

The Influence of Year-end Bonuses on Colorectal Cancer Screening

Brian S. Armour, PhD; Carol Friedman, DO; M. Melinda Pitts, PhD;
Jennifer Wike, MBA, MPH; Linda Alley, PhD; and Jeff Etchason, MD

Objective: To estimate the effect of physician bonus eligibility on colorectal cancer (CRC) screening, controlling for patient and primary care physician characteristics.

Study Design: Retrospective study using managed care plan claims data from 2000 and 2001.

Methods: Data on 50-year-old commercially insured patients in a managed care health plan were linked to enrollment and provider files. The data included information on 6749 patients (3058 in 2000 and 3691 in 2001). Multivariate logistic regression models were used to assess the association between CRC screening receipt and physician bonus eligibility.

Results: From 2000 to 2001, CRC screening use increased from 23.4% to 26.4% ($P < .01$). Results from the multivariate logistic regression analysis revealed that the probability that a patient received a CRC screening was approximately 3 percentage points higher in the bonus year, 2001 ($P < .01$).

Conclusions: Bonuses targeted at individual physicians were associated with increased use of CRC screening tests. However, more research is needed to examine the effect of performance-based incentives on resource use and the quality of medical care. Specifically, there is a need to determine whether explicit financial incentives are effective in reducing racial disparities in the quality of patient care. This has particular relevance for CRC screening given that black patients are less likely to be screened, they have higher CRC incidence and mortality rates compared with other racial groups, and screening has been shown to be more cost effective in this population.

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Colorectal cancer (CRC) is the second leading cause of cancer-related death in the United States. The American Cancer Society (ACS) estimated that there would be 147 500 newly diagnosed cases of CRC and almost 57 100 deaths in 2003.¹ In addition, CRC is expensive to treat, with costs estimated at \$6.5 billion per year.² Several national organizations have recommended fecal occult blood testing (FOBT), flexible sigmoidoscopy, colonoscopy, or double-contrast barium enema as effective screening options for persons aged 50 years and older.³⁻⁶ Despite an increasing body of evidence that screening of asymptomatic persons significantly reduces mortality,⁷⁻⁹ the percentage of individuals who have been screened remains low. Estimates from the 2001 Behavioral Risk Factor Surveillance System suggest that 23.5% of respondents aged 50 and older reported having FOBT in the previous year and 47.3% reported undergoing lower endoscopy in the last 10 years.³

An extensive review of the literature has documented various barriers to all types of cancer services, including screening, in different settings and populations.¹⁰ One explanation offered for the low rates of CRC screening is the growth in managed care organizations (MCOs). A type of plan that has flourished during the last 2 decades is the individual practice association. Individual practice associations have grown to dominate the health maintenance organization segment of managed care.¹¹ The growth in individual practice associations may be attributable, in part, to their willingness to accept insurer contracts that include explicit financial incentives.¹²

Managed care advocates suggest that MCOs' use of implicit (capitation and salary) and explicit (bonuses) financial incentives are an effective means of containing healthcare expenditures. Although there are numerous articles examining the effect of implicit financial incentives on physician behavior, little is known about the influence of explicit financial incentives on the quality of patient care.¹² Despite the paucity of empirical evidence, the use of financial incentives is considered controversial and has been the subject of intense public scrutiny and litigation,¹³ because it is generally perceived that physicians with managed care contracts face perverse financial incentives to limit access to services.^{12,14-16}

To reduce public concern surrounding MCO cost-containment measures, several health plans are using explicit physician financial incentives to improve the quality of preventive care, including cancer screening. Whether bonuses are effective in improving the quality of preventive cancer services is an empirical question. However, it is difficult to evaluate how the structure and financing of MCOs affect access to and outcomes of cancer care.¹⁷ The reason is that managed care has rap-

From the National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention (BSA, CF, LA); Federal Reserve Bank of Atlanta (MMP); and Kerr L. White Institute for Health Services Research (JW, JE); Atlanta, Ga.

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Address correspondence to: Brian S. Armour, PhD, Office on Smoking and Health, Centers for Disease Control and Prevention, 4770 Buford Highway NE, MS K50 (Rhodes), Atlanta, GA 30041. E-mail: barmour@cdc.gov.

idly evolved during the last 25 years, and little information is available on the new types of plans and physician incentive arrangements.^{12,16}

Beginning in January 2001, a large managed care health plan operating in the southeastern United States implemented a year-end bonus program that was designed, in part, to improve CRC screening use among an individual practice association's primary care physicians (PCPs). The objective of this study was to estimate the effect of physician bonus eligibility on CRC screening, controlling for patient and PCP characteristics. From a policy standpoint, it is important to establish that MCOs' use of explicit financial incentives contributes to improving the quality of care. This is especially relevant in an area such as CRC screening, in which practice has been documented to be particularly deficient.³

METHODS

Data

Managed care health plan claims data for 2000 and 2001 for all commercially insured persons aged 50 years as of January 1, 2000, and January 1, 2001, were retrospectively linked to enrollment and provider files to examine the association between CRC screening rates and year-end bonuses. The patient data included enrollment information, demographic characteristics (age and sex), ZIP code, and CRC procedure codes. Several patient characteristics, including race, income, and educational attainment, are associated with CRC screening receipt.¹⁹⁻²⁵ Because these variables were not collected by the health plan, we imputed this information using patients' 5-digit ZIP codes, which were linked to the *Census 2000: Summary File 3* of the US Bureau of the Census.²⁶ *Race* was defined as the percentage of the population in each ZIP code that is black. *Income* was defined as income per capita by ZIP code. *Educational attainment* information was used to create 3 variables that categorized the patient's neighborhood as follows: percentage with less than a high school education, percentage of high school graduates, and percentage of college graduates.

The provider data included PCP characteristics such as sex, year of medical school graduation, medical specialty, and whether the provider was eligible for the year-end bonus. Primary care physician experience was measured in years and was calculated by subtracting the date of a provider's medical school graduation from the date of his or her patient's screening. For patients not screened, physician experience was calculated by subtracting the year of medical school graduation from the midpoint in the year (July 1) 2000 or 2001.

The selection criteria used to determine PCP bonus program eligibility are proprietary. Therefore, to avoid potential bias associated with selection of PCPs into the bonus program, we excluded providers and data on the patients of those providers who were ineligible for the bonus program (data on patients of PCPs ineligible for the bonus are available from the author). We also limited our sample to 50-year-old patients who were continuously enrolled in the health plan in calendar years 2000 and 2001.

The Centers for Medicare & Medicaid Services procedure coding system and *Current Procedural Terminology* codes were used to identify CRC screening procedures, including the following: FOBT, flexible sigmoidoscopy, colonoscopy, and double-contrast barium enema (a list of procedure codes used is available from the author). For persons reaching age 50 in 2000 or 2001, the CRC screening procedure codes were used to identify enrollees who received a CRC screening. Furthermore, if there was documentation of flexible sigmoidoscopy or colonoscopy in a prior year, the PCP was also given credit for a CRC screening. Screening rates for the bonus program were calculated 120 days after the close of the bonus year to minimize problems associated with time lags in the filing of claims data.

Statistical Analysis

Bivariate statistical tests (χ^2 and *t* tests) were used to compare descriptive statistics across years. A multivariate logistic regression model was used to estimate the effect that PCP bonus eligibility had on CRC screening use. The dependent variable was an indicator variable denoting whether a patient received a CRC screening. To examine the effect of the bonus, we used the year of bonus eligibility to approximate the effects of bonuses on the likelihood of CRC screening. Independent variables were patient sex (female),^{27,28} race (black),²⁸⁻³⁰ per capita income,³¹ and educational attainment.³¹⁻³³ In addition to the variable denoting the year of bonus eligibility, we included the following PCP characteristics: sex (female)³⁴ and years of experience.^{35,36} The independent variable "years of experience" was squared to capture any potential nonlinear effects of physician experience on CRC use. The inclusion of the squared term in our model was based on theory, statistical significance, goodness of fit, and biasness.^{37,38} We included a term to assess the interaction between female patient and female provider. Previous research has shown that female patients treated by female physicians were more likely to receive mammograms and Pap smears.³⁹ This interaction term allowed us to determine whether this finding extends to CRC screening. Finally, an indicator variable that distinguished PCPs with an internal medi-

cine specialty from other specialties was included to control for any unobserved differences in CRC screening rates between specialties.

All analyses were performed using SAS software, version 8 (SAS Institute, Cary, NC). This study was approved by the Institutional Review Board of the Centers for Disease Control and Prevention.

RESULTS

Sociodemographic characteristics of the patients are shown in **Tables 1** and **2**. At the ZIP code level, we estimate that 28.2% of the population was black, and per capita income averaged \$24 508. Approximately 16% of the population had less than a high school education, 54.5% were high school graduates, and 29.2% had attended college. Approximately 53% of the patients were female, and approximately 20% of all patients had a female PCP. Physician experience averaged 19.6 years. Slightly more than half (52.1%) of the patients' PCPs listed internal medicine as their specialty.

Of the 6749 patients included in our analysis, approximately 25% received a CRC screening (Table 1). Overall, CRC screening use increased approximately 3 percentage points between 2000 and 2001 (23.4% vs 26.4%, $P < .01$). Most of the increase in CRC use was attributed to a 2.8 percentage points increase in the use of FOBT (17.8% vs 20.6%, $P < .01$). The percentage of patients who received a flexible sigmoidoscopy or colonoscopy increased 1.2 percentage points between 2000 and 2001 (8.6% vs 9.8%, $P = .07$). Total CRC screening use differed by sex, with women more likely than men to have received a CRC screening test in 2000 (27.1% vs 19.0%, $P < .01$) and 2001 (32.0% vs 20.3%, $P < .01$).

Table 3 shows the odds of receiving a CRC screening procedure in the bonus year (2001), controlling for patient and PCP characteristics. The

coefficient on the key variable of interest "bonus eligibility" is positive and statistically significant ($P < .01$), indicating that patients were more likely to have received a CRC screening in 2001, the year the bonus program took effect.

The coefficient on black race is negative and statistically significant ($P = .03$), suggesting that black patients were less likely than nonblack patients to have received a CRC screening (Table 3). The coefficient on the per capita income variable is positive but not statistically significant ($P = .54$). Patients with less than a high school education were less likely to have received a CRC screening than those with a high school education; however, the difference was not statistically significant ($P = .74$). Also, college-educated patients were more likely than high school-educated patients to have received a CRC screening, although this difference was not statistically significant ($P = .21$).

Table 1. Patient and Primary Care Physician (PCP) Characteristics by Year*

Variable	2000 (n = 3058)	2001 (n = 3691)	P
Patient characteristic			
Female	54.2	52.6	.21
Black	28.5	28.0	.49
Income, per capita, \$	24 333	24 653	.13
Educational attainment			
<High school	16.5	16.1	.63
High school	54.8	54.3	.26
College	28.7	29.7	.01
CRC screening total [†]	23.4	26.4	<.01
Fecal occult blood testing	17.8	20.6	<.01
Flexible sigmoidoscopy or colonoscopy [‡]	8.6	9.8	.07
Double-contrast barium enema	1.3	1.2	.52
Multiple tests	4.2	4.8	.25
PCP characteristic			
Female	18.9	19.8	.37
Experience, years	19.2	20.0	<.01
Internal medicine specialty	51.7	52.5	.56

*Data are expressed as percentages unless otherwise indicated.

[†]The colorectal cancer (CRC) screening percentages by procedure type do not sum to the screening total because 4.2% of patients in 2000, 4.8% in 2001, and 4.5% overall received 1 or more of the screening procedures.

[‡]Because of the small sample size, we combined flexible sigmoidoscopy and colonoscopy procedures into one variable.

Table 2. Patient and Primary Care Physician (PCP) Characteristics by Type of Colorectal Cancer (CRC) Screening Procedure and Year*

Variable	CRC Screening Receipt [†]					
	Fecal Occult Blood Testing		Flexible Sigmoidoscopy or Colonoscopy [‡]		CRC Screening Total [§]	
	2000 (n = 545)	2001 (n = 760)	2000 (n = 262)	2001 (n = 363)	2000 (n = 715)	2001 (n = 976)
Patient characteristic						
Female	67.7	67.4	52.7	51.0	62.8	63.6
Black	25.7	25.5	28.9	27.3	26.4	26.6
Income, per capita, \$	25 464	25 556	26 063	25 887	25 641	25 678
Educational attainment						
<High school	15.5	15.4	14.3	15.5	15.1	15.3
High school	53.4	53.3	53.6	53.4	53.5	53.4
College	31.1	31.3	32.0	31.1	31.4	31.3
PCP characteristic						
Female	20.2	25.1	18.7	20.7	19.3	23.9
Experience, years	19.5	19.7	18.6	19.3	19.3	19.7
Internal medicine specialty	54.9	57.5	59.9	56.8	54.6	57.1

*Data are expressed as percentages unless otherwise indicated.

[†]Descriptive statistics for the double-contrast barium enema procedure were excluded because so few patients (41 in 2000 and 43 in 2001) received this type of test.

[‡]Because of the small sample size, we combined flexible sigmoidoscopy and colonoscopy procedures into one variable.

[§]The CRC screening totals for fecal occult blood testing and flexible sigmoidoscopy or colonoscopy do not sum to the overall total because patients may have received more than 1 screening procedure.

The sign on the coefficient for the female patient variable is positive and statistically significant ($P < .01$) (Table 3). The sign on the coefficient of the variable indicating whether a patient's physician was female is negative but not statistically significant ($P = .23$). The interaction term of female patient with female physician is positive and statistically significant ($P = .02$). This suggests that female patients treated by a female PCP were more likely to have received a CRC screening than male patients treated by a female PCP and male or female patients treated by a male PCP. Primary care provider experience and experience squared had no statistically significant effects on CRC screening. Physicians with internal medicine listed as their specialty were significantly more likely to provide CRC screening ($P < .01$).

Table 4 shows reestimation of the logistic regression model using FOBT and, in turn, flexible sigmoidoscopy or colonoscopy as the dependent variables. Because of the small sample size, we combined flexible sigmoidoscopy and colonoscopy procedures into one variable. For the model that had FOBT as the dependent variable, the coefficient on bonus eligibility is positive and statis-

tically significant ($P < .01$). This result indicated that the odds that a patient received FOBT increased in the bonus year. The sign on the coefficient for the female variable is positive and statistically significant ($P < .01$), indicating that women were more likely than men to have received FOBT. The coefficient on black race is negative and statistically significant ($P < .01$), suggesting that black patients were less likely than nonblack patients to have received FOBT.

For the model that had flexible sigmoidoscopy or colonoscopy as the dependent variable, the coefficient on bonus eligibility is positive ($P = .08$) (Table 4). The coefficient on the per capita income variable is positive and statistically significant ($P = .02$). A \$10 000 increase in income raises the probability of flexible sigmoidoscopy or colonoscopy screening by approximately 2%.

DISCUSSION

Our analysis shows that CRC screening use increased significantly between 2000 and 2001, sug-

gesting that year-end bonuses targeted at individual physicians were effective in improving the delivery of CRC screening procedures. This finding differs from previous work that suggested that bonuses targeted at physician group practices were ineffective in improving physician delivery of cancer screening procedures to female Medicaid managed care beneficiaries.⁴¹ However, our finding is consistent with previous empirical evidence that bonuses are more effective if they are targeted at individuals as opposed to a physician group.⁴²

One might argue that it may be appropriate to cluster at the level of the physician and perform the analysis using a random-effects model. Doing so yielded results that, for the key variable of interest, were similar to those attained at the patient level (physician-level random-effects results are available from the author).

Previous research suggests that sex and racial differences may affect CRC screening rates by type of procedure.²⁸ Among Medicare beneficiaries, women were more likely than men to receive FOBT and less likely to receive invasive procedures.²⁸ To determine whether results from previous research were generalizable to a commercially insured population, we reestimated our logistic regression model using FOBT and, in turn, flexible sigmoidoscopy or colonoscopy as the dependent variables. Consistent with previous work, we found that commercially insured women were more likely than men to have received FOBT, but found no significant gender difference for the more invasive screening procedures.

Our results suggest that the previously published finding that black Medicare beneficiaries were less likely than nonblacks to receive FOBT²⁸ extends to a com-

mercially insured population. Other findings pointed to educational attainment and income as factors accounting for racial disparities in CRC screening among Medicaid recipients.³¹⁻³³ Because we controlled for educational attainment and income in our model, we minimized these factors as possible confounders for racial differences in FOBT use in a commercially insured population.

Income was a statistically significant predictor of flexible sigmoidoscopy or colonoscopy use. Therefore, for the commercially insured population, our results suggest that costs (in particular, copays and deductibles) may be an important barrier to the use of these more expensive invasive procedures.

Our study had several limitations. We analyzed data for 2 years, the year before and the year coinciding with

Table 3. Predictors of Colorectal Cancer (CRC) Screening Use Among 6749 Patients

Variable	Adjusted Odds Ratios (95% Confidence Intervals)	Marginal Effects (P Values)*
Patient characteristic[†]		
Female	1.61 (1.42-1.83)	8.72 (<.01)
Black	0.77 (0.61-0.98)	-4.82 (.03)
Income, per capita [‡]	1.01 (0.99-1.02)	0.08 (.54)
Educational attainment		
<High school	0.84 (0.30-2.35)	-3.22 (.74)
College	1.83 (0.71-4.71)	11.17 (.21)
Primary care provider (PCP) characteristic		
Bonus eligibility	1.18 (1.05-1.32)	3.02 (<.01)
Female	0.84 (0.64-1.12)	-3.05 (.23)
Experience	1.02 (0.99-1.04)	2.90 (.19)
Experience squared	1.00 (0.99-1.00)	-0.01 (.15)
Internal medicine specialty	1.18 (1.05-1.32)	3.04 (<.01)
Female × provider female [§]	1.49 (1.07-2.05)	7.84 (.02)
Log likelihood	-3716.7

*Because of the nonlinear nature of the logistic regression model, a coefficient is not equal to the derivative of an expected value with respect to a variable. Therefore, in addition to the odds ratios, the marginal effects were estimated at the sample means and are reported as percentage point changes for each variable. The marginal effects were reported, in part, because the presenter at an econometric methods workshop, sponsored by the Centers for Disease Control and Prevention, questioned the public's understanding of odds ratio units.⁴⁰ The odds ratio gives the change in the probability of a dummy variable.⁴⁰ Patients may not think in terms of odds ratio units, but they think in terms of change (eg, if income increases by \$10 000, the probability that they received a flexible sigmoidoscopy or colonoscopy increased by approximately 0.8%).⁴⁰ Therefore, the marginal effects were reported because they are more intuitive, particularly when it comes to interpreting the effects of continuous explanatory variables such as income.

[†]The referent group is male, nonblack, and high school-educated, with a male PCP or family or general practitioner in 2000.

[‡]The income variable is measured in thousands of dollars.

[§]This term denotes the interaction between the female variable and the provider female variable.

Table 4. Predictors of Fecal Occult Blood Testing (FOBT) and Flexible Sigmoidoscopy or Colonoscopy Screening Use Among 6749 Patients*

Variable	Fecal Occult Blood Testing		Flexible Sigmoidoscopy or Colonoscopy*	
	Adjusted Odds Ratios (95% Confidence Intervals)	Marginal Effects (P Values) [†]	Adjusted Odds Ratios (95% Confidence Intervals)	Marginal Effects (P Values) [†]
Patient characteristic[‡]				
Female	1.93 (1.68-2.23)	9.79 (<.01)	0.88 (0.73-1.06)	-1.02 (.19)
Black	0.65 (0.50-0.85)	-6.49 (<.01)	1.38 (0.99-1.93)	2.66 (.06)
Income, per capita [§]	0.99 (0.98-1.01)	-0.08 (.51)	1.02 (1.01-1.04)	0.19 (.02)
Educational attainment				
<High school	1.67 (0.54-5.15)	7.71 (.37)	0.34 (0.07-1.60)	-8.97 (.17)
College	3.32 (1.17-9.37)	18.02 (.02)	0.57 (0.15-2.19)	-4.65 (.41)
Primary care provider (PCP) characteristic				
Bonus eligibility	1.20 (1.06-1.36)	2.69 (<.01)	1.16 (0.98-1.37)	1.23 (.08)
Female	0.85 (0.61-1.18)	-2.36 (.32)	0.85 (0.58-1.24)	-1.29 (.37)
Experience	1.02 (0.99-1.04)	0.24 (.21)	1.00 (0.96-1.03)	-0.02 (.91)
Experience squared	1.00 (0.99-1.00)	-0.01 (.26)	1.00 (0.99-1.00)	-0.00 (.66)
Internal medicine specialty	1.19 (1.05-1.35)	2.57 (<.01)	1.25 (1.06-1.48)	1.85 (<.01)
Female × provider female	1.54 (1.06-2.22)	7.11 (.02)	1.27 (0.81-2.00)	2.09 (.31)
Log likelihood -3215.9 -2062.7	

*Because of the small sample size, we combined flexible sigmoidoscopy and colonoscopy procedures into one variable.

[†]Because of the nonlinear nature of the logistic regression model, a coefficient is not equal to the derivative of an expected value with respect to a variable. Therefore, in addition to the odds ratios, the marginal effects were estimated at the sample means and are reported as percentage point changes for each variable. The marginal effects were reported, in part, because the presenter at an econometric methods workshop, sponsored by the Centers for Disease Control and Prevention, questioned the public's understanding of odds ratio units.⁴⁰ The odds ratio gives the change in the probability of a dummy variable.⁴⁰ Patients may not think in terms of odds ratio units, but they think in terms of change (eg, if income increases by \$10 000, the probability that they received a flexible sigmoidoscopy or colonoscopy increased by approximately 2%).⁴⁰ Therefore, the marginal effects were reported because they are more intuitive, particularly when it comes to interpreting the effects of continuous explanatory variables such as income.

[‡]The referent group is male, nonblack, and high school-educated, with a male PCP or family or general practitioner in 2000.

[§]The income variable is measured in thousands of dollars.

^{||}This term denotes the interaction between the female variable and the provider female variable.

the implementation of the year-end bonus program. Therefore, we were unable to distinguish the effect of financial bonuses from temporal trends. However, among health plan PCPs who were ineligible for the bonus program, CRC use remained unchanged between 2000 and 2001 (26.8% vs 26.4%). The presumption that the lack of a temporal trend in CRC use among PCPs ineligible for the bonus is applicable to PCPs eligible for a bonus provides credence to the effectiveness of the bonus program. Nevertheless, more research is needed to examine the effect of various financial incentive programs during a longer period to better distinguish these effects.

Changes in health status over time and the generosity of patient health insurance benefits, including deductibles and copays, are factors that may influence the use of CRC preventive screening. This information was unavailable. As a consequence, our estimates of the bonus programs' effectiveness in improving CRC screening may be biased. Also, we analyzed data for commercially insured patients residing in one state; therefore, our findings may not be generalizable to other areas of the country. We were unable to distinguish reliability between CRC procedures for screening vs diagnostic purposes. Consequently, we may have overestimated the CRC screening rates.

Providers may sometimes forgo billing for FOBT under more traditional reimbursement arrangements because they do not consider the reimbursement to be worth the administrative burden. If so, the bonus may induce providers to increase their billing for FOBT. This could bias our estimates of the actual increase in screening activities. It is beyond the capability of the present study to verify this possibility. However, we believe that the improvements in screening demonstrated in this study were not merely a function of increased billing because we found improvements in the use of other more expensive screening modalities, such as flexible sigmoidoscopy, which would not have been subject to underreporting before the bonus program.

Colorectal cancer screening is recommended for persons aged 50 years and older. However, our analysis was limited to persons aged 50 as of January 1, 2000, and January 1, 2001. The exclusion of older persons was designed to reduce problems associated with the time frame surrounding current guidelines for CRC screening. For example, the ACS⁴³ recommends flexible sigmoidoscopy every 3 to 5 years beginning at age 50 for persons at average risk for CRC. Given that we were limited to 2 years of data, we would have been unable to determine with certainty whether persons aged 52 years and older had previously received one of the more invasive types of screening procedures within the ACS's recommended time frame. Therefore, by excluding older individuals, we avoid understating CRC screening rates. We plan future studies with at least 5 years of data to determine whether our findings extend to older commercially insured persons.

Several patient characteristics, including race, income, and educational attainment, that are associated with CRC screening receipt were unavailable in the data. We imputed this information using neighborhood information obtained at the ZIP code level from the US Bureau of the Census.²⁶ By using neighborhood-level data to proxy for missing individual-level variables, our results are only suggestive of the true effects of race, income, and educational attainment on CRC screening use. Therefore, the direction of the bias of our results can only be determined when the individual-level data become available. The validity of augmenting microdata with aggregate proxies has been demonstrated⁴⁴⁻⁵² (a summary is available from the author).

In general, studies that examine the influence of explicit financial incentives on physician behavior do not usually describe the specifics of the incentive arrangement.⁵³ This is due, in part, to the fact that bonus algorithms are proprietary and unavailable to researchers. According to Kane et al,⁵³ no study has provided information on the frequency and timing of

incentive payments for preventive care. The limited amount of information that was available for the present study suggested that bonuses were paid annually and were, in part, a function of the number of a PCP's patients who were screened for CRC. We believe that the present study is one of the first to report such information. However, with additional information, including the magnitude of the bonus, one would be better able to gauge the effectiveness of explicit financial incentives.

An absolute increase of 3 percentage points in the receipt of CRC screening, while statistically significant, may not appear to some to be clinically significant. However, because of the low level of adoption of CRC screening, which has been demonstrated to be effective in reducing mortality, it is important to consider that the bonuses in our study were associated with a 12.8% relative increase in CRC screening. Because of the pronounced and persistent underuse of these lifesaving screening modalities, and in light of the fact that the National Committee for Quality Assurance recently adopted CRC screening as a new Health Plan Employer Data and Information Set effectiveness-of-care measure, evidence of interventions resulting in any improvements in screening rates should be given careful consideration by health policy decision makers.

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CONCLUSIONS

Managed care organizations are using explicit financial incentives, such as year-end bonuses, to influence physician behavior, despite a paucity of empirical evidence as to the effectiveness of these strategies.¹² The results from our study suggest that bonuses targeted at individual providers resulted in an increase in the use of CRC screening tests among a commercially insured population. However, to definitively establish a connection, additional information pertaining to the individual physician bonus amount, physician implementation expenses, and patient expenses (copays and deductibles) is required. More research is needed to examine the effect of performance-based incentives on resource use and the quality of medical care. In particular, there is a need to determine how physicians respond to the magnitude of bonus amounts at the individual and group levels. There is also a need to investigate whether explicit financial incentives are effective in reducing racial disparities in the quality of patient care. This has particular relevance for CRC screening given that black patients are less likely to be screened, they have higher CRC incidence and mortality rates compared with other racial groups, and

screening has been shown to be more cost-effective in this population.^{28,54,55}

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