Published in final edited form as:

Urology. 2018 June ; 116: 68–75. doi:10.1016/j.urology.2018.01.056.

Impact of Accountable Care Organizations on diagnostic testing for prostate cancer

Amy N. Luckenbaugh¹, Brent K. Hollenbeck^{1,2}, Samuel R. Kaufman^{1,2}, Phyllis Yan^{1,2}, Lindsey A. Herrel^{1,2}, Ted A. Skolarus^{1,2}, Edward C. Norton^{3,4,5}, Florian R. Schroeck⁶, Bruce L. Jacobs⁷, David C. Miller^{1,2}, John M. Hollingsworth^{1,2}, Vahakn B. Shahinian^{2,3}, and Tudor Borza^{1,2}

¹University of Michigan, Department of Urology

²University of Michigan, Department of Urology, Dow Division of Health Services Research

³University of Michigan, Department of Internal Medicine

⁴Department of Economics, University of Michigan, Ann Arbor, Michigan

⁵National Bureau of Economic Research, Cambridge, Massachusetts

⁶The Dartmouth Institute for Health Policy and Clinical Practice

⁷University of Pittsburgh, Department of Urology, Graduate School of Public Health

Abstract

Introduction—Changes in national PSA screening recommendations for prostate cancer have reduced screening. Accountable Care Organizations (ACOs) have the potential to accelerate the impact of these screening recommendations. The extent to which physicians in ACOs translate policy into real world practice is uncertain.

Methods—We performed a retrospective cohort study using Medicare data evaluating rates of PSA testing and prostate biopsy among men without prostate cancer between 2011–2014. We assessed PSA testing and biopsy rates before and after policy implementation among patients of ACO and non-ACO aligned physicians. To control for secular trends, difference-in-differences methods were used to determine the effects of ACO implementation.

Results—We identified 1.1 million eligible men without prostate cancer. From 2011–2014, rates of PSA testing and biopsy declined by 22.3% and 7.0%, respectively. PSA testing declined similarly regardless of ACO participation—from 618 to 530 tests per 1,000 beneficiaries among ACO-aligned physicians and from 607 to 516 tests per 1,000 beneficiaries among non-ACO aligned physicians (difference-in-differences $p=0.11$). While rates of prostate biopsy remained constant for patients of non-ACO aligned physicians at 12 biopsies per 1,000 beneficiaries, they increased from 11.6 to 12.5 biopsies per 1,000 beneficiaries of patients of ACO aligned physicians (difference-in-differences $p=0.03$).

Corresponding Author: Tudor Borza MD, MS, Dow Division for Health Services Research, Department of Urology, University of Michigan, 2800 Plymouth Road, Bldg. 16, Ann Arbor, MI 48109-2800, tborza@med.umich.edu, Office #:734-936-0054, Fax #: 734-232-2400.

Disclosures: The authors have no conflicts of interest related to this work.

Conclusion—PSA testing and prostate biopsy rates decreased significantly between 2011–2014. The rate of PSA testing was not differentially affected by ACO participation. Conversely, there was an increase in the rate of prostate biopsy among patients of ACO aligned physicians. ACOs did not accelerate de-implementation of PSA testing of eligible Medicare beneficiaries without prostate cancer.

Keywords

accountable care organizations; prostate-specific antigen; cancer screening

Introduction

Prostate cancer is the most common malignancy among men in the United States. However, many men diagnosed with the disease do not die from it,¹ raising concerns about over-treatment. Though being reconsidered,² the United States Preventative Services Task Force (USPSTF) instituted a Grade D recommendation against prostate cancer screening in 2012.³ Subsequent to this national policy statement, the American Urological Association changed professional guidelines and recommended against screening for men with a life expectancy less than ten years.⁴ As a result, there has been a decline in the rates of PSA testing,⁵ prostate biopsy performance⁶ and prostate cancer diagnosis;⁷ however, screening outside of the policy recommendations continues.⁸

Accountable Care Organizations (ACOs), which aim to improve the value of healthcare (i.e., improve quality and decrease costs),^{9,10} have the potential to accelerate the adoption of recommendations against PSA testing. ACOs participating in the Medicare Shared Savings Program are incentivized to achieve quality and spending benchmarks through receipt of bonus payments. In this context, the use of both PSA testing and prostate biopsy increase potentially wasteful spending, making their use a potential target for cost-reduction efforts. The USPSTF recommendations provide grounds by which PSA testing and subsequent biopsy could be avoided. Since much of PSA testing is performed by primary care physicians, those providers with incentives to reduce spending through ACO alignment may demonstrate better adherence with national policy statements. Conversely, prostate biopsies are performed by urologists—whose participation in ACOs is limited¹¹—and may be less responsive to the spending benchmarks set forth by ACOs.

Given this dichotomy, we hypothesized that strong engagement of primary care physicians in ACOs would result in lower rates of PSA testing for those aligned to ACOs. We further hypothesized that rates of prostate biopsy would be unaffected by ACO alignment. To test these hypotheses, we used national Medicare data for 2011 through 2014—the period surrounding ACO implementation—and utilized difference-in-differences analyses to isolate the impact of ACO implementation from established secular trends in PSA testing and prostate biopsy use.

Methods

Study Population

We used a 20% sample of national Medicare data to perform a retrospective cohort study among men 66 years and older. To ensure complete assessment of medical care, we included men with continuous enrollment in Medicare Parts A and B and excluded those enrolled in Medicare Advantage plans. We identified men with prevalent and incident prostate cancer using established methods.¹² These men were excluded, as they no longer represent a population suitable for screening. Men developing prostate cancer during the study period were censored at the time of diagnosis.

Alignment of Beneficiaries to ACO Physicians

Using the Provider-level Research Identifiable File provided by CMS, we determined whether primary care providers were aligned with a Shared Savings ACO for the years 2012 through 2014 (N.B. The first ACOs came online in July 2012). This created two groups of primary care providers—those aligned to ACOs and those unaligned. Using rules established by the Centers for Medicare and Medicaid Services (CMS),¹³ we then assigned patients to their respective primary care provider beginning in 2011. This design allowed us to compare two distinct patterns of healthcare delivery—trends over time within organizations (i.e., ACOs and non-ACOs) before and after ACO policy implementation; and, differences in trends between organizations (i.e., ACOs versus non-ACOs).

Analysis

We assessed overall trends in PSA testing and prostate biopsy between 2011 and 2014 using International Classification of Diseases, Ninth Revision diagnosis codes (for PSA testing) and Healthcare Common Procedures Coding System (for prostate biopsy). Rates were measured at the beneficiary level. The numerator was determined by the number of beneficiaries receiving a test in a given year; the denominator was defined by the number of beneficiaries that met our inclusion criteria.

We assessed differences in patient characteristics according to ACO alignment using chi-square tests. We then measured rates in PSA testing and prostate biopsy over time using generalized estimating equations. Models were adjusted for age, race, comorbidity, neighborhood socioeconomic status assessed at the zip code level, and extent of urbanization [i.e., large city (> 1 million metropolitan county), small city (<1 million metropolitan county), town (>2500 urban population), or rural (<2500 urban population)].

To separate the effect of the ACO policy from changes due to secular trends (i.e., decrease in PSA screening as a function of USPSTF recommendations³) we used difference-in-differences methods.¹⁴ Since both ACO and non-ACO providers had similar exposures to the changing landscape of PSA screening, differences in trends between these two groups can be attributed to the ACO policy. To do this, we separately modeled adjusted rates of PSA testing and prostate biopsy according to ACO alignment using generalized estimating equations. For ACO aligned physicians, rates were estimated before and after they became ACO aligned. For non-ACO aligned physicians, pre-ACO implementation rates were

estimated between January 1, 2011, and December 31, 2012. Post-ACO implementation rates were assessed from January 1, 2013 through December 31, 2014. The difference-in-differences in rates over time between ACO and non-ACO aligned physicians represents the isolated effect of the ACO policy on either PSA testing or prostate biopsy.^{15–17}

We used the same approach to assess the effect of ACO implementation on two subgroups that stand to benefit the least from early detection of prostate cancer. Clinical guidelines suggest that men with a life-expectancy less than 10 years are highly unlikely to benefit from intervention, particularly for low and intermediate risk tumors.^{18–21} To explore the ACO effect in this population, we identified two subgroups of men. The first group was men aged 75 years and older. The second group was those beneficiaries with a greater than 75% probability of dying within 10 years, derived from claims using established methods.^{22,23} While there may be reasons for early diagnosis and/or treatment in either of these groups, both should be enriched with men who stand less to gain from detection, relative to younger, healthier men. We posited that these subgroups would be more sensitive to evidence-based practice implied by the USPSTF recommendation, as the use of both PSA testing and biopsy is even more controversial in these populations.

Statistical analysis was performed using SAS 9.4 and Stata 14. All statistical testing was two-tailed and P-values <0.05 were considered significant. The University of Michigan institutional review board deemed this study exempt.

Results

Among eligible men, 144,109 (13.8%) were aligned to primary care providers in ACOs, while 900,939 (86.2%) were not. The characteristics of patients according to ACO participation by their physician are shown in Table 1. We observed small, but statistically significant differences in age, race, and comorbidity. However, these differences were small in magnitude and unlikely to be of clinical significance. In contrast, there were significant, larger differences between the two groups in terms of their neighborhood socioeconomic status and location of residence. Patients aligned to ACO physicians resided in more affluent areas (42.7% versus 36.8% in the highest socioeconomic class) and were likely to be located in more urban areas (50.7% versus 43.9%).

As shown in Figure 1, the unadjusted number of PSA tests and prostate biopsies decreased by 22.3% and 7.0%, respectively, between 2011 and 2014. After risk adjustment, annual PSA testing declined similarly regardless of ACO participation by a patient's primary care physician - from 607 to 516 PSA tests per 1,000 beneficiaries ($p<0.0001$) and from 618 to 530 PSA tests per 1,000 beneficiaries ($p<0.0001$) among ACO and non-ACO aligned physicians, respectively. We found no impact of ACO participation by primary care providers on PSA testing overall (Figure 2a, difference-in-differences estimator $p=0.11$). Among men aged 75 years and older and those with high risk of mortality in 10 years we found a decline in PSA testing overall ($p<0.0001$). However, we found no impact of ACO participation by primary care providers on PSA testing among men aged 75 years and older (Figure 2b, difference-in-differences estimator $p=0.55$) and among those with high risk of mortality within 10 years (Figure 2c, difference-in-differences estimator $p=0.85$).

In contrast, for ACO aligned beneficiaries prostate biopsy increased from 11.6 to 12.5 biopsies per one-thousand beneficiaries ($p<0.0001$). For non-ACO aligned beneficiaries prostate biopsy rate remained stable at 12 biopsies per 1,000 beneficiaries ($p<0.0001$). Alignment of primary care providers with ACOs resulted in an increase in the rate of prostate biopsy (Figure 3a, difference-in-differences estimator $p=0.04$). However, ACO alignment did not affect the rate of prostate biopsy for men 75 years and older (Figure 3b, difference-in-differences estimator $p=0.11$) or in men with the highest risk of mortality within 10 years (Figure 3c, difference-in-differences estimator $p=0.80$).

Discussion

Consistent with prior work in this area,⁵ rates of PSA testing declined between 2011 and 2014—a period of time which included USPSTF recommendations against PSA screening for prostate cancer.³ However, ACO alignment of primary care physicians did not accelerate the de-implementation of PSA testing. There was no effect in either the overall cohort or in subgroups least likely to benefit from early detection of prostate cancer. Commensurate with declines in PSA testing, we observed a decline in the rate of prostate biopsy. However, ACO participation attenuated the rate of decline.

ACOs were established with the goal of improving population health by improving quality and decreasing spending.²⁴ How they aim to achieve the former is through the use of evidence based medicine, care coordination and enhanced integration across disciplines.²⁵ Accomplishing the latter will invariably require eliminating unnecessary spending. It is surprising that rates of PSA testing were not declining faster among ACO participating providers, especially for patients least like to benefit from PSA testing—those over 75 and with the highest risk of 10-year mortality. Although speculative, one reason might be the strong multidimensional incentives to de-implement testing for all primary care physicians, not just for those aligned to ACOs. Potential incentives include enhanced adherence guideline-based care, on which performance rewards can be based, and the associated reduction in workload (i.e., need for follow-up).

With regard to prostate biopsy, we would not suspect the rate of abnormal PSA test results to vary systematically across the large populations of men in and out of ACOs. Thus, the attenuated decline in the rate of prostate biopsy among ACOs represents a lower threshold to follow-up on a presumably abnormal result. Whether this reflects better or worse quality is unclear. On one hand, ACOs are more common in urban areas with competitive marketplaces. Thus, urologists caring for men aligned with ACOs may be pressured to maintain market share, therefore continuing to perform prostate biopsies at higher rates relative to urologists managing men not aligned with ACOs. On the other hand, primary care providers aligned with ACOs may be more likely to refer to urologists for consideration of prostate biopsy given a positive result. In this context, the higher rates of prostate biopsy may reflect improved care coordination among ACO participants.

Our findings have several important implications. For patients, reductions in PSA testing, independent of ACO alignment, results in fewer prostate cancer diagnoses. This reflects efforts to reduce over-diagnosis and overtreatment of prostate cancer.^{7,26} However, men least

likely to benefit from prostate cancer screening (men over 75 and those with the highest risk of mortality at 10 years) continue to be screened. This is an area for further improvement in prostate cancer screening. Furthermore, lack of ability of ACOs to further reduce PSA testing and biopsy performance may reflect limitations of ACO policy. Specifically, with regards to PSA performance ACOs do not explicitly focus on reducing PSA testing and thus this may not be a current focus of ACO aligned primary care physicians. Biopsy performance remains largely in the hands of urologists who are often unengaged in ACOs. Stronger engagement of specialty providers in ACOs is needed to maximize the impact of ACO policy.

Our findings should be considered in the context of several limitations. An important limitation of our study is the prevalence of prostate cancer and the potential inclusion of patients with pre-existing prostate cancer in our analysis. We expect this to have minimal impact on our findings for two reasons. First, we used an established validated algorithm to identify men with prostate cancer in Medicare claims and excluded them.²⁷ Second, as we would not expect the rate of prevalent prostate cancer to differ across large populations, any misclassification would be non-differential. A second limitation of our study is the absence of clinical detail available in administrative data sets. We do not have information regarding PSA levels or digital rectal exam; thus, we cannot comment on the appropriateness of PSA testing or prostate biopsy, or on the underlying rationale motivating the test. Regardless, there is no biological reason to suspect that such clinical characteristics would vary systematically across these large populations.

These limitations notwithstanding, ACO alignment did not accelerate the decline in PSA testing among male Medicare beneficiaries, even for patients over 75 and those with the highest risk of mortality in 10 years, who are least likely to benefit from PSA testing. ACOs aim to improve quality through adherence to evidence based medicine, and therefore, the absence of an accelerated de-implementation of PSA testing in this group is surprising. As national recommendations evolve to favor screening in some populations, it will be important to determine if ACOs can devise strategies that facilitate guideline-concordant PSA testing in the populations who stand to benefit the most, while continuing with de-implementation of screening amongst those who should not be screened.

Acknowledgments

Source of funding: This work was supported by the American Cancer Society (RSG 12-323-01-CPHPS), the National Cancer Institute (R01 CA168691, R01 CA174768, T32 CA180984), the National Institute on Aging (R01 AG048071) and the Agency for Healthcare Research and Quality (R01 HS025707, 1R01HS024525 01A1, and 1R01HS024728 01).

References

1. Miller KD, Siegel RL, Lin CC, et al. Cancer treatment and survivorship statistics, 2016. *CA Cancer J Clin.* 2016; 66:271–89. [PubMed: 27253694]
2. U.S. Preventive Services Task Force: Draft Recommendation Statement: Prostate Cancer: Screening. 2017
3. Moyer VA. Force USPST: Screening for prostate cancer. U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2012; 157:120–34. [PubMed: 22801674]

4. Carter HB, Albertsen PC, Barry MJ, et al. Early detection of prostate cancer: AUA Guideline. *J Urol.* 2013; 190:419–26. [PubMed: 23659877]
5. Jemal A, Ma J, Siegel R, et al. Prostate Cancer Incidence Rates 2 Years After the US Preventive Services Task Force Recommendations Against Screening. *JAMA Oncol.* 2016; 2:1657–1660. [PubMed: 27541955]
6. Halpern JA, Shoag JE, Artis AS, et al. National Trends in Prostate Biopsy and Radical Prostatectomy Volumes Following the US Preventive Services Task Force Guidelines Against Prostate-Specific Antigen Screening. *JAMA Surg.* 2017; 152:192–198. [PubMed: 27806151]
7. Barocas DA, Mallin K, Graves AJ, et al. Effect of the USPSTF Grade D Recommendation against Screening for Prostate Cancer on Incident Prostate Cancer Diagnoses in the United States. *J Urol.* 2015; 194:1587–93. [PubMed: 26087383]
8. Sammon JD, Abdollah F, Choueiri TK, et al. Prostate-Specific Antigen Screening After 2012 US Preventive Services Task Force Recommendations. *JAMA.* 2015; 314:2077–9. [PubMed: 26575066]
9. Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health Aff (Millwood).* 2008; 27:759–69. [PubMed: 18474969]
10. Berwick DM. ACOs—promise, not panacea. *JAMA.* 2012; 308:1038–9. [PubMed: 22968894]
11. Hawken SR, Herrel LA, Ellimoottil C, et al. Urologist Participation in Medicare Shared Savings Program Accountable Care Organizations (ACOs). *Urology.* 2016; 90:76–80. [PubMed: 26809069]
12. Hollenbeck BK, Bierlein MJ, Kaufman SR, et al. Implications of evolving delivery system reforms for prostate cancer care. *Am J Manag Care.* 2016; 22:569–75. [PubMed: 27662220]
13. CMS.gov. Medicare Shared Savings Program: Shared Savings and Losses and Assignment Methodology Specifications, Version 4. <https://http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/sharedsavingsprogram/Financial-and-Assignment-Specifications.html>
14. Dimick JB, Ryan AM. Methods for evaluating changes in health care policy: the difference-in-differences approach. *JAMA.* 2014; 312:2401–2. [PubMed: 25490331]
15. EC N. Computing interaction effects and standard errors in logit and probit models. *Stata J.* 2004; 4:255–274.
16. Karaca-Mandic P, Norton EC, Dowd B. Interaction terms in nonlinear models. *Health Serv Res.* 2012; 47:255–74. [PubMed: 22091735]
17. Herrel LA, Norton EC, Hawken SR, et al. Early impact of Medicare accountable care organizations on cancer surgery outcomes. *Cancer.* 2016; 122:2739–46. [PubMed: 27218198]
18. Albertsen PC, Moore DF, Shih W, et al. Impact of comorbidity on survival among men with localized prostate cancer. *J Clin Oncol.* 2011; 29:1335–41. [PubMed: 21357791]
19. Daskivich TJ, Chamie K, Kwan L, et al. Comorbidity and competing risks for mortality in men with prostate cancer. *Cancer.* 2011; 117:4642–50. [PubMed: 21480201]
20. Lu-Yao GL, Albertsen PC, Moore DF, et al. Outcomes of localized prostate cancer following conservative management. *JAMA.* 2009; 302:1202–9. [PubMed: 19755699]
21. Tewari A, Johnson CC, Divine G, et al. Long-term survival probability in men with clinically localized prostate cancer: a case-control, propensity modeling study stratified by race, age, treatment and comorbidities. *J Urol.* 2004; 171:1513–9. [PubMed: 15017210]
22. Gross CP, McAvay GJ, Krumholz HM, et al. The effect of age and chronic illness on life expectancy after a diagnosis of colorectal cancer: implications for screening. *Ann Intern Med.* 2006; 145:646–53. [PubMed: 17088577]
23. Jacobs BL, Zhang Y, Schroek FR, et al. Use of advanced treatment technologies among men at low risk of dying from prostate cancer. *JAMA.* 2013; 309:2587–95. [PubMed: 23800935]
24. McWilliams JM, Hatfield LA, Chernew ME, et al. Early Performance of Accountable Care Organizations in Medicare. *N Engl J Med.* 2016; 374:2357–66. [PubMed: 27075832]
25. Khullar D, Rao SK, Chaguturu SK, et al. The evolving role of subspecialties in population health management and new healthcare delivery models. *Am J Manag Care.* 2016; 22:e192–5. [PubMed: 27355905]
26. Lee DJ, Mallin K, Graves AJ, et al. Recent Changes in Prostate Cancer Screening Practices and Epidemiology. *J Urol.* 2017

27. Borza T, Kaufman SR, Shahinian VB, et al. Sharp Decline In Prostate Cancer Treatment Among Men In The General Population, But Not Among Diagnosed Men. *Health Aff (Millwood)*. 2017; 36:108–115. [PubMed: 28069853]

a.

b.

Figure 1.
Overall trends in the use of **a.** PSA testing and, **b.** prostate biopsy

a.

b.

c.

Figure 2. Changes in annual PSA testing with regard to ACO Implementation for **a.** entire cohort, **b.** men age 75 and older, **c.** men with life expectancy less than ten years

a.

b.

c.

Figure 3. Changes in annual biopsy with regard to ACO implementation for **a.** entire cohort **b.** men age 75 and older **c.** life expectancy less than ten years

Table

Patient characteristics by ACO Alignment

	ACO Aligned (n=144109)	Non-ACO Aligned (n=900939)	P-value
Age (%)			0.003
66–69	26.8	26.5	
70–74	27.4	27.4	
75–79	19.8	20.2	
80–84	14.2	14.3	
85+	11.8	11.6	
Race (%)			<0.001
Caucasian	92.4	91.9	
African-American	4.5	4.5	
Hispanic	0.4	0.4	
Asian	0.7	0.8	
Other/unknown	2	2.4	
Comorbidity (%)			0.003
0	64.2	64.7	
1	22.1	21.9	
2	8.3	8.0	
3+	5.4	5.4	
Neighborhood Socioeconomic Status (%)			<0.001
Low	23.6	29.9	
Medium	33.7	33.3	
High	42.7	36.8	
Urban status			<0.001
Large City	50.7	43.9	
Small City	34.8	35.1	
Town	12.9	18.8	
Rural	1.6	2.2	