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Tobacco use by pregnant Medicaid beneficiaries: Validating a claims-based measure in Oregon

Jeff Luck[a,*], Anne E. Larson[a], Van T. Tong[b], Jangho Yoon[a], Lisa P. Oakley[a], S. Marie Harvey[a]

[a] College of Public Health and Human Sciences, Oregon State University, United States
[b] Division of Reproductive Heath, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, United States

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ABSTRACT

In Oregon, more than 4 in 5 pregnant women who smoke are covered by Medicaid. Although birth certificate data for smoking during pregnancy are not accessible in a timely manner, Medicaid claims data are available monthly and provide person-level data. This study utilized an individually linked database of Medicaid claims and birth certificate data to compare the prevalence of tobacco use diagnosis codes in Medicaid claims data to self-reported smoking during pregnancy reported on birth certificates.

We computed the sensitivity and specificity of Medicaid claims data to ascertain tobacco use during pregnancy compared to self-report on linked birth certificates. Using logistic regression models, we also examined demographic, prenatal care, and behavioral health factors that predicted agreement between claims and birth certificates.

From 2008 to 2013, 17.9% of women with Medicaid births reported smoking during pregnancy on birth certificates compared to 3.8% of non-Medicaid births. Tobacco-related claims during pregnancy were present for 12.6% of Medicaid births. Overall agreement between claims and birth certificates rose from 87.0% in 2008 to 90.2% in 2013; sensitivity rose from 43.0% to 62.2%. Sensitivity was lowest for Hispanic women and highest for White women, and declined as maternal education increased. Sensitivity was 33.9 percentage points higher for women with any mental illness diagnosis and 27.3 percentage points higher for women with any substance use disorder diagnosis. Specificity was greater than 95% in all years.

Medicaid claims data may help in surveillance of maternal smoking rates and assessment of smoking cessation programs for female Medicaid beneficiaries of reproductive age.

1. Introduction

Smoking cessation during pregnancy improves birth outcomes and is an important national and state policy objective (Dietz et al., 2010; Mohlman and Levy, 2016), particularly among Medicaid beneficiaries (Curtin and Matthews, 2016). In Oregon, the smoking rate among all Medicaid beneficiaries in 2013 was more than three times higher than for persons with other types of health insurance (Buelow et al., 2017), and the state's Consumer Assessment of Health Plan Survey (CAHPS) data show that more than a quarter of female Oregon Medicaid beneficiaries aged 18–44 years smoked in 2014 (Oregon Health Authority, 2016).

The Patient Protection and Affordable Care Act (ACA) mandated that, starting in October 2010, state Medicaid plans cover comprehensive tobacco cessation treatments for pregnant women without cost-sharing (Singleterry et al., 2014). In Oregon, where Medicaid covers approximately half of all births, smoking as reported on 2013 birth certificates was 16.8% for Medicaid-financed births, compared to only 2.6% for non-Medicaid births. These data suggest that more than 4 in 5 pregnant women who smoke are covered by the state's Medicaid program. Therefore, reducing maternal smoking among female Medicaid enrollees could substantially reduce Oregon's maternal smoking rates.

In 2012, Oregon transformed its Medicaid financing and care delivery system by implementing accountable care organizations called Coordinated Care Organizations (CCOs). Sixteen geographically defined CCOs cover the state; each is a consortium of payers and practitioners providing comprehensive physical, behavioral, and oral health care for Medicaid beneficiaries (Howard et al., 2014). At the end of 2013, 81.1% of Oregon Medicaid beneficiaries were enrolled in CCOs (Oregon Health Plan, 2013). CCOs receive a global payment and financial incentives for high-quality care. CCOs are, therefore, at the center of Oregon efforts to decrease smoking before, during, and after pregnancy.

* Corresponding author at: 401 Waldo Hall, Oregon State University, Corvallis, OR 97331, United States.
E-mail address: Jeff.Luck@oregonstate.edu (J. Luck).

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Although CCOs would benefit from a valid and timely surveillance measure to assess progress with smoking cessation efforts and examine and explain differences across CCOs, traditional data sources that report maternal smoking rates are not available in a timely manner. For example, CAHPS data have long lag times and small sample sizes of pregnant women per CCO. Electronic medical record data are not available for all CCO members and do not provide historical data from which to calculate trends. Pregnancy Risk Assessment Monitoring System (PRAMS) data cover only a small proportion of births, and have several years' lag time. Birth certificate data are comprehensive, but have a year or more of lag time and are not routinely available to CCOs.

Medicaid claims provide person-level data and are reported by CCOs on at least a monthly basis. However, to our knowledge, prior research has not directly compared Medicaid managed care claims data to self-reported smoking from birth certificates. This study therefore utilized an individually linked database of Medicaid claims and birth certificate data to examine the validity of a claims-based measure of maternal smoking. It compared the prevalence of tobacco use diagnosis codes in Medicaid claims to self-reported smoking during pregnancy reported on birth certificates, and examined maternal characteristics and behavioral health conditions associated with agreement between the two data sources. Study results can inform CCOs, state and local public health departments, and community partners working to evaluate and improve their smoking cessation efforts.

2. Methods

2.1. Study sample

This study utilized data from Oregon birth certificates and Oregon Medicaid eligibility and claims files. Data sources were linked in Oregon's Integrated Client Services (ICS) Data Warehouse, which houses client identity data for multiple state programs including Vital Statistics and Medicaid. ICS maintains a client matching table that contains a unique Master ID for all Oregon women who gave birth or enrolled in various public health and welfare programs since 1989. Program enrollment data are updated and matched to Master IDs monthly. ICS deterministically matched Medicaid eligibility files to birth certificates based on full name and date of birth for mother and infant. The average linkage rate was 96.1% over the full study period.

Eligible women for this study included adult Oregon women of reproductive age (18–44 years) who had a Medicaid-financed birth in Oregon during 2008–2013. This study period begins in 2008 when Oregon began reporting data using the 2003 revision of the US Standard Certificate of Live Birth and ends after the first year of CCO implementation, just prior to the large increase in Medicaid enrollment as a result of expanded Medicaid pursuant to the ACA (Oregon Health Authority, 2014).

2.2. Measures

Data about tobacco use during pregnancy were drawn from both Medicaid claims and birth certificate data files. In the claims data, all Medicaid-financed deliveries were identified using a combination of obstetric International Classification of Diseases, 9th revision (ICD-9) diagnosis and procedure codes and hospital Medicare Severity Diagnosis Related Groups (MS-DRGs) (see Appendix). The pregnancy period for which Medicaid claims were analyzed was determined from the birth certificate by subtracting gestational weeks from the delivery date. Tobacco-related claims were identified using the tobacco-related ICD-9 diagnosis codes covered by the Oregon Health Plan Prioritized List of Health Services for 2013, specifically 305.1 or 649.00–649.04 (see Appendix). Women with any tobacco-related Medicaid claim during the pregnancy period were coded as tobacco users during that pregnancy. In the birth certificate data, women who reported smoking in any trimester were coded as tobacco users during that pregnancy.

Additionally, demographic variables were derived from birth certificates and included age (18–44 years), race (White, African American, American Indian or Alaska Native, Asian or Native Hawaiian Pacific Islander, other or multiple race, or unknown), Hispanic ethnicity, and highest level of education (less than high school degree, high school degree or General Equivalency Diploma (GED), some college, or college degree or greater). Timing of the first prenatal care visit (1st trimester or $\leq$13 weeks, 2nd trimester or $\geq$14 and $\leq$26 weeks, or 3rd trimester or not at all $\geq$27 weeks or none) was also obtained from birth certificates. Women who did not receive any prenatal care (0.7% of births) were excluded because they may not have had any claims prior to delivery.

Behavioral health conditions frequently related to tobacco use were also identified using claims data. Women with a claim for mental illness (major depression, schizophrenia or bipolar disorder) or a substance use disorder at any time during the study period were identified by the presence of ICD-9 diagnosis codes for those conditions (see Appendix).

2.3. Analytic methods

Statistical analyses included the sensitivity and specificity of Medicaid claims data to ascertain tobacco use during pregnancy compared to self-report on the linked birth certificates. Medicaid claims and birth certificate tobacco use variables were defined as being in agreement (overall agreement) for women who did not have any tobacco-related claim during the pregnancy period and did not report smoking on the birth certificate, or who had a tobacco claim during the pregnancy period and reported smoking on the birth certificate. Women who showed tobacco use in one data source but not the other were coded as not in agreement.

Logistic regression models were also constructed that included agreement between claims and birth certificate as the dependent variable and included demographic, prenatal care, and behavioral health predictor variables. These models were restricted to women who self-reported smoking on the birth certificate, so that the magnitude and direction of coefficients could be unambiguously interpreted. Average marginal effects were calculated to quantify the impact of each predictor on the sensitivity of Medicaid claims data to detect smoking as self-reported on birth certificates.

Stata version 12 (College Station, TX) was used for all analyses, which were performed during 2018. The Oregon Health Authority Institutional Review Board approved this research.

3. Results

From 2008 to 2013, the total number of births among women 18–44 years of age in Oregon ranged from a low of 40,557 in 2012 to a high of 44,242 in 2008. The number of Medicaid-financed births varied from a low of 18,972 in 2008 to a high of 20,011 in 2010. Over the full study period, nearly half (46.9%) of all births in Oregon were financed by Medicaid (Table 1). Of those, 17.9% reported smoking during pregnancy on the birth certificate, compared to only 3.8% of non-Medicaid births. Tobacco-related diagnoses during pregnancy were present for 12.6% of Medicaid-financed births.

More than 90% of Medicaid-financed births were to women between ages 18 and 34 years (Table 1). For both self-reported birth certificates and Medicaid claims, tobacco use decreased as age increased and was lower among mothers who were Hispanic or Latino than non-Hispanic mothers. Also both data sources show that American Indians/Alaska Natives had the highest prevalence of smoking during pregnancy, while Asians and Native Hawaiian/Pacific Islanders had the lowest prevalence of smoking during pregnancy among women of known race. Only 5.9% of mothers with Medicaid-financed births had a college degree or higher education. The percentage of college-educated mothers reporting smoking on the birth certificate or based on Medicaid claims was lower than among women with lower levels of education.

Table 1
Smoking prevalence and selected characteristics of Oregon women with live births, 2008–13.

			Tobacco Use During Pregnancy		
	N	%	Smoking per Birth Certificate	Tobacco-related Medicaid Claim	Sensitivity of Medicaid Claims
All Births					
Medicaid-financed	117,650	46.9%	17.9%	12.6%	54.1%
Non-Medicaid	132,993	53.1%	3.8%	N/A	N/A
	250,643	100.0%			
Medicaid-financed Births					
Age: 18–24	52,170	44.3%	20.7%	13.9%	51.7%
25–34	54,659	46.5%	16.5%	12.1%	56.3%
35–44	10,821	9.2%	11.8%	8.8%	58.5%
Hispanic or Latino	37,385	31.8%	3.4%	2.5%	43.5%
Not Hispanic or Latino	80,265	68.2%	24.6%	17.4%	54.8%
White	92,302	78.5%	19.6%	13.8%	54.6%
African American	3,780	3.2%	13.8%	11.0%	50.0%
AI/AN	2,376	2.0%	23.5%	16.2%	50.6%
Asian or NHPI	4,064	3.5%	5.2%	3.4%	36.0%
Other/Multiple Race	13,825	11.8%	11.5%	8.1%	52.4%
Unknown	1,303	1.1%	4.3%	4.6%	58.2%
Education					
< HS diploma	35,647	30.5%	17.8%	13.1%	57.1%
HS diploma/GED	39,194	33.5%	21.3%	14.7%	53.3%
Some college	35,329	30.2%	17.1%	11.9%	52.4%
≥ Bachelors	6,860	5.9%	3.3%	2.3%	42.2%
PNC trimester					
1st	82,863	71.4%	17.1%	12.2%	54.5%
2nd	27,500	23.7%	19.4%	13.1%	52.7%
3rd	5,708	4.9%	23.2%	15.9%	54.5%
Any mental illness diagnosis	2,533	2.2%	45.9%	38.2%	88.1%
No diagnosed mental illness	115,117	97.9%	17.3%	12.1%	53.6%
Any substance use diagnosis	8,950	7.6%	54.8%	47.0%	79.9%
No diagnosed substance use	108,700	92.4%	14.9%	9.8%	52.2%

AI/AN = American Indian/Alaska Native; NHPI = Native Hawaiian or Pacific Islander; HS = High School; GED = General Equivalency Diploma; PNC = Prenatal Care;
All columns exclude births where no prenatal care utilization was reported. "Smoking per Birth Certificate" excludes an additional 2,006 births where smoking data are missing.

Over 70% of mothers reported receiving their first prenatal care visit during the first trimester; mothers who initiated prenatal care after the first trimester has higher levels of tobacco use during pregnancy. About 46% of all mothers who had a Medicaid claim diagnosis of mental illness any time during the study period reported smoking on the birth certificate during their pregnancy. Mothers who had a Medicaid claim diagnosis for substance use disorder any time during the study period had the highest prevalence of tobacco use during their pregnancy based on the birth certificate (54.8%).

Among mothers not covered by Medicaid, smoking rates reported on birth certificates fell from 5.4% in 2008 to 2.6% in 2013 (Table 2). Comparable smoking rates for Medicaid-financed births fell from 18.9% in 2008 to 16.8% in 2013. In 2008, 10.4% of women whose birth was covered by Medicaid had at least 1 claim with a tobacco-related diagnosis during the pregnancy period; that prevalence increased to 13.9% in 2013.

The overall rate of agreement between claims data and Medicaid-financed birth certificates rose monotonically, from 87.0% in 2008 to 90.2% in 2013 (Table 2). Sensitivity, which represents the proportion of Medicaid-financed birth certificates with reported smoking for which there was at least one associated pregnancy tobacco claim, rose from 43.0% in 2008 to 62.2% in 2013. Specificity, which describes the proportion of birth certificates without reported smoking for which there were no pregnancy tobacco claims, was greater than 95% in all years. An alternative analysis that used an estimated average gestational age (Martin et al., 2015), as health plans without access to birth certificate data could do, yielded virtually identical rates of agreement, sensitivity, and specificity.

Table 2
Tobacco use during pregnancy measured by medicaid claims and birth certificate, Oregon births, 2008–2013.

	Non-Medicaid Births	Medicaid-Financed Births				
Year	Smoking Reported on Birth Certificate	Smoking Reported on Birth Certificate	Tobacco-related Medicaid Claims	Sensitivity	Specificity	Overall Agreement
2008	5.4%	18.9%	10.4%	43.0%	97.4%	87.0%
2009	4.3%	18.5%	11.6%	48.4%	96.9%	87.8%
2010	3.8%	18.4%	12.9%	53.8%	96.4%	88.5%
2011	3.3%	17.4%	13.3%	58.4%	96.3%	89.7%
2012	2.9%	17.5%	13.6%	59.5%	96.2%	89.7%
2013	2.6%	16.8%	13.9%	62.2%	95.9%	90.2%

Excludes births where no prenatal care utilization was reported or smoking data are missing on birth certificate.
Sensitivity, specificity, and overall agreement are calculated for Medicaid-financed births only.

Table 3
Agreement of tobacco use during pregnancy between medicaid claims and birth certificates, Oregon mothers, 2008–2013.

Maternal Characteristics	Marginal Effect	P value	95% Confidence Interval	
Age (year)	**0.6%**	**< 0.001**	0.5%	0.8%
Hispanic or Latino	**−11.2%**	**< 0.001**	−14.0%	−8.4%
African American	**−4.8%**	**0.031**	−9.1%	0.4%
AI/AN	**−4.5%**	**0.036**	−8.7%	−0.3%
Asian or NHPI	**−16.6%**	**< 0.001**	−23.1%	−10.1%
Other/Multiple Race	−1.1%	0.390	−3.8%	1.5%
Unknown	2.3%	0.781	−13.8%	18.3%
Education				
HS diploma/GED	**−4.3%**	**< 0.001**	−5.9%	−2.7%
Some College	**−6.6%**	**< 0.001**	−8.4%	−4.8%
≥ Bachelors	**−19.3%**	**< 0.001**	−25.7%	−12.8%
PNC trimester				
2nd	**−2.6%**	**0.001**	−4.1%	−1.0%
3rd	−2.2%	0.133	−5.0%	0.7%
Any mental illness diagnosis	**33.9%**	**< 0.001**	29.6%	38.1%
Any substance use disorder diagnosis	**27.3%**	**< 0.001**	25.0%	29.5%

AI/AN = American Indian/Alaska Native; NHPI – Native Hawaiian or Pacific Islander;
HS = High School; GED = General Equivalency Diploma; PNC = Prenatal Care;
Results are from logistic regression analysis for Medicaid-financed births where smoking is reported on birth certificate.
Excludes births where no prenatal care utilization was reported or smoking data are missing on birth certificate.
Omitted categories from Table 1 are reference groups.
Statistically significant marginal effects and p-values are shown in bold.

Table 3 describes the marginal effect of maternal characteristics on the sensitivity of Medicaid claims to detect smoking as reported on the birth certificate. Coefficients represent the percentage change in sensitivity for each group compared to the (omitted) reference group. Sensitivity was greater for women of older age. Sensitivity was 11.2 percentage points lower for Hispanic women than for the non-Hispanic reference group. Sensitivity was lower for all racial groups as compared to Whites (with exception of other/mixed or unknown race), and lowest for Asians or Native Hawaiian/Pacific Islanders. Sensitivity dropped markedly as level of maternal education increased compared to those with less than a high school education, and was somewhat lower for women who initiated prenatal care in the second trimester as compared to the first. Sensitivity was 33.9 percentage points higher for women with any mental illness diagnosis and 27.3 percentage points higher for women with any substance use disorder diagnosis.

4. Discussion

Linked birth certificates and Medicaid claims from Oregon were analyzed to assess the validity of claims records to identify women who smoke during pregnancy. The sensitivity of Medicaid claims to detect birth certificate-reported smoking improved each year from less than 50% in 2008 to 62.2% in 2013. Multivariate analyses showed that sensitivity was highest for women who had a diagnosis of mental illness or substance use disorder, and was lower among women who were Hispanic, reported a race other than White, or had a college education. The specificity of Medicaid claims data was high, and overall agreement between claims data and Medicaid-financed birth certificates was 87% or higher during the study period.

Prior research on the validity of claims data to measure smoking prevalence is limited. One study found that ICD-9 diagnosis codes in a hospital outpatient medical record had a sensitivity of 32% to detect tobacco use compared to natural language processing of medical records (Wiley et al., 2013). Some studies use claims data to measure the use of smoking cessation (Jarlenski et al., 2015; Li and Dresler, 2012) but not the underlying prevalence of smoking, while others estimate that prevalence indirectly (Scheuermann et al., 2017).

Although birth certificates provide the most widely reported data on rates of smoking during pregnancy (Curtin and Matthews, 2016; Paul et al., 2009), they yield lower estimates of smoking prevalence compared to other individual-level data sources. One study found that birth certificates identified approximately 74% of pregnant smokers compared to medical records (Howland et al., 2015). A study from Washington state found that birth certificates identified 85% of women whom bioassay results (cotinine) identified as smoking during pregnancy (Searles Nielsen et al., 2014). Survey-based methods generally report the highest rates of smoking (Jamal et al., 2016; Tong et al., 2013). PRAMS data from 2011 indicate that 23.2% of Oregon women smoked in the three months before becoming pregnant, (PRAMStat, 2011) compared to 12.6% of women who report smoking during that time period on the birth certificate.

A few studies that directly compared claims data to survey-based measures of smoking found lower sensitivities than did our study. Malloy and colleagues (2017) found that ICD-9 and -10 diagnosis codes in New York Medicaid claims data had a sensitivity of approximately 45% compared to 3 survey-based measures of smoking prevalence. Huo and colleagues (2018) found a sensitivity of 27% for commercial claims data compared to linked surveys of the insured persons. A smaller study of Medicare claims found a sensitivity of 28% compared to linked patient surveys (Desai et al., 2016).

Physician reimbursement mechanisms may affect the completeness of smoking information in claims data. For example, physicians in practices receiving capitated reimbursement may not fully document smoking diagnoses or cessation counseling, because those activities are not directly reimbursed. However, mechanisms used to risk adjust capitated payments, such as those made to Medicare Advantage plans, provide a countervailing incentive for physicians to code detailed information about patient risk factors and clinical conditions (Kronick and Welch, 2014; Landon and Mechanic, 2017).

Oregon's Medicaid program strives to collect accurate claims data (often called encounter data) from CCOs and providers. CCOs face a 1% penalty for not reporting complete encounter data. Quality measures based mostly on claims data are the basis for large pay-for-performance incentives to CCOs and for Oregon accountability to the Centers for Medicare & Medicaid Services. Many providers receive fee-for-service payment from CCOs, which incentivizes more compete coding. Previous studies of the usefulness of Medicaid claims data for research have found Oregon's encounter data to be of good quality (Byrd and Dodd, 2015).

Smoking rates among Oregon women with Medicaid-financed births are considerably higher than for other women, most of who are commercially insured. By 2013, women with Medicaid-financed births were almost 6 times more likely than women with non-Medicaid financed births to report smoking during pregnancy. This finding indicates that the large majority of Oregon women who smoke during pregnancy are covered by Medicaid. However, Ku and colleagues (2016) report that cessation services are widely under-utilized by Medicaid beneficiaries.

Because CCOs provide both physical and behavioral health care for Medicaid beneficiaries, their efforts could have an important impact on maternal smoking and thereby improve birth outcomes. CCOs would benefit from a valid maternal smoking surveillance tool that produces results for all women with a short time lag. Such a surveillance tool could be used to target smoking cessation activities and assess the effectiveness of those activities over time. Surveillance data could also be used to compare smoking prevalence and cessation across CCOs, and across providers within a CCO.

This study suggests that Medicaid claims data are a useful tool for surveillance of maternal smoking. In the last year of the study, more

than 6 in 10 (62.2%) women with Medicaid-financed births who reported smoking on their birth certificates were identified by a tobacco-related claim during their pregnancy. The corresponding specificity of 95.9% means that women who do not smoke are extremely unlikely to have a tobacco-related Medicaid claim. Potential reasons for the observed increase in sensitivity over the study period, such as electronic health record implementation (Huo et al., 2018) or other systems or individual level changes that increased tobacco screening or disclosure to healthcare providers, merit further investigation.

Over the full study period, sensitivity results by subgroup (Table 1) show that claims data identified tobacco use among 88.1% of women with a diagnosis of mental illness, and 79.9% of women with a diagnosis of substance use disorder, who smoked during pregnancy. These are the groups at highest risk, with approximately half reporting smoking during pregnancy on their birth certificates. Sensitivity results suggests that smoking is more likely to be ascertained during prenatal care for these high risk groups, and further study to identify best practices in cessation efforts for these women is warranted.

Claims data were least effective in identifying smoking among college-educated women, Hispanic women, and Asian/Native Hawaiian/Pacific Islander women; these demographic groups also had low birth-certificate reported rates of smoking. The sensitivity of claims data was lower for all other known or single category racial minority groups than for Whites, including American Indian/Alaska Natives (who had the highest birth-certificate reported rates of smoking of any race).

Claims data were less effective in identifying tobacco use among women who initiated prenatal care in the second trimester as compared to the first. This may reflect gaps in provider screening and fewer clinical opportunities to engage with such women, and highlights the importance of early prenatal care.

The sensitivity of claims data to identify smoking can still be improved, and these results suggest several steps that Oregon CCOs and Medicaid accountable care organizations in other states could take to enhance screening and cessation efforts for pregnant women. First, tobacco use screening is encouraged for all pregnant women (Ordean et al., 2017). In addition, culturally and linguistically tailored screening approaches may be needed for racial and ethnic minority women. Evidence-based smoking cessation services can be provided to all women who use tobacco during pregnancy. These interventions could be tailored for subgroups with the highest tobacco use rates, particularly women diagnosed with behavioral health conditions. State Medicaid programs can also use claims data to benchmark tobacco screening and cessation progress across provider organizations.

CCOs' flexibility to spend money on programs targeted to their local population further allows them to test innovative approaches to reduce maternal smoking. Their incentive to do so has recently increased; since 2016, decreased smoking prevalence has been one of the incentivized metrics in the CCOs' pay-for-performance system (Oregon Health Authority, 2015). Future research could include CCO-level analyses as linked data become available, but will also need further validation to distinguish changes in smoking rates from improvements in identification of smoking in claims data.

4.1. Limitations

This study has several limitations. The data are from only one state and may not be generalizable to other populations. Results from more recent years may differ, but trends during the time period of this study suggest that the findings reported herein are likely to be conservative. Medicaid claims data do not identify women who are not screened, or who fail to disclose their smoking to their healthcare provider; claims data also do not contain some details about tobacco use, such as packs per day, that are collected on birth certificates. In addition, behavioral health conditions were identified from claims data, thus diagnoses not reflected therein will be missed. Although birth certificate smoking rates are generally lower than those obtained from biochemical validation or surveys, they measure smoking across all births rather than a sample of births. PRAMS data were not available for linkage at the time of analysis.

5. Conclusions

Medicaid claims data, which are available to accountable care organizations in Oregon and other states, may be useful to help these plans achieve the important goal of better monitoring maternal smoking, as well as assessing the impact of smoking cessation programs that target Medicaid beneficiaries of reproductive age.

CRediT authorship contribution statement

Jeff Luck: Conceptualization, Methodology, Writing - original draft, Funding acquisition. **Anne E. Larson:** Formal analysis, Data curation, Writing - original draft. **Van T. Tong:** Conceptualization, Writing - review & editing, Supervision. **Jangho Yoon:** Methodology. **Lisa P. Oakley:** Writing - review & editing. **S. Marie Harvey:** Project administration, Funding acquisition.

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Appendix A. Supplementary data

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