Effect of the 2012 US Preventive Services Task Force Recommendations on Prostate-Specific Antigen Screening in a Medicare Advantage Population

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Background: In 2012, the US Preventive Service Task Force revised its recommendations for prostate-specific antigen (PSA) screening from "insufficient evidence" to "do not recommend" for men aged 70–74 while maintaining "do not recommend" for men aged 75+.

Methods: Using the difference-in-difference approach, we evaluated whether the rate of change in the use of low-value PSA screening differed between the control group (men aged 75+, N = 7,856,204 person–years) and the intervention group (men aged 70–74, N = 5,329,192 person–years) enrolling in the Medicare Advantage plan without a history of prostate cancer within the OptumLabs Data Warehouse claims data (2009–2019). A generalized estimating equation logistic model was specified with independent variables: an intervention group indicator, a pre- and post-period (after 2012 Q2) indicator, index time, and interaction terms. We assumed a 12-month dissemination period.

Results: Before the revised recommendation in 2012, the trends did not significantly differ between the 2 age groups with the odds of receiving PSA screening decreasing by 1.2% (95% confidence interval [1.0, 1.4%]) per quarter. However, the odds of receiving PSA screening increased by 3.0% [2.8, 3.2%] per quarter across both groups since the revision. There was no significant additional change in the trend for those aged 70–74 (0.1% [−0.2, 0.5%]).

Conclusions: Although the 2012 US Preventive Service Task Force's recommendations were expected to only change behaviors among men aged 70–74, our analysis found that men aged 70–74 and aged 75+ exhibited similar trends from 2009 to 2019, including the increased use of low-value PSA screening since 2016. Multifaceted efforts to discourage low-value PSA screening would be important for a sustained impact.

Key Words: low-value care, preventive service, prostate cancer screening, USPSTF, medical advantage

(*Med Care* 2022;00: 000–000)

The US Preventive Services Task Force (USPSTF) provides evidence-based national recommendations for preventive services.[1] Its recommendations have been influential, as reflected by the elimination of copayments for any USPSTF preventive services receiving an A or B grade in the Affordable Care Act.[2] The USPSTF recommendations for prostate-specific antigen (PSA) screening for prostate cancer have evolved.[3–5] PSA tests for prostate cancer screening among men 75 and older have not been recommended as evidence suggests that its risk of harms outweighs its benefits.[3–5] Potential harms include risk for false-positive results, pain, and infection associated with the follow-up biopsy, over-diagnosis resulting in non-beneficial treatment, and treatment complications such as urinary or fecal incontinence and erectile dysfunction. The survival benefits of PSA tests for older adults have also been small.[3–5]

In 2008, the USPSTF recommended against PSA screening (Grade D) for men aged 75 and older while claiming "insufficient evidence" (I statement) for men younger than 75.[3] In 2012, however, the USPSTF changed its recommendation for PSA screening to Grade D for all ages.[4] Another change was made in 2018. The USPSTF maintained a Grade D recommendation for men aged 70 and above but revised the recommendation for men aged 55–69 from Grade D to Grade C (the decision should be an individual one "based on professional judgment and patient preferences").[5] In sum, since 2008 those aged 75 and above remained a D grade recommendation, while those aged 70–74 changed from an I statement to a D grade after 2012.

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All the authors are supported a research grant (19-02632) from Arnold Ventures (formerly, Laura and John Arnold Foundation). The funder had no role in the design or conduct of the study, analysis of the data, or the decision to submit the manuscript for publication.

Wong is a member of the US Preventive Services Task Force (USPSTF). This article does not necessarily represent the views and policies of the USPSTF.

The authors declare no conflict of interest.

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Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website, www.lww-medicalcare.com.

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ISSN: 0025-7079/22/000-000

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The changes in the 2012 USPSTF recommendation provide a quasi-experiment by which to study its effect on PSA screening. Our study aims to compare the long-term effects of the 2012 revised recommendations against PSA-based screening for men aged 70–74, relative to those aged 75 and above.

METHODS

Data

We utilized data from the OptumLabs® Data Warehouse (OLDW), including de-identified administrative claims on over 200 million commercially-insured and Medicare Advantage enrollees.[6] OLDW incorporates rich health, clinical, and socioeconomic information of the participants.[6] Our study sample consisted of men aged 65 and above (N = 18,338,212 person–years) enrolling in Medicare Advantage plans from January 1, 2009 to December 31, 2019. We excluded existing prostate cancer patients and those with elevated PSA or with a history of prostate cancer during the 12 months before the observation. To handle the ICD-9 to ICD-10 transition in 2015, we used both types of codes based on the OptumLabs Crosswalk (ICD-9: 185, 233.4, 790.93, V16.42, V76.44, 236.5, V10.46, 600; ICD-10: C61, D07.5 D40.0, R97.2, Z80.42).

Main Analysis

Using a difference-in-differences approach, we first defined the control group as men aged 75+ (N = 7,856,204 person–years) and the intervention group as men aged 70–74 (N = 5,329,192 person–years). We implemented a generalized estimating equation regression model with a logit link and binomial distribution to account for within-subject correlation.[7] Equation (1) provides the full model specification. Further details can be found in Appendix Section 1, Supplemental Digital Content 1, http://links.lww.com/MLR/C521.

$$\begin{aligned} g(PSA_{it}) = {} & \beta_0 + \beta_1 70to74_{it} + \beta_2 After2012_t + \beta_3 Quarter\_index_t \\ & + \beta_4 70to74_{it} * After2012_t + \beta_5 After2012_t * Quarter\_index_t \\ & + \beta_6 70to74_{it} * Quarter\_index_t + \beta_7\, 70to74_{it} * After2012_t * Quarter\_index_t + \varepsilon_{it} \end{aligned} \quad (1)$$

The dependent variable (PSA_{it}) was a binary variable indicating whether an individual received PSA screening in a specific quarter. Independent variables included an age group indicator (70 to 74_{it}, 70–74 vs. 75+), pre- and post-period indicator ($After2012_t$, before or after publication of the revised recommendations in 2012 second quarter [Q2]), index time measured in quarters since 2012 Q2 ($Quarter\_index_t$), and interaction terms between these independent variables. Following a previous study, we assumed a 12-month evidence dissemination period around the publication of the recommendations in 2012 Q2 (ie, 2011 Q4–2012 Q4) to ensure a larger sample size than a longer dissemination period.[8] The difference-in-differences approach assumed that there was no significant difference in the rate of change in PSA use between 2 groups before the revised recommendations. We tested this assumption by examining the coefficient of the interaction term between the index time and age group ($\beta_5 = 1.00$ [95% confidence interval: 1.00, 1.01]) to confirm nonsignificant differences in pretrends in PSA use.

Secondary Analysis: Changes in Beneficiary's Cost-sharing

To better understand potential factors influencing changes in the rate of low-value PSA screening, we additionally examined yearly trends in out-of-pocket (OOP) costs of PSA tests (Appendix Section 4.1-4.6, Supplemental Digital Content 1, http://links.lww.com/MLR/C521). With overall and OOP average costs ($18 and $0.7 in 2019) being small, we estimated the beneficiary's cost-sharing level (ie, ratio of OOP to total PSA costs) and the proportion of beneficiaries without any OOP costs. We further calculated the elasticity of demand for PSA screening (ie, percent changes in PSA utilization rates to percent changes in beneficiary OOP costs) from 2016 to 2017.

Sensitivity Analysis

We conducted 2 sensitivity analyses to test the robustness of the main results. First, we utilized a longer 24-month dissemination period (2011 Q2–2013Q2), instead of 12-month (2011 Q4–2012 Q4), around the publication of the 2012 USPSTF recommendations (Appendix Section 3.1, Supplemental Digital Content 1, http://links.lww.com/MLR/C521). Second, we expanded our model covariates by adding Charlson Comorbidity Index, homeowner status, race, seasons, age-squared, and regions (Appendix Section 3.2, Supplemental Digital Content 1, http://links.lww.com/MLR/C521). We selected the base model as our main model based on its higher quasi-information criteria (QIC, base model = 8,382,144; expanded model = 8,276,588).[9] In addition, we investigated the effect of the 2018 USPSTF recommendations among those aged 65–69 and 70–74 to further understand the drivers of changes in PSA use after 2016 among male beneficiaries aged over 70 (Appendix Section 4.7, Supplemental Digital Content 1, http://links.lww.com/MLR/C521).

RESULTS

Main Analysis

The average Charlson Comorbidity Index ranged from 0.64–1.02 during 2009 Q1–2019 Q1 among men aged 70–74, and from 0.88–1.48 over time among the age group 75+ (Table 1). The proportion of non-white race equaled 19.5%–23.0% of male beneficiaries aged 70–74 during the study period, and 18.1%–22.1% of the age 75+. The composition of those aged 70–74 and 75+ was similar over time—the age group 70–74 accounted for 38.8% and 40.6% of the population before and after the publication of USPSTF recommendations in 2012 (Table 1). Further details of characteristics by quarters and age group with missing values can be found in Appendix Section 2, Appendix Table 1, Supplemental Digital Content 1, http://links.lww.com/MLR/C521.

Figure 1 shows quarterly trends of PSA use from 2009 to 2019 among those aged 70–74 and 75 and above, suggesting a similar trend of PSA screening between the 2 age groups. Before the revised 2012 recommendations, our

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TABLE 1. Descriptive Characteristics by Age Group and Year, 2009–2019

	09Q1	10Q1	11Q1	12Q1	13Q1	14Q1	15Q1	16Q1	17Q1	18Q1	19Q1
Aged 70–74											
N	29,106	39,110	46,492	61,261	72,215	73,782	82,949	110,461	216,007	288,239	312,676
PSA rate	11.8%	11.3%	11.9%	11.3%	11.8%	10.1%	10.0%	9.9%	13.4%	15.0%	15.0%
Mean CCI	0.64 (1.29)	0.71 (1.34)	0.70 (1.34)	0.72 (1.35)	0.78 (1.38)	0.79 (1.40)	0.79 (1.40)	0.84 (1.44)	0.95 (1.53)	0.99 (1.55)	1.02 (1.57)
Regions											
South	45.5%	48.1%	46.6%	44.4%	35.1%	29.9%	35.1%	37.5%	43.2%	46.0%	46.2%
Northeast	12.7%	10.0%	8.0%	11.6%	21.0%	23.7%	23.2%	20.4%	17.6%	18.3%	19.0%
West	9.9%	11.6%	11.3%	11.4%	11.7%	11.8%	10.2%	9.6%	9.9%	9.8%	10.2%
Midwest	31.8%	30.3%	34.1%	32.6%	32.2%	34.6%	31.5%	32.5%	29.3%	25.9%	24.6%
Race/Ethnicity											
White	78.7%	78.2%	80.2%	80.5%	78.9%	80.0%	77.0%	78.5%	78.5%	78.0%	78.1%
Asian	2.9%	2.7%	2.6%	2.5%	4.4%	4.5%	4.3%	3.9%	3.4%	3.4%	3.6%
Black	12.6%	13.9%	12.1%	11.8%	11.1%	9.7%	9.5%	9.7%	10.5%	10.3%	10.0%
Hispanic	5.8%	5.2%	5.0%	5.3%	5.5%	5.8%	9.1%	8.0%	7.6%	8.3%	8.3%
Homeowner Status											
Homeowners	99.6%	99.6%	99.5%	99.4%	99.0%	98.8%	98.4%	97.8%	96.7%	96.2%	96.0%
Renters	0.4%	0.4%	0.5%	0.6%	1.0%	1.2%	1.6%	2.2%	3.3%	3.8%	4.0%
Aged 75+											
N	47,534	62,565	70,756	92,531	105,955	110,193	126,034	166,267	307,615	416,450	458,151
PSA rate	8.2%	8.1%	8.1%	7.2%	7.8%	6.4%	6.4%	6.4%	9.5%	10.9%	11.0%
Mean CCI (SD)	0.88 (1.48)	0.96 (1.53)	0.95 (1.51)	0.95 (1.50)	1.07 (1.57)	1.08 (1.57)	1.07 (1.57)	1.19 (1.66)	1.35 (1.76)	1.43 (1.80)	1.48 (1.81)
Regions											
South	40.5%	42.2%	41.7%	39.2%	30.5%	26.4%	32.4%	34.1%	39.0%	42.1%	42.4%
Northeast	14.7%	12.2%	9.4%	13.8%	22.5%	24.4%	23.4%	20.5%	18.9%	18.7%	19.1%
West	8.7%	10.7%	10.7%	10.7%	10.9%	11.0%	10.0%	9.7%	10.0%	10.5%	10.9%
Midwest	36.2%	34.9%	38.1%	36.3%	36.1%	38.2%	34.2%	35.7%	32.1%	28.7%	27.6%
Race/Ethnicity											
White	81.4%	80.8%	81.4%	81.9%	80.3%	81.4%	77.9%	78.8%	78.9%	79.1%	79.4%
Asian	2.1%	1.9%	2.1%	2.1%	3.7%	3.8%	3.8%	3.6%	3.4%	3.2%	3.2%
Black	11.1%	12.3%	11.5%	10.9%	10.7%	9.4%	9.1%	9.3%	10.0%	9.7%	9.4%
Hispanic	5.3%	5.0%	5.0%	5.1%	5.4%	5.5%	9.2%	8.3%	7.7%	8.0%	8.0%
Homeowner Status											
Homeowners	99.8%	99.8%	99.7%	99.6%	99.3%	99.2%	98.9%	98.3%	97.4%	97.0%	97.0%
Renters	0.2%	0.2%	0.3%	0.4%	0.7%	0.8%	1.1%	1.7%	2.6%	3.0%	3.0%

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model estimated that the odds of receiving PSA screening decreased by 1.2% [95% CI: 1.0, 1.4%] per quarter (Table 2: Coefficient β3) with no significant difference between men aged 70–74 and 75+ (Table 2: Coefficient (β_3). This result validated our assumption that there are no statistically significant differences in trends of PSA use across the intervention and control group. We also found that the 2012 recommendations immediately decreased PSA tests by 16.1% [14.6, 17.5%] across both groups (Table 2: Coefficient β_2), but no additional impact for men aged 70–74 (–0.3% [–3.0, 2.4%]) (Table 2: Coefficient β_4). After the 2012 publication of recommendations, however, the odds of receiving PSA screening increased by 3.0% [2.8, 3.2%] per quarter (Table 2: Coefficient $\beta_6 = 1.030$ [1.028, 1.032]) across both groups without significant difference in the trend for those aged 70–74 (0.1% [–0.2, 0.5%]) (Table 2: Coefficient β_7). This trend was particularly salient between 2016 and 2017, suggesting an annual increase by 33.1% (34.7%→46.2%) among men aged 70–74 and 44.1% (22.0%→31.7%) among the age group 75+ (Appendix Figure 1, Supplemental Digital Content 1, http://links.lww.com/MLR/C521).

Secondary Analysis

Our analysis found reductions in average cost-sharing level for PSA screening from 2016 to 2017 in both groups (aged 70–74, -30.3% [7.6%→5.3%]; aged 75+, -27.4% [9.5%→6.9%] (Fig. 2)). Accordingly, the proportion of beneficiaries with no OOP costs increased during the same period (87.2%→89.7%; Appendix Figure 2, Supplemental Digital Content 1, http://links.lww.com/MLR/C521). The corresponding elasticity of demand for PSA screening was -1.09 for those aged 70–74, and -1.61 for those aged 75+.

Sensitivity Analysis

Our sensitivity analyses confirmed a nondifferential long-term effect of the 2012 USPSTF recommendations for men aged 70–74 allowing for a 24-month dissemination period (Appendix Table 2, Supplemental Digital Content 1, http://links.lww.com/MLR/C521; OR = 1.00 [1.00,1.00]) or including additional covariates (Appendix Table 3, Supplemental Digital Content 1, http://links.lww.com/MLR/C521; OR = 1.00 [1.00,1.00]). We found an immediate spillover effect of the 2018 recommendations on increasing PSA tests among those aged 70–74 (Appendix Table 4, Supplemental Digital Content 1, http://links.lww.com/MLR/C521; OR = 1.25 [1.22,1.27]) although the revised recommendations (Grade D to C) was only applicable for aged 55–69.

DISCUSSION

In 2012, the USPSTF revised its recommendations for PSA screening from "insufficient evidence" to "do not recommend" for men aged 70–74, while maintaining "do not recommend" for men aged 75+, expecting to change behaviors among those aged 70–74. Although men aged 70–74 in the Medicare Advantage plans received more low-value PSA tests than those aged 75+ throughout the study period (2009–2019), both groups exhibited similar long-term increases in low-value PSA screening since 2016, after a short

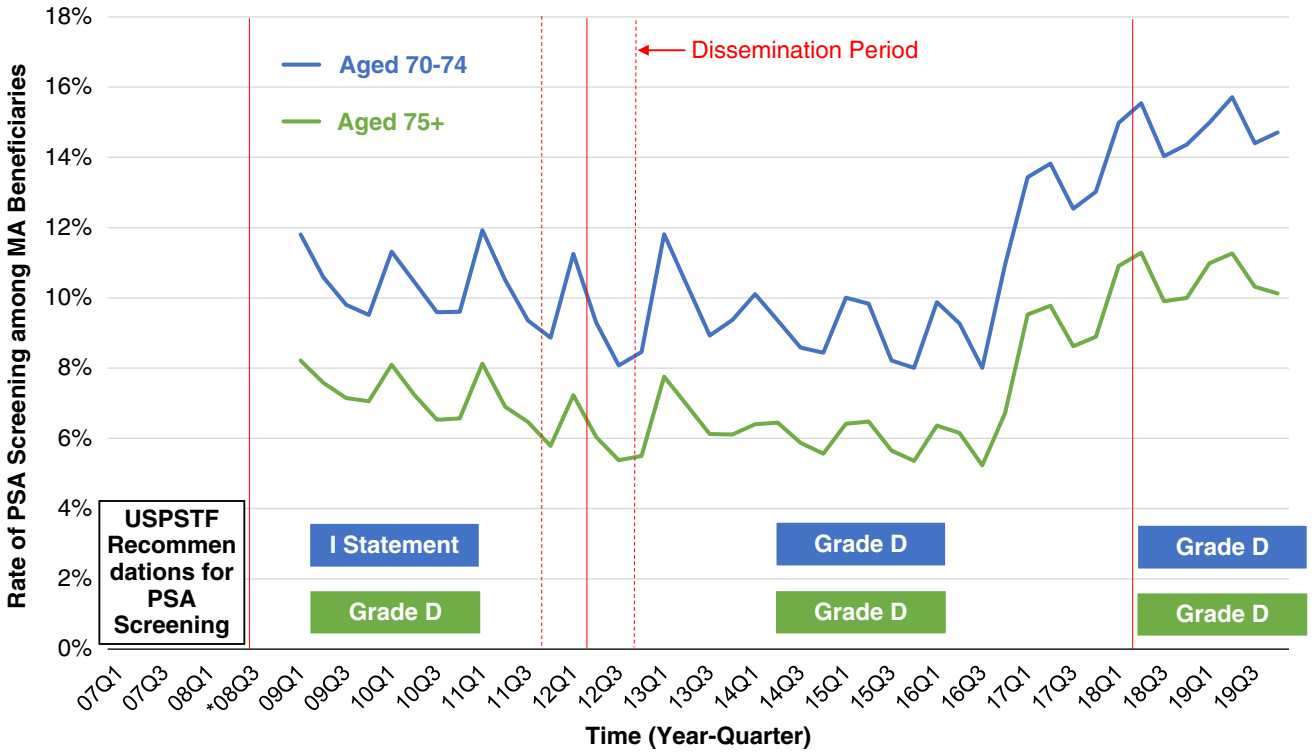

FIGURE 1. The Prevalence of Prostate-Specific Antigen Screening Among Medicare Advantage Beneficiaries Aged 70–74 and 75+, 2009–2019. full color online

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TABLE 2. Generalized Estimating Equation (GEE) Regression of Prostate-Specific Antigen Use, 2009–2019 (N = 12,724,020 Person–Years)

Parameter	OR	95% Confidence Intervals	
β_0: Intercept	0.087	0.085	0.088
β_1: 70–74[†]	1.352	1.318	1.386
β_2: After 2012[‖]	0.839	0.825	0.854
β_3: Quarter index[‡]	0.988	0.986	0.990
β_4: 70–74* after 2012	0.997	0.970	1.024
β_5: 70–74* quarter index	1.002	0.999	1.005
β_6: After 2012* quarter index	1.030	1.028	1.032
β_7: 70–74* after 2012*quarter index	1.001	0.998	1.005

[†]A dummy variable equal to 1 if an individual is aged 70–74 and 0 if aged 75 and above.
[‖]A dummy variable equal to 1 if an individual is observed in 2012 Q4 to 2019 Q4 and 0 if observed 2009 Q1–2011 Q4.
[‡]Indexed time measured by quarters since 2012 Q2.
GEE indicates Generalized estimating equation; OR, odds ratio.

period of reductions after the publication of the recommendations. We did not find any additional effects on the rate of changes in PSA tests among aged 70–74 relative to aged 75+. Our findings suggest that both age groups equally responded (or equally did not respond) to the 2012 revised recommendations. One explanation is that "insufficient evidence" is regarded as similar to "do not recommend", so the revised recommendation might not have differently affected the targeted group of the aged 70–74.[10]

We found an immediate 16% decrease in odds of PSA screening for age group 70+ after the publication of the 2012 recommendations. Previous studies based on self-reported National Health Interview Survey data in 2010 and 2013 found that PSA rates decreased by 5–25% (odds: 15–34%) among those aged 50 and above.[11–14] Magnani *et al*,[8] comparing the effect of 2012 USPSTF recommendations on PSA use based on electronic health records from an academic center and administrative claims from OLDW (2008–2016), found a 3–13% decrease in PSA tests depending on data source/sample and age among the age group 55+. Our findings of the short-term effects of the USPSTF recommendations were similar to previous findings.

However, we did not find long-term sustained effects of the USPSTF recommendations to discourage the use of PSA screening in these groups. Our results, instead, highlighted a 3% annual increase in odds of receiving PSA tests after 2012, particularly after 2016. A notable finding was a dramatic increase in the use of low-value PSA screening in both groups since 2016, which was consistent with a recent study suggesting a 12–16% increase in PSA use by age from 2013 to 2019 among a commercially-insured population.[15] The reduction in beneficiary OOP cost after 2016, as a demand-side financial incentive, might have driven increasing PSA rates. Because previous estimates of price elasticities of preventive services, (−0.17 to −0.43) would have explained 5–13% out of 33 % increase in PSA rates among the aged 70–74 and 5–12% out of 44% increase for aged above 75, our price elasticities (aged 70–74: −1.09; 75+: −1.61) suggest that other non-financial factors, such as patient preference, might have additionally encouraged PSA screening.[16]

Our analyses of the 2018 revised USPSTF recommendations also indicated a possible spillover effect for nontargeted groups that contributed to the increasing PSA screening among those aged over 70. This updated recommendations reflected the emergence of new clinical evidence about potential survival benefits of PSA screening among those aged 55–69, resulting in revised recom-

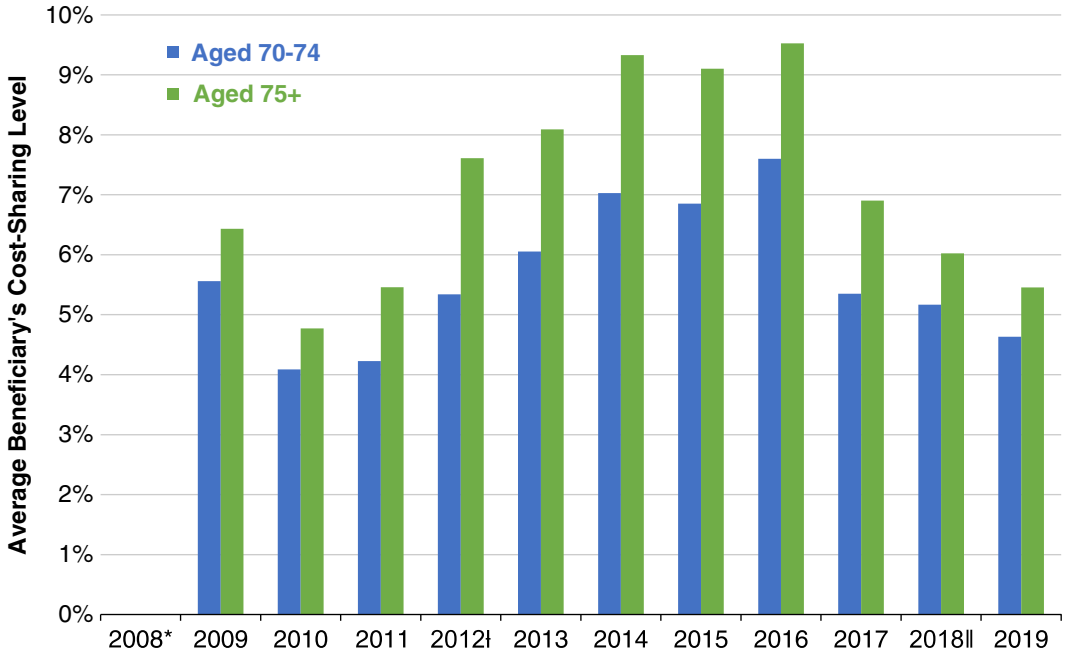

FIGURE 2. The Average Cost-Sharing Level for Prostate-Specific Antigen Screening among Beneficiaries Aged 70–74 and 75+, 2009–2019. full color online

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mendations for this age group from Grade D [Not recommended] to C [individual decisions].[15,17] Although the updated recommendations was only applicable to men aged 55–69, both our sensitivity analysis and Leapman et al.[15] showed that the 2018 USPSTF recommendation encouraged PSA tests among those aged 70 and above. This spillover effect of scientific evidence on medical practice has been observed in other medical fields.[18] A study about another consumer-based intervention additionally found that physicians and beneficiaries responded similarly to the targeted and nontargeted outcomes.[19] One potential explanation for this spillover effect of the 2018 revised recommendations is rising ambiguity, uncertainty, or confusion about the potential benefits and harms of PSA screening among other age groups because of the updated clinical evidence/recommendations. In addition, lack of education and individual preferences—such as aversion towards the risk of prostate cancer—might have driven the use of low-value PSA screening despite the recommendations.[20] Improved physician education, better coordination for shared decision-making, and greater consistency across various low-value care guidelines, would strengthen the impact of reducing low-value PSA screening in the targeted population.[10,20–23]

Our study has several strengths and limitations. In terms of its strengths, first, we applied a rigorous analytic approach to compare the effects of the 2012 revised recommendations against PSA-based screening for men aged 70–74 versus those aged 75+. Comparing PSA use between these 2 age groups eliminated the confounding effects of PSA use among those aged 55–69, for whom the USPSTF recommendations was updated again (Grade D to C) in 2018.[5] Also, we analyzed claims data (instead of self-report data) over an 11-year period for the Medicare Advantage population to capture the long-term effects of the revised 2012 recommendations and to improve the validity of the results.[11–14] Our secondary analysis of changes in beneficiary cost-sharing levels before and after 2016 provided insights into potential drivers of the increase in PSA use. Our sensitivity analyses confirmed the robustness of the main results and indicated a spillover effect of the 2018 USPSTF recommendations that further encouraged PSA tests after 2016. To our knowledge, this paper is the first study to distinguish short-term and long-term effects of the 2012 USPSTF recommendations through statistical modeling and to examine how financial incentives and spillover effects may mediate its impact.

In terms of limitations, our analysis focused on the Medicare Advantage population. Although recent studies highlighted similarities between Medicare Advantage and traditional Medicare beneficiaries in terms of demographic characteristics and patterns of PSA screening, additional research is needed to investigate the effect of the 2012 revised recommendations among traditional Medicare beneficiaries.[24,25] In addition, future studies should further explore factors associated with the increase in PSA use after 2016, such as changes in preferences and perceptions from both physicians and beneficiaries.

CONCLUSION

Although the 2012 USPSTF's revised recommendations were expected to change behaviors mainly among men aged 70–74, our analysis found that men aged 70–74 and aged 75+ exhibited similar trends from 2009 to 2019, including the increased use of low-value PSA screening since 2016. A range of consorted efforts, such as modified financial incentives, improved physician education, better coordination for shared decision-making, and greater consistency across various guidelines, would enhance the sustained impact of the USPSTF recommendations on discouraging low-value PSA screening.

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