prevention will have a significant impact on clinical outcomes of patients with cardiovascular disease.

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REFERENCES

Allen JG, Arnaoutakis GJ, Orens JB, et al. 2011. Insurance status is an independent predictor of long-term survival after lung transplantation in the United States. J Heart Lung Transplant 30:45-53.

Bachrach D, Boozang PM, Dutton MJ, Holahan D. 2011. "Revisioning" Medicaid as Part of New York's Coverage Continuum. New York: Medicaid Institute at United Hospital Fund. Available at: http://healthcarereform.ny.gov/research_and_resources/docs/revisioning_medicaid.pdf. Accessed June 22, 2011.

Centers for Medicare and Medicaid Services, US Department of Health and Human Services, Medicaid Eligibility, December, 14 2005. Available at: http://www.cms.gov/MedicaidEligibility/02_AreYouEligible. Accessed June 22, 2011.

DeNavas-Walt C, Proctor BD, Smith JC. 2010. US Census Bureau, Current Population Reports, P60-238. *Income, Poverty, and Health Insurance Coverage in the United States: 2009*. Washington, CD: US Government Printing Office. Available at: http://www.census.gov/prod/2010pubs/p60-238.pdf. Accessed June 22, 2011.

Diez Roux AV, Merkin SS, Arnett D, et al. 2001. Neighborhood of residence and incidence of coronary heart disease. N Engl J Med 345:99-106.

Higgins RS, Paone G, Borzak S, Jacobsen G, Peterson E, Silverman NA. 1998. Effect of payer status on outcomes of coronary artery bypass surgery in blacks. Circulation 98:II46-9.

Koch CG, Li L, Kaplan GA, et al. 2010. Socioeconomic position, not race, is linked to death after cardiac surgery. Circ Cardiovasc Qual Outcomes. 3:267-76.

Kwok J, Langevin SM, Argiris A, Grandis JR, Gooding WE, Taioli E. 2010. The impact of health insurance status on the survival of patients with head and neck cancer. Cancer 116:476-85.

Lapar DJ, Bhamidipati CM, Walters DM, et al. 2011. Primary payer status affects outcomes for cardiac valve operations. J Am Coll Surg 212:759-67.

Lemaire A, Cook C, Tackett S, Mendes DM, Shortell CK. 2008. The impact of race and insurance type on the outcome of endovascular abdominal aortic aneurysm (AAA) repair. J Vasc Surg 47:1172-80.

Nashef SA, Roques F, Michel P, Gauducheau E, Lemeshow S, Salamon R. 1999. European system for cardiac operative risk evaluation (EuroSCORE). Eur J Cardiothorac Surg 16:9-13.

New York State Department of Health, Division of Primary and Acute Care Services, Cardiac Services Program. Cardiac Surgery Report, Adult. 2008.

Patient Protection and Affordable Care Act of 2010, Pub. L. No. 111-148, 124 Stat 1025 (2010)

The Henry J. Kaiser Family Foundation Focus on Health Reform. 2011. Summary of New Health Reform Law. Available at: http://www.kff.org/healthreform/upload/8061.pdf. Accessed June 22, 2011.

The Kaiser Commission on Medicaid and the Uninsured. 2006. Deficit Reduction Act of 2005: Implications for Medicaid. Available at: http://www.kff.org/medicaid/upload/7465.pdf. Accessed June 22, 2011.

The Kaiser Commission on Medicaid and the Uninsured. 2011. Enhanced Medicaid Match Rates Expire in June 2011. Available at: http://www.kff.org/medicaid/upload/8205.pdf. Accessed June 22, 2011.

US Census Bureau, American Fact Finder: Census 2000, Washington, DC, 2011; http://factfinder.census.gov/

US Congressional Budget Office. Estimates of direct spending and revenue effects of the Patient Protection and Affordable Care Act. November 18, 2009. Available at http://www.cbo.gov/ftpdocs/107xx/doc10731/Reid_letter_11_18_09.pdf. Accessed June 22, 2011.

Zacharias A, Schwann TA, Riordan CJ, et al. 2005. Operative and late coronary artery bypass grafting outcomes in matched African-American versus Caucasian patients: evidence of a late survival-Medicaid association. J Am Coll Cardiol 46:1526-35.