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Smoking-Cessation Assistance: Before and After Stage 1 Meaningful Use Implementation

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Abstract

Introduction—Brief smoking-cessation interventions in primary care settings are effective, but delivery of these services remains low. The Centers for Medicare and Medicaid Services' Meaningful Use (MU) of Electronic Health Record (EHR) Incentive Program could increase rates of smoking assessment and cessation assistance among vulnerable populations. This study examined if smoking status assessment, cessation assistance, and odds of being a current smoker changed after Stage 1 MU implementation.

Methods—EHR data were extracted from 26 community health centers with an EHR in place by June 15, 2009. AORs were computed for each binary outcome (smoking status assessment, counseling given, smoking-cessation medications ordered/discussed, current smoking status), comparing 2010 (pre-MU), 2012 (MU preparation), and 2014 (MU fully implemented) for pregnant and non-pregnant patients.

Results—Non-pregnant patients had decreased odds of current smoking over time; odds for all other outcomes increased except for medication orders from 2010 to 2012. Among pregnant patients, odds of assessment and counseling increased across all years. Odds of discussing or

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ordering of cessation medications increased from 2010 compared with the other two study years; however, medication orders alone did not change over time, and current smoking only decreased from 2010 to 2012. Compared with non-pregnant patients, a lower percentage of pregnant patients were provided counseling.

Conclusions—Findings suggest that incentives for MU of EHRs increase the odds of smoking assessment and cessation assistance, which could lead to decreased smoking rates among vulnerable populations. Continued efforts for provision of cessation assistance among pregnant patients is warranted.

INTRODUCTION

The National Commission of Prevention Priorities identified tobacco use screening and cessation interventions as the highest priority clinical preventive service for adults in the general population.[1] Evidence-based guidelines for primary care delivery of smoking-cessation treatments now constitute standard care[2–4] and clinical practice guidelines stress the "5 A's" (Ask, Advise, Assess, Assist, Arrange). Although healthcare provider adherence to the first two is relatively high,[4,5] assessment of readiness to quit, assistance in quitting, and arranging for follow-up remain low.[2,4–7]

Through efforts to increase the likelihood of assessing and treating tobacco use, advances have been made in the use of electronic health records (EHRs) during primary care visits. A recent Cochrane review found an increase in some of the recommended provider guidelines after EHR modifications specific to prompting smoking assessment and treatment[8]; however, effects were modest and additional research was recommended. As part of the American Recovery and Reinvestment Act of 2009, the Centers for Medicare and Medicaid Services was authorized to provide incentive payments to clinicians and hospitals with the goal of achieving specified improvements in care processes and outcomes through the "meaningful use" (MU) of EHRs.[9] Stage 1 MU included two mandatory tobacco-specific measures. One required recording of smoking status for at least 50% of patients aged ≥ 13 years.[10] The other required recording the percentage of patients aged ≥ 18 years who were screened for tobacco use one or more times within 24 months and who received a cessation intervention if identified as a tobacco user; there was no benchmark minimum proportion that the provider needed to meet.

This study examined changes in the screening and treatment of smoking pre- and post-implementation of Stage 1 MU among Oregon community health center (CHC) patients, most of whom are uninsured or Medicaid recipients[11] and have disproportionately high rate of smoking compared with patients seen in private primary care clinics. Oregon's MU incentive program launched in September 2011[12]; however, for the first year of the program, eligible professionals were only required to attest to EHR adoption, implementation, or upgrade. Thus, the present analyses compared rates of assessment/assistance in 2010 (prior to preparation or implementation of Stage 1 MU), 2012 (OCHIN Oregon-wide preparation for Stage 1 MU with the addition of readiness to quit and counseling given fields to the vital signs in April 2012), and 2014 (Stage 1 MU fully implemented). Given the amount of resources invested in this incentive program, it is critical to determine if these efforts result

in measurable improvements in patient care, and ultimately, in patient health outcomes. It was hypothesized that the odds of assessment and assistance would increase over time, with a corresponding decrease in odds of smoking.

METHODS

Study Sample

OCHIN electronic health record—OCHIN (formerly the Oregon Community Health Information Network and abbreviated to OCHIN as it expanded beyond Oregon) is a nonprofit health information technology organization providing a single, linked (each patient has a single ID number and medical record shared across every clinic in the network) instance of the Epic® EHR.[13,14] Data from 26 Oregon CHCs, federally qualified heath centers that are subsidized to serve low-income and vulnerable populations, that were using OCHIN's EHR before July 1, 2009 were extracted from both structured EHR fields, as well as from non-structured fields (i.e., progress notes, clinical comment fields, after visit summaries, and patient education materials handed out at clinical visits) using natural language processing (NLP).[15] In particular, this study used the MediClass system (a MEDIcal record CLASSifier), configured and validated to detect smoking-cessation care events in EHR data for the 5A's of smoking cessation.[16] This application of the MediClass system has been utilized in diverse EHR systems, including the OCHIN EHR.[17,18]

Adults aged ≥ 18 years with at least one primary care visit to one of the study CHCs in 2010, 2012, or 2014 were included, and a subset of the patients coded in the EHR as current smokers within each measurement year were identified. Individual patients may have been included in more than 1 of the 3 years, but data were examined independently each year; that is, the authors did not link data for individual patients across the included years. Given the potential differences in smoking rates and cessation assistance among pregnant women, data were analyzed separately for this subgroup.

Measures

All outcomes were dichotomized (yes versus no). Changes made within the EHR are date stamped and saved; thus, an outcome was considered "yes" if date stamped within the measurement year. The denominator for smoking status assessment included all study patients within a measurement year; the denominator for all other outcomes included patients identified as smokers within a measurement year.

Smoking status was considered to be assessed if changes were made to the discrete data field with drop-down options for smoking status (located in both the vital signs and social history in all study years), if the button was selected to confirm that smoking status was reviewed, or if a status was captured via NLP in the free-text notes within the measurement year.

A patient was identified as a current smoker if smoking status in the discrete data field was "current every day," "current some day," "smoker, current status unknown," "heavy tobacco smoker," or "light tobacco smoker."

Receipt of counseling was deemed “yes” if the discrete field, “counseling given,” was coded as “yes,” if identified by standard procedure codes for smoking-cessation counseling or an internal OCHIN Epic code for counseling referral, or if any statements in the free-text fields about smoking and cessation (e.g., goals, triggers, efforts) were identified.

Smoking-cessation medication orders (bupropion, varenicline, and all nicotine-replacement therapy products) were extracted from the medication orders list. In addition to orders, another variable was created (“medications ordered or discussed”) that included orders or any discussion of cessation medications as captured in the free text via NLP. It was deemed important to capture whether discussions of medication increased, even if it did not result in an order for a medication per se. This included discussions of medications the patient was already taking or might have wanted to try, education about available medications, nicotine-replacment therapy that might not have resulted in an order because it wsa available over the counter, and medications that were ordered or adjusted.

The independent variable was measurement year. In 2010, the “ready to quit” and “counseling given” fields were located in the social history tab of the EHR; in April 2012, in preparation for Stage 1 MU, these fields were also made accessible via the vital signs tab. Therefore, rates were examined prior to Stage 1 MU and prior to moving these indicators (2010), after these indicators were moved to the Vital Signs (April 2012), and after full implementation of Stage 1 MU (2014).

Statistical Analysis

Patient characteristics by smoking status and measurement year were described. Logistic regression was used to compute unadjusted (Appendix Tables 1 and 2) and AORs for each binary outcome, comparing 2012 versus 2010, 2014 versus 2012, and 2014 versus 2010. Models were adjusted for known variables associated with smoking rates/assistance: race/ethnicity, gender, age category, household percentage of federal povery level (≤100% vs >100%), insurance status at majority of visits (insured versus uninsured), number of visits in the measurement year, and comorbid diseases (hypertension, lipid disorder, asthma/chronic obstructive pulmonary disease, cancer diagnosis, diabetes, psychiatric diagnosis, substance abuse diagnosis excluding tobacco use disorders).[19–23] Service area of the patient’s primary clinic was included as a fixed effect to adjust for potential differences between health centers. The authors did not adjust for urban versus rural health center as >90% had a ZIP code in an urban setting across years, as identified using rural–urban commuting area codes. All analyses were conducted in 2016 using SAS, version 9.4.

RESULTS

Table 1 describes the demographic characteristics of the total sample, and smoking subgroups by year. There were significant differences in all characteristics over time for the total sample and the non-pregnant sample. For the subgroup of pregnant smokers, there were differences for prevalence of cancer (which may reflect small numbers), number of visits in the study year, and insurance status.

Table 2 presents AORs for the subgroup of non-pregnant patients by study year (Appendix Table 1 lists comparable unadjusted ORs). Compared with patients in 2010, those seen in 2012 had higher odds of smoking status assessment. Current smokers seen in 2012 had higher odds of receipt of cessation counseling, and medications ordered/discussed, but not in having a smoking-cessation medication ordered only, compared with 2010. Finally, the odds of being a current smoker were lower in 2012 than in 2010.

Compared with patients seen in 2010, those seen in 2014 had more than twice the odds of having smoking status assessed, and seven times the odds of counseling receipt. Patients seen in 2014 had higher odds of having a cessation medication ordered only, and of having a cessation medication ordered/discussed compared with those seen in 2010. The odds of being a current smoker were lower in 2014 than in 2010.

Comparing 2014 to 2012 revealed significantly higher odds of smoking status assessment in 2014, and twofold increase in the odds of receipt of counseling among current smokers. Patients seen in 2014 also had 10% increased odds of having a smoking-cessation medication ordered only and almost 40% increased odds of a cessation medication ordered/discussed at a visit. Finally, the odds of having a current smoking status were significantly lower in 2014 than in 2012.

Table 3 presents data for the subgroup of pregnant women by study year. The adjusted odds of having smoking status assessed increased over the measurement years (Appendix Table 2 lists comparable unadjusted ORs). Compared with pregnant smokers seen in 2010, those seen in 2012 had five times higher odds of receiving counseling; odds were more than ten times higher in 2014 versus 2010. Comparisons between 2014 and 2012 revealed more than two times the odds for receipt of counseling in 2014 as in 2012. Odds of having smoking-cessation medications ordered/discussed were higher in both 2014 and 2012 compared with 2010; however, there were no significant differences between any of the study years for smoking-cessation medication orders only. The only statistically significant difference in current smoking was between 2010 and 2012.

DISCUSSION

This study used 3 years of EHR data from CHCs to examine the potential impact of Stage 1 MU on smoking assessment and cessation assistance, and on odds of current smoking. The results were noteworthy, with significantly higher ORs for all outcomes for non-pregnant adult patients, and an increase in counseling provided among pregnant patients, after implementation of MU (2014) compared with years prior. These findings suggest that this public policy initiative has had a significant and positive effect on smoking-cessation assessment and assistance among a population of underserved patients with disproportionately high rates of smoking. The corresponding reduction in the percentage of current smokers over the study years is also notable. Though the overall decrease in current smoking was small, 30.3% in 2010 versus 27.2% in 2014, given the public healthcare costs and comorbidities associated with smoking, this change is highly significant from a public health perspective. Although causality cannot be assumed, the internal consistency of the

data, with increases in assessment, counseling, and medication provision paralleling the fall in odds of current smoking, it is reasonable to hypothesize that there is a causal link.

The CHCs in this study were already assessing a high proportion of patients for smoking status, even prior to the implementation of MU. In 2014, less than 3% patients were not screened or had not had their smoking status reviewed. This is substantially lower than rates reported in most studies,[8,24–28] although consistent with research that has shown that inclusion of smoking status as a vital sign increases the rates of identifying smokers.[8,29–35] Higher rates of assessment over all study years could be indicative of the OCHIN workflow standard, which requires review and documentation of tobacco use status at each primary care encounter, and the increase in odds over time suggests that the MU initiative had an impact, despite already meeting the Stage 1 MU benchmark of ≥ 50% of patients assessed.

The proportion of patients provided smoking-cessation counseling increased substantially over the years. This was expected given the inclusion of this field in the vital signs in April 2012; however, this does not tell the whole story as there were significant differences between 2012 and 2014. Counseling was provided to 69% of patients in 2014 versus 54% in 2012. This is substantially higher than reported in most studies, although many prior studies were conducted before MU implementation.[6,21,24,26,36] These results are similar to a survey-based study among CHC patients, reporting 68% of current smokers received some counseling during an office visit.[20] The 2014 Heath Center Data from the Health Services and Resources Administration reported a national rate of 81% of patients screened for use and receiving appropriate cessation assistance among health centers and 75% among lookalike centers (i.e., those meeting all health center program requirements, but not receiving health center grant funding).[37] The higher reported rate from the Health Services and Resources Administration could be due to differences in the numerator and denominator criteria. It should be noted that providers were not incentivized for reaching a set benchmark proportion of patients with receipt of smoking-cessation assistance. They were only required to show that they could extract, and report on, these data from their EHR. The increases over time are promising and suggest that health centers are providing much-needed smoking-cessation assistance to many of the nation’s most vulnerable populations.

Finally, among the non-pregnant study population of current smokers, there was a significant increase in smoking-cessation medication orders only in 2014 compared with 2012 and 2010. These are likely conservative estimates of medication assistance as nicotine-replacement therapy is available without a prescription and may not be entered in the order list unless covered by health insurance. This may be more likely among uninsured patients, as they would pay regardless of whether or not a medication was prescribed.

Including NLP to identify mention of smoking-cessation medications within a visit provides further evidence that providers are actively discussing medication assistance with patients, and not just fulfilling documentation requirements. In 2014, almost half of all smokers had evidence of documentation of at least one smoking-cessation medication discussed or ordered at a visit, compared with 40% in 2012, and less than 30% in 2010. This is important as it suggests that even if smoking-cessation medication orders are relatively low, discussions of available options might be increasingly common during office visits. These

dialogues can result in informed decision making by patients if they decide to make a quit attempt.

Similar patterns were seen among the subset of pregnant women, except for medication orders only and odds of current smoking. The insignificant change over time in medication orders recorded among this population was expected as provision of pharmacotherapy for cessation among pregnant women is not an A or B recommendation of the U.S. Preventive Services Task Force.[38] Current smoking did not decrease over time, despite the increase in receipt of counseling. Given that medication plus counseling substantially increases cessation rates compared with counseling alone[2] and only a little more than half of pregnant women received counseling, the insignificant change in smoking rates is not surprising, albeit it is concerning.

Compared with non-pregnant patients in 2014, a slightly higher percentage of pregnant women were assessed for smoking status (97.8% vs 95.5%), but a lower percentage was provided counseling for smoking-cessation assistance (55.4% vs 69.5%). Future studies are warranted to understand the disparities between these two groups and to design specialized provider training for cessation assistance among pregnant women who smoke.

Limitations

This study was limited to an Oregon population of CHC patients; thus, results might not generalize to patients in other states or adults who seek care at non-CHCs. It could not be determined from the data available which patients had providers who had registered and attested to meeting MU measures; therefore, all adult patients who met study inclusion criteria were included. The denominator was limited to patients seen within each measurement year, whereas MU includes patients seen in the past 24 months; therefore, these findings should not be interpreted as a direct measure of MU performance.

As in most non-randomized, “natural experiments” of public policy changes, causality cannot be assumed, as it is difficult to control for other initiatives, programs, or trends that could impact results. For example, the Health Resources and Services Administration initiated required reporting of tobacco measures within the Uniform Data System for health centers in 2011, and the Affordable Care Act mandated tobacco-cessation assistance coverage beginning in 2014.[39] The changes in Uniform Data System reporting likely influenced the higher rates of reporting in 2012; one would expect a leveling off in subsequent years, but this was not the case.[37] The Affordable Care Act did provide coverage for smoking-cessation medications through insurance market places and Medicaid beginning in 2014; however, Oregon has had one of the most comprehensive cessation assistance programs since 1998, including elimination of copays on cessation products in 2009 for Medicaid-covered patients.[40] Further, the Affordable Care Act mandated cessation coverage for pregnant women in 2010, yet there were substantial increases in rates of counseling assistance over all three study years, suggesting that insurance coverage was not the sole impetus of the changes reported over time in the current study.

Finally, although it could not be determined if providers documented solely to meet MU criteria without actually providing services, this seems unlikely as there was no benchmark

to meet for cessation assistance, and smoking status assessment was already greater than 50% in 2010. Further, the contemporary decrease in smoking rates supports the conclusion that providers were delivering appropriate assessment and cessation services.

CONCLUSIONS

Findings from this study suggest that incentives for MU of EHRs can increase receipt of smoking-cessation assistance, which could lead to decreases in smoking rates among vulnerable populations. Continued efforts for provision of smoking-cessation assistance among pregnant patients are warranted.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Patient Study Sample Characteristics by Study Year

Demographics	All patients***			Non-pregnant smokers***			Pregnant smokers		
	2010 N (%)	2012 N (%)	2014 N (%)	2010 N (%)	2012 N (%)	2014 N (%)	2010 N (%)	2012 N (%)	2014 N (%)
Gender									
Female	**37,602 (64.71)**	**40,499 (63.97)**	**43,150 (62.29)**	**9,813 (57.36)**	**10,101 (56.36)**	**9,957 (54.04)**	305 (100)	292 (100)	314 (100)
Male	**20,509 (35.29)**	**22,809 (36.03)**	**26,123 (37.71)**	**7,294 (42.64)**	**7,822 (43.64)**	**8,468 (45.96)**	0 (0)	0 (0)	0 (0)
Age (at last encounter in period)									
18–24 years	**8,495 (14.62)**	**8,414 (13.29)**	**8,738 (12.61)**	**2,032 (11.88)**	**1,904 (10.62)**	**1,765 (9.58)**	135 (44.26)	126 (43.15)	107 (34.08)
25–34 years	**13,638 (23.47)**	**14,002 (22.12)**	**15,131 (21.84)**	**3,865 (22.59)**	**3,874 (21.61)**	**4,168 (22.62)**	138 (45.25)	126 (43.15)	167 (53.18)
35–44 years	**12,133 (20.88)**	**13,371 (21.12)**	**14,654 (21.15)**	**3,795 (22.18)**	**3,848 (21.47)**	**3,886 (21.09)**	27 (8.85)	35 (11.99)	37 (11.78)
45–54 years	**11,247 (19.35)**	**12,191 (19.26)**	**13,398 (19.34)**	**4,417 (25.82)**	**4,568 (25.49)**	**4,497 (24.41)**	3 (0.98)	5 (1.71)	3 (0.96)
55–64 years	**7,912 (13.62)**	**9,733 (15.37)**	**10,992 (15.87)**	**2,400 (14.03)**	**2,937 (16.39)**	**3,260 (17.69)**	2 (0.66)	0 (0)	0 (0)
65+ years	**4,686 (8.06)**	**5,597 (8.84)**	**6,360 (9.18)**	**598 (3.50)**	**792 (4.42)**	**849 (4.61)**	0 (0)	0 (0)	0 (0)
Race/Ethnicity									
Hispanic	**14,748 (25.38)**	**16,736 (26.44)**	**18,321 (26.45)**	**1,327 (7.76)**	**1,481 (8.26)**	**1,554 (8.43)**	46 (15.08)	30 (10.27)	37 (11.78)
Non-Hispanic white	**34,449 (59.28)**	**36,834 (58.18)**	**40,215 (58.05)**	**13,096 (76.55)**	**13,645 (76.13)**	**14,048 (76.24)**	206 (67.54)	214 (73.29)	218 (69.43)
Non-Hispanic other	**7,287 (12.54)**	**8,653 (13.67)**	**9,428 (13.61)**	**2,131 (12.46)**	**2,496 (13.93)**	**2,452 (13.31)**	47 (15.41)	46 (15.75)	56 (17.83)
Unknown	**1,627 (2.80)**	**1,085 (1.71)**	**1,309 (1.89)**	**553 (3.23)**	**301 (1.68)**	**371 (2.01)**	6 (1.97)	2 (0.68)	3 (0.96)
Household income (% of FPL)									
≤100%	**38,682 (66.57)**	**42,600 (67.29)**	**45,088 (65.09)**	**12,518 (73.17)**	**13,227 (73.80)**	**13,494 (73.24)**	239 (78.36)	232 (79.45)	259 (82.48)
>100%	**16,488 (28.37)**	**17,836 (28.17)**	**20,691 (29.87)**	**4,004 (23.41)**	**4,223 (23.56)**	**4,394 (23.85)**	64 (20.98)	56 (19.18)	48 (15.29)
Missing	**2,941 (5.06)**	**2,872 (4.54)**	**3,494 (5.04)**	**585 (3.42)**	**473 (2.64)**	**537 (2.91)**	2 (0.66)	4 (1.37)	7 (2.23)
Chronic conditions									
Hypertension	**12,885 (22.17)**	**15,372 (24.28)**	**16,452 (23.75)**	**3,877 (22.66)**	**4,530 (25.27)**	**4,510 (24.48)**	10 (3.28)	3 (1.03)	10 (3.18)
Diabetes	**6,532 (11.24)**	**7,978 (12.60)**	**9,028 (13.03)**	**1,598 (9.34)**	**1,937 (10.81)**	**1,969 (10.69)**	1 (0.33)	4 (1.37)	6 (1.91)
Asthma/COPD	**7,110 (12.24)**	**8,526 (13.47)**	**9,309 (13.44)**	**3,154 (18.44)**	**3,619 (20.19)**	**3,634 (19.72)**	53 (17.38)	38 (13.01)	61 (19.43)
Lipid disorder	**12,191 (20.98)**	**15,138 (23.91)**	**16,879 (24.37)**	**3,501 (20.47)**	**4,211 (23.49)**	**4,280 (23.23)**	8 (2.62)	12 (4.11)	10 (3.18)
Cancer	**2,728 (4.69)**	**3,523 (5.56)**	**4,347 (6.28)**	**812 (4.75)**	**1,063 (5.93)**	**1,162 (6.31)**	**2 (0.66)** *	**4 (1.37)** *	**10 (3.18)** *
Psychiatric diagnosis	**14,872 (25.59)**	**18,046 (28.51)**	**19,943 (28.79)**	**6,212 (36.31)**	**7,197 (40.16)**	**7,301 (39.63)**	83 (27.21)	97 (33.22)	104 (33.12)
Substance use disorder[a]	**7,256 (12.49)**	**8,684 (13.72)**	**10,061 (14.52)**	**4,623 (27.02)**	**5,387 (30.06)**	**5,951 (32.30)**	73 (23.93)	91 (31.16)	108 (34.39)

Demographics	All patients***			Non-pregnant smokers***			Pregnant smokers		
	2010 N (%)	2012 N (%)	2014 N (%)	2010 N (%)	2012 N (%)	2014 N (%)	2010 N (%)	2012 N (%)	2014 N (%)
Number of visits in study year									
1	**7,000 (12.05)**	**4,734 (7.48)**	**8,894 (12.84)**	**1,899 (11.10)**	**1,322 (7.38)**	**2,457 (13.34)**	**34 (11.15)****	**37 (12.67)****	**47 (14.97)****
2–5	**15,304 (26.34)**	**15,368 (24.27)**	**21,215 (30.63)**	**4,432 (25.91)**	**4,119 (22.98)**	**5,698 (30.93)**	**80 (26.23)****	**65 (22.26)****	**104 (33.12)****
6+	**35,807 (61.62)**	**43,206 (68.25)**	**39,164 (56.54)**	**10,776 (62.99)**	**12,482 (69.64)**	**10,270 (55.74)**	**191 (62.62)****	**190 (65.07)****	**163 (51.91)****
Insurance status[b]									
Insured	**34,301 (59.03)**	**39,288 (62.06)**	**56,375 (81.38)**	**10,756 (62.87)**	**12,308 (68.67)**	**16,851 (91.46)**	**251 (82.30)*****	**242 (82.88)*****	**293 (93.31)*****
Uninsured	**23,810 (40.97)**	**24,020 (37.94)**	**12,898 (18.62)**	**6,351 (37.13)**	**5,615 (31.33)**	**1,574 (8.54)**	**54 (17.70)*****	**50 (17.12)*****	**21 (6.69) *****

Notes: Boldface indicates statistical significance using the χ^2 test (*p<0.05; **p<0.01; ***p<0.001).

[a]Substance use disorder excludes tobacco use disorders

[b]Categorized as insured if the majority of visits in the study year were insured or categorized as uninsured if majority of visits in the study year were uninsured

FPL, federal poverty level; COPD, chronic obstructive pulmonary disease

Table 2

AORs of Smoking Assessment and Cessation Assistance Among Non-pregnant Patients by Study Year

Outcome	2010 N (%)	2012 N (%)	2012 vs 2010 (ref) AOR (95% CI)[a]	2014 N (%)	2014 vs 2010 (ref) AOR (95% CI)[a]	2014 vs 2012 (ref) AOR (95% CI)[a]
All non-pregnant patients	55,398	60,610		66,712		
Smoking status assessed	52,019 (93.90%)	58,282 (96.16%)	**1.54 (1.46,1.63)****	64,981 (97.41%)	**2.52 (2.37,2.69)****	**1.58 (1.47,1.69)****
Current smoker	16,802 (30.33%)	17,631 (29.09%)	**0.93 (0.90,0.96)****	18,111 (27.15%)	**0.81 (0.79,0.83)****	**0.85 (0.79,0.82)****
Among non-pregnant smokers	16,802	17,631		18,110		
Counseling given	4,998 (29.75%)	9,500 (53.88%)	**3.66 (3.48,3.85)****	12,585 (69.49%)	**7.76 (7.35,8.20)****	**2.24 (2.13,2.35)****
Smoking cessation medication ordered	2,032 (12.09%)	2,338 (13.26%)	1 (0.93,1.07)	2,839 (15.68%)	**1.15 (1.07,1.23)****	**1.1 (1.03,1.17)***
Smoking cessation medication ordered and/or discussed	4,638 (27.60%)	6,987 (39.63%)	**1.65 (1.57,1.73)****	8,747 (48.30%)	**2.25 (2.14,2.37)****	**1.38 (1.32,1.45)****

Notes: All outcomes used discrete fields and natural language processing from the electronic health record except for Current smoker and Smoking cessation medication ordered (only discrete fields in the electronic health record). Boldface indicates statistical significance (*p<0.01; **p<0.0001).

[a]OR adjusted for race/ethnicity, gender, age category, household percent of federal poverty level, insurance status at majority of visits, number of visits in the measurement year, and comorbid diseases, with service area of the patient's primary clinic included as a fixed effect to adjust for potential differences between health centers.

Table 3

AORs of Smoking Assessment and Cessation Assistance Among Pregnant Patients by Year

Outcome	2010 N (%)	2012 N (%)	2012 vs. 2010 (ref) AOR (95% CI)[a]	2014 N (%)	2014 vs. 2010 (ref) AOR (95% CI)[a]	2014 vs. 2012 (ref) AOR (95% CI)[a]
All pregnant patients	2,713	2,698		2,561		
Smoking status assessed	2,553 (94.10%)	2,613 (96.85%)	**1.93 (1.45, 2.56)*****	2,520 (98.40 %)	**4.31 (2.99, 6.20)*****	**2.18 (1.46, 3.25)****
Current smoker	305 (11.24 %)	292 (10.82 %)	**0.80 (0.65, 0.97)***	314 (12.26 %)	0.84 (0.69, 1.02)	1.00 (0.81, 1.22)
Among pregnant smokers	305	292		314		
Counseling given	49 (16.07 %)	124 (42.47 %)	**5.27 (3.28, 8.48)*****	174 (55.41 %)	**10.36 (6.45, 16.64)*****	**2.37 (1.63, 3.44)*****
Smoking cessation medication ordered	28 (9.18%)	25 (8.56%)	0.9 (0.48, 1.67)	30 (9.55%)	0.81 (0.44, 1.50)	1 (0.53, 1.87)
Smoking cessation medication ordered and/or discussed	53 (17.38 %)	82 (28.08 %)	**1.97 (1.26, 3.09)****	90 (28.66 %)	**1.84 (1.18, 2.88)****	1.11 (0.73, 1.69)

Note: All outcomes used discrete fields and natural language processing from the electronic health record except for Current smoker and Smoking cessation medication ordered (only discrete fields from the electronic health record); Boldface indicates statistical significance (*p<0.05; **p<0.01; ***p<0.0001).

[a]OR adjusted for race/ethnicity, gender, age category, household percent of federal poverty level, insurance status at majority of visits, number of visits in the measurement year, and comorbid diseases, with service area of the patient's primary clinic included as a fixed effect to adjust for potential differences between health centers.

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