2016

Use of claims data to estimate annual cervical cancer screening percentages in Portland metropolitan area, Oregon

Nasreen Abdullah
Acute and Communicable Disease Prevention Program, Oregon Public Health Division, Portland, Oregon,
nasreen.abdullah@state.or.us

Robert S. Laing
Acute and Communicable Disease Prevention Program, Oregon Public Health Division, Portland, Oregon

Susan Hariri
Division of STD Prevention, National Center for HIV, Viral Hepatitis, STD, and TB Prevention, Centers for Disease Control and Prevention

Collette M. Young
Acute and Communicable Disease Prevention Program, Oregon Public Health Division, Portland, Oregon

Sean Schafer
Acute and Communicable Disease Prevention Program, Oregon Public Health Division, Portland, Oregon

Cancer Epidemiology 41 (2016) 106–112

Contents lists available at ScienceDirect

Cancer Epidemiology

The International Journal of Cancer Epidemiology, Detection, and Prevention

journal homepage: www.cancerepidemiology.net

Use of claims data to estimate annual cervical cancer screening percentages in Portland metropolitan area, Oregon

Nasreen Abdullah[a,*], Robert S. Laing[a], Susan Hariri[b], Collette M. Young[a], Sean Schafer[a]

[a] Acute and Communicable Disease Prevention Program, Oregon Public Health Division, Portland, Oregon, United States
[b] Division of STD Prevention, National Center for HIV, Viral Hepatitis, STD, and TB Prevention, Centers for Disease Control and Prevention, United States

ARTICLE INFO

Article history:
Received 1 May 2015
Received in revised form 18 January 2016
Accepted 20 January 2016
Available online xxx

Keywords:
Human papillomavirus (HPV)
Cervical dysplasia
Cervical intraepithelial neoplasia (CIN)
Cervical cancer screening
HPV vaccines

ABSTRACT

Background: Human papillomavirus (HPV) vaccine should reduce cervical dysplasia before cervical cancer. However, dysplasia diagnosis is screening-dependent. Accurate screening estimates are needed.
Purpose: To estimate the percentage of women in a geographic population that has had cervical cancer screening.
Methods: We analyzed claims data for (Papanicolau) Pap tests from 2008–2012 to estimate the percentage of *insured* women aged 18–39 years screened. We estimated screening in *uninsured* women by dividing the percentage of insured Behavioral Risk Factor Surveillance Survey respondents reporting previous-year testing by the percentage of uninsured respondents reporting previous-year testing, and multiplying this ratio by claims-based estimates of insured women with previous-year screening. We calculated a simple weighted average of the two estimates to estimate overall screening percentage. We estimated credible intervals using Monte-Carlo simulations.
Results: During 2008–2012, an annual average of 29.6% of women aged 18–39 years were screened. Screening increased from 2008 to 2009 in all age groups. During 2009–2012, the screening percentages decreased for all groups, but declined most in women aged 18–20 years, from 21.5% to 5.4%. Within age groups, compared to 2009, credible intervals did not overlap during 2011 (except age group 21–29 years) and 2012, and credible intervals in the 18–20 year group did not overlap with older groups in any year.
Conclusions: This introduces a novel method to estimate population-level cervical cancer screening. Overall, percentage of women screened in Portland, Oregon fell following changes in screening recommendations released in 2009 and later modified in 2012.

1. Introduction

Cervical intraepithelial neoplasia and adenocarcinoma in situ (CIN2+) are high grade cervical lesions caused by persistent infection with human papillomavirus (HPV) [1]. Although asymptomatic, these lesions can progress to invasive cervical cancer. CIN2+ can be detected and treated through routine cervical cancer screening with the Papanicolau (Pap) test which has been the basis of cervical cancer prevention since the 1950s [2]. During 2008, in collaboration with the Centers for Disease Control and Prevention (CDC), five states including California, Connecticut, New York, Tennessee, and Oregon established population-based surveillance of CIN2+ in order to monitor the impact of HPV vaccines that target the HPV types that cause the majority of CIN2+ and cervical cancers [3]. However, diagnosis of CIN2+ is screening-dependent, and directly impacted by recent changes in recommendations for older age at first screening and longer screening intervals for all ages [4]. Therefore, accurate estimates of the percentage of women screened are needed to determine the independent impact of HPV vaccination on reducing the burden of CIN2+.

Determining the actual number of women screened in the United States is challenging. New Mexico has the only existing state-level cervical cancer screening registry, established in 2006 [4]. Collecting cervical cancer screening information from labs would be resource intensive and add substantial reporting burden for laboratories. Women may have multiple Pap tests in one year from the same or different providers leading to overestimation of cervical cancer screening percentages, if data are not de-duplicated.

Historically, estimates of cervical cancer screening percentages in the U.S. have been obtained from national surveys such as the National Health Interview Survey (NHIS) and the Behavioral Risk Factor Surveillance System (BRFSS) survey [5,6]. These data are

* Corresponding author at: 800 NE Oregon St, Suite 772, Portland, Oregon 97232, United States.
E-mail address: nasreen.abdullah@state.or.us (N. Abdullah).

http://dx.doi.org/10.1016/j.canep.2016.01.010
1877-7821/

self-reported and are subject to reporting bias, leading to overestimation of cervical cancer screening percentages [7]. In addition, surveys produce national and state-level estimates, but lack granularity to produce precise estimates for smaller areas. Non-telephone-equipped households, cell phone-only households, and increased non-response percentages have also become a growing challenge for telephone surveys [8].

Administrative health care claims data represent an alternative data source for estimating the percentage of insured women that receive a Pap smear. Claims data have been used within health plans to measure the percentage of women with recent Pap tests in closed populations [9]. In a study published in 2004, Insinga et al. used claims data for enrollees ≥10 years old insured by the Kaiser Permanente Northwest (KPNW) health plan and estimated an annual Pap smear percentage of 31.2 per 100 women enrolled [10]. However, claims data provide no estimates of Pap smears among uninsured women. In the current study, we aimed to estimate cervical screening percentages among women residing in the Portland, Oregon metropolitan area, one of the 5 defined geographic areas established to monitor HPV vaccine impact on CIN2+. Specifically, we used claims data to directly estimate the percentage of insured women living within the catchment area and enrolled in a variety of health plans that received at least one Pap test during a calendar year, and adjusted these estimates by the relative frequency of Pap tests among uninsured women to derive an indirect estimate of screening in uninsured women. Finally, we combined these two estimates to arrive at an estimate of the percentage of the entire population screened.

2. Methods

2.1. Study population

The Oregon Health Authority (OHA), Public Health Division, conducts CIN2+ surveillance among women who reside in a contiguous 28-zip-code area of the Portland metropolitan area. Women were included in the study if they were aged 18–39 years, resided in the catchment area, and had at least one Pap smear in a calendar year. We categorized women into three age groups: 18–20, 21–29, and 30–39 years. We chose these age groupings because they coincide with the ages for which screening recommendations vary. We cut the upper age group off at 39 years because this is the upper age limit for inclusion in the CIN2+ surveillance project. In 2010, 119,558 women aged 18–39 years lived in the surveillance area [11]. An estimated 79.3% of this population had health insurance coverage, defined as individual, group, Medicare, Medicaid, or a combination of these [12].

2.2. Data sources

We acquired county-level population data by age in 1-year intervals from the U.S. census [11]. We used estimates of percentages of insured and uninsured women in the catchment area from the American Community Survey (ACS) (Table 1).

Administrative claims data for health plan enrollees were obtained from Quality Corporation (QCorp). QCorp is a non-profit organization that collaborates with health insurance companies, Medicaid, and Medicare in Oregon to collect and compile healthcare-related administrative claims data [13]. Both private and public health care insurers use these data to track and report on performance measures. QCorp reports that claims data are available for approximately 85% of the insured population in the catchment area. We used QCorp-supplied claims data for services provided during 2008–2012 to determine whether a claim for a Pap test had been submitted on behalf of a woman enrolled by any of the collaborating insurers. QCorp mostly used Current Procedure Terminology (CPT), and Health Care Procedure Coding System (HCPCS), and on rare occasions, Hospital Revenue Code sets, and International Classification of Diseases (ICD) codes to identify Pap claims (see Appendix A for a list of codes). These codes are included in the specifications for the National Committee for Quality Assurance (NCQA) Healthcare Effectiveness Data and Information Set (HEDIS) cervical cancer screening measure. QCorp also provided a count of insured women by age and county of residence whose claims would have been eligible to be captured, i.e., "number enrolled."

We used survey responses to the Oregon Behavioral Risk Factor Surveillance System (BRFSS) to determine *relative frequency of cervical screening* among uninsured and insured women, but not to directly estimate the percentage of insured or uninsured women that had a Pap test [14]. BRFSS surveyors asked respondents if they ever had a Pap test, and how long it had been since they had their last Pap test. In addition, the survey included a question about whether or not a respondent had health insurance, and asked respondents if they had any kind of health care coverage, including individual or group health insurance, prepaid plans such as HMOs, or government plans such as Medicare. The BRFSS survey is conducted by telephone and is designed to produce state-level estimates [15].

2.3. Analysis

We estimated the percentage of women living in the catchment area with at least one Pap test during a calendar year differently for insured and uninsured women as outlined below and in Fig. 1.

(A) Screening percentage estimation among *insured* women with ≥1 Pap smear during a calendar year:

First we estimated the number of insured women living in the catchment area by age group by multiplying US Census population estimates by estimates of the percentage of the population insured from the American Community Survey (ACS). ACS data offered only one overall estimate of the percentage insured by year for so we used that same estimate for all age groups. Then, we estimated the percentage of all insured women whose claims were captured by QCorp by dividing the number of enrollees reported by QCorp for calendar year by our census- and

Table 1
Data sources used to estimate cervical cancer screening percentages.

Data source	Data obtained
Census data	Population counts
American Community Survey	Estimates of percentage of insured and uninsured women
Claims administrative data	De-duplicated counts of women enrolled in a health plan
	De-duplicated counts of insured women who had a Pap
Oregon's behavioral risk factor Surveillance system (BRFSS)	Pap percentage in insured and uninsured women
	Relative frequency of Pap smear among uninsured and insured women

A. Estimate percentage of *insured* women that received a Pap during calendar year

1. Estimate size of insured population

- Obtain population counts for catchment area*
- Obtain estimate of percentage of catchment area women insured**
- Estimate total number of women with insurance in catchment area by multiplying estimate of percentage insured by total population

* US Census. **American Community Survey

2. Determine number of insured women who received a Pap

- Obtain count of insured women in catchment whose claims would have been captured ("enrolled") by QCorp
- Divide count of enrolled women provided by QCorp by estimate of total insured population from number 1 above to estimate percentage of all Pap smear claims among insured women that were captured by QCorp.
- Divide number of women with Pap smear claim captured by QCorp by percentage of all claims captured by QCorp to estimate total Pap smears among insured women.

3. Calculate percentage of insured women in catchment area that had a Pap smear

$$\text{Pap rate} = \frac{100 \times \text{Total number of Pap smears in insured women}}{\text{Total insured population (est.)}}$$

during calendar year

B. Estimate percentage of *uninsured* women that received a Pap during calendar year.

1. Estimate relative frequency of Pap smear among uninsured and uninsured women.

$$\text{Relative Pap test frequency} = \frac{\text{Percentage of uninsured BRFSS respondents reporting a Pap smear during the past 12 months}}{\text{Percentage of insured BRFSS respondents reporting a Pap smear during the past 12 months}}$$

2. Apply relative Pap test frequency (RP) to estimate of percentage of insured women with Pap screening

Pap percentage in uninsured = RP*Known (insured) Pap percentage among insured women

C. Estimate overall percentage of women that had Pap

Pap rate = weighted avg. of insured + uninsured

Fig. 1. Estimating annual Pap screening percentage by insurance status.

ACS-based estimate of the number of insured women in the catchment area. Then we estimated the total number of Pap smears done among all insured women in the catchment area by dividing the number of women living in the catchment area with at least one QCorp Pap smear claim during a calendar year by our estimate of the percentage of all insurance claims captured by QCorp. This latter step adjusted counts of Pap tests reported by QCorp for incomplete claims capture. Finally, we estimated screening percentages among insured women in the catchment area by dividing the adjusted count of insured women with at least one Pap test during the calendar year by overall estimates of the insured population.

We report cervical cancer screening percentages by calendar year overall, and within age groups among women aged 18–20, 21–29, and 30–39 years, based on current screening guidelines that do not recommend regular screening for women aged <21 years and include extended screening intervals of three years for women aged >29 years if they have had 3 consecutive negative high risk HPV test results.

(B) Screening percentage estimation among *uninsured* women with ≥1 Pap smear during calendar year:

To estimate the percentage of uninsured women who had a Pap during each calendar year, we multiplied the claims-based estimates of the percentage of insured women with ≥1 Pap test by an estimate of *relative Pap test frequency* among uninsured and insured women. We estimated relative Pap test frequency by age-group using aggregated Oregon BRFSS survey data from 2010, 2012, 2013 and 2014 by dividing the percentage of uninsured women who reported a Pap test within the previous 12 months by the percentage of insured women who reported a Pap test within the

Table 2
Estimates of insured population, numbers of Pap smears among insured women, and percentage of women with Pap smears by year by insured, uninsured and overall, by age group, 28-zipcode area, Portland, Oregon 2008–2012.

Year	Estimated number of insured women	Estimated number of Pap smears, insured women	Estimated insured women (%) with ≥1 Pap smear	Estimated uninsured women (%) with ≥1 Pap smear[a]	Overall estimated women (%) with ≥1 Pap smear[b]	Credible range (%)
Age 18–20						
2008	9076	1439	15.9	18.2	16.3	(11.3–18.4)
2009	9043	1892	20.9	24.1	21.5	(16.7–26.4)
2010	8496	1067	12.6	14.4	12.9	(9.7–16.3)
2011	8629	734	8.5	9.8	8.7	(6.7–10.8)
2012	8699	460	5.3	3.7	5.4	(4.3–6.6)
Age 21–29						
2008	41685	14270	34.2	21.3	31.9	(29.8–34.0)
2009	42239	15691	37.1	23.1	34.6	(32.4–37.0)
2010	40315	14064	34.9	21.7	32.2	(30.0–34.5)
2011	41578	14136	34.0	21.1	31.6	(29.5–33.8)
2012	42672	12975	30.4	20.1	28.5	(26.6–30.4)
Age 30–39						
2008	45507	17043	37.5	21.6	34.6	(32.5–37.3)
2009	46149	17913	38.8	22.4	35.9	(33.5–38.4)
2010	44122	15670	35.5	20.5	32.4	(30.1–34.8)
2011	45587	15168	33.3	19.2	30.6	(28.6–32.8)
2012	46810	14133	30.2	15.4	28.0	(26.2–30.0)
Age 18–39						
2008	96268	32267	33.5	20.8	31.2	(29.3–33.1)
2009	97431	34913	35.8	22.3	33.4	(31.4–35.5)
2010	92933	30049	32.3	20.1	29.8	(27.9–31.8)
2011	95794	29146	30.4	18.9	28.3	(26.5–30.1)
2012	98181	26718	27.2	15.5	25.5	(23.9–27.1)

[a] Obtained by multiplying claims-based estimate of percentage of insured women by Behavioral Risk Factor Surveillance-based estimate of relative Pap test frequency among insured and uninsured women.
[b] Weighted average of estimates among insured and uninsured women.

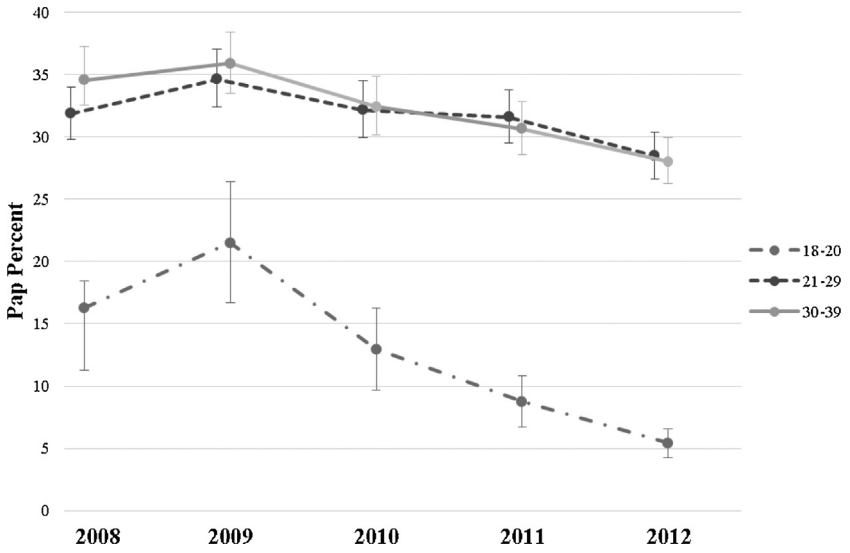

Fig. 2. Percentage of women who reported cervical cancer screening in the past 12 months by age group, Oregon 2008–2012.

previous 12 months, appropriately weighted for BRFSS survey design.

(C) Overall estimate:

We estimated the overall percentage with a Pap during a calendar year as a weighted average of the estimates of percentages of insured and uninsured women that received a Pap smear during calendar year [16].

2.4. Credible intervals

To create ranges around annual percentage calculations, we used Monte Carlo simulations to reflect the combined uncertainty in input parameters, including percentage of population insured from American Community Survey, total Population from US Census, number of claims and number of insured women whose claims could have been captured by QCorp ("enrolled"), and relative prevalence ratio from Behavioral Risk Factor Surveillance Survey. For those estimates drawn from sources with published methods for which variance was provided or could be calculated, we assigned normal distributions. For estimates of claims and enrolled women provided by QCorp we assigned a more conservative triangular distribution and allowed the estimates to range by 5% in either direction. We set the variation in QCorp counts after discussion with QCorp analysts. Using the Crystal Ball software application, we created credible intervals around Pap smear percentage estimates by conducting 100,000 repeated calculations for each point estimate.

3. Results

(A) Screening percentage estimation among insured women with ≥1 Pap smear during a calendar year: From 27.2% to 33.5% of insured women aged 18–39 years were screened annually from 2008 to 2012 (Table 2).
(B) Screening percentage estimation among *uninsured* women with ≥1 Pap smear during calendar year: The relative past-year Pap test frequency smear among insured and uninsured women was 1.6.
(C) Overall estimate: Among women aged 18–39 years, the estimated percentage screened increased from 31.2% in 2008 to 33.4% in 2009; and then declined to 25.5% in 2012 (Table 2 and Fig. 2). Compared to 2009, credible intervals did not overlap in 2011 or 2012. From 2008 to 2009, screening increased in women aged 18–20 years (16.3% to 21.5%), then fell each year to 5.4% in 2012. Compared with 2009, credible intervals did not overlap in 2010, 2011 or 2012. Among women aged 20–29 years screening increased from 31.9% in 2008 to 34.6% in 2009 and then decreased slightly in subsequent years to 28.5% in 2012. However, compared to 2009 credible intervals overlapped during 2010, 2011, but not in 2012. Among women aged 30–39 years screening increased slightly from 2008 to 2009 (34.6–35.9%), then fell in each year during 2009 (35.9%) through 2012 (28.0%). Compared to 2009, credible intervals did not overlap in 2011 or 2012. Between groups (Fig. 2), credible intervals did not overlap in any year for women aged 18–20 years compared to women in either of the two older age groups. Between the two older age groups, credible intervals overlapped in every year.

4. Discussion

As far as we know, these are the first published estimates of the percentage of women with Pap screening in a general population derived from actual Pap test counts based on administrative claims. We found that screening increased for all age groups from 2008 to 2009 and declined for all groups thereafter. Declines were more dramatic for women aged 18–20 years in whom the percentage screened decreased from almost 21.5% to 5.4%. We also observed significant but less dramatic declines in Pap smear screening percentages among women aged 21–29 and 30–39 years. These results likely reflect new screening guidelines introduced in 2009 and modified in 2012. In 2009, screening guidelines recommended that screening begin at age 21 years, with routine screenings every 2 years until age 29 years [17]. Decreasing Pap smear screening percentages in our study area likely represent adoption of these guidelines. Newer guidelines released in 2012 recommend that screening begin at age 21 years, with routine screenings every 3 years [18]. We expect to see the same or even lower screening percentages following addition of new screening guidelines.

Similar percentages of women screened and declines in screening during the same period were recently reported by

Cuzick et al. based on data from New Mexico's unique Pap smear registry in 2013 [4]. The decrease was greatest in the 15–20 years age-group from 22.4% in 2008 to 8.7% in 2011. Reductions in all other age groups during this period were smaller, ranging between 3% and 6% for absolute reductions.

Our annual average estimate of the percentage of women aged 18–39 years screened from 2008 through 2012 was 29.6%. This estimate of the percentage of women screened differs from estimates obtained from BRFSS. From 2008 to 2012, BRFSS estimated that an average of 61.5% of insured women reported a Pap smear within the previous 12 months. The BRFSS survey relies on self-report. Over-estimation due to self-report bias probably explains the substantially higher survey-based screening percentages compared to claims data.

In 2004, Insinga et al. reported 31.2% of girls and women enrolled in Kaiser Permanente Northwest Health Plan in Oregon and aged ≥10 years received any Pap smear screening during 1998 [10]. Most Kaiser patients reside in the same metropolitan area that we studied. Though our age groups do not precisely coincide, this is somewhat higher than the 25.5% of all women—insured and uninsured—aged 18–39 that we estimate receive a Pap smear during 2012. The difference is likely explained by the fact that Insinga et al. studied a fully insured, health maintenance organization population at a time when major professional organizations recommended initiating Pap smears at the time of onset of sexual activity with annual Pap smears thereafter.

Before 2012, cervical cancer screening guidelines by American Cancer Society (ACS), United States Preventive Services Task Force (USPSTF), and the American College of Obstetricians and Gynecologist (ACOG), differed on age to start and frequency of screening [18]. In 2012, however, all three organizations recommended that screening begin at 21 years of age regardless of onset of sexual activity, should be performed every 3 years for women 21–29 years of age, and combined with HPV testing for longer screening intervals for women 30–65 years. Recommendations for screening women aged ≥65 years continue to differ slightly among these organizations. As a result of the new guidelines, frequent use of liquid-based cytology and HPV testing technologies, the National Cancer Institute has predicted that fewer Pap tests will be performed.

HPV vaccination is expected to reduce the incidence of cervical disease and consequently, cervical cancer [19]. Measured incidence of CIN2+ depends on the actual occurrence of disease and on the percentage of the population that gets screened. Therefore, in light of the changing recommendations, and the current use of HPV vaccine, accurate estimates of women who receive a Pap smear during a given time period are key to measuring the impact of the HPV vaccine. Future estimates of cervical dysplasia incidence should adjust for screening to avoid wrongly attributing changes in measured incidence related to screening utilization to changes in underlying disease incidence.

5. Limitations

Our source of claims data extended across multiple insurers and the majority of insured women. This allowed us to avoid double counting women who had multiple Pap tests during a calendar year, even if claims were made within different health systems. However, though the source captures a majority of claims, not all insurers participate and not all claims are captured. We attempted to adjust for incomplete claims capture by assuming that the percentage of insured women screened by non-participating insurers was the same as the percentage screened by participating insurers. If non-reporting health plans had systematically higher or lower overall percentages of women screened during a calendar year than reporting plans, our estimate would be affected. We are not aware of any reason to believe that either of these scenarios might be true. We also used a wide range around our estimates of claims and enrolled women with a conservative triangular distribution to account for greater uncertainty of these estimates in generation of Monte-Carlo simulation-based credible intervals.

We derived our estimate of the percentage of uninsured women screened directly from our estimate of the percentage of insured women screened by multiplying by an estimate of the "relative frequency" of Pap smears among uninsured to insured women screened from survey data. This approach propagates any error inherent in the direct approach to estimation of percentage of insured women screened. This approach introduces further error only to the extent that accuracy of self-report varies by insured status. Assuming, as we did, that self-report bias is equivalent in insured and uninsured women, our approach eliminates self-report bias.

American Community Survey, our source of data about the percentage of the population that was insured did not offer the ability to estimate age-group specific percentages. To the extent that we over- or underestimated in-group proportions of insured women our estimates might be flawed. Underestimating insured proportion would bias estimates downward while overestimating would bias them upwards.

6. Conclusion

This study introduces a novel method for population-level estimates of cervical cancer screening percentages. Traditionally, these estimates have been obtained by self-reported data, or from administrative data from a single managed care provider. Our methods estimate Pap smear screening percentages in both insured and uninsured women to derive population-level screening percentages.

Overall, the cervical cancer screening rate for women aged 18–39 years and residing within the Portland, Oregon catchment area increased from 31.2% in 2008 to 33.4% in 2009. Thereafter, the screening percentage decreased to 25.5% in 2012. We expect HPV vaccination to reduce the incidence of high-grade cervical dysplasia (and ultimately, cervical cancer). However, because of recent changes in screening recommendations, ascertainment of incident cases of CIN2+ is likely to decrease as well, rendering crude (unadjusted for screening) estimates of high-grade dysplasia incidence difficult to interpret. This method allows evaluating the impact of vaccination of CIN2+ trends that are not confounded by changes in screening.

Conflict of interest

All authors declare no conflicts of interest, financial or otherwise.

Financial disclosure

No financial disclosures were reported by the authors of this paper.

Acknowledgments

The authors would like to thank Katherine Ellingson, MPH, PhD for providing assistance with developing credible intervals for the Pap smear estimates.

This work was supported by Cooperative Agreement 5U50CK000197 from the Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of CDC.

Appendix A.

Codes to identify cervical cancer screening

CPT code	
88141	Cytopathology, cervical or vaginal requiring interpretation by physician
88142	Cytopathology, cervical or vaginal, manual screening under physician supervision
88143	Cytopathology, cervical or vaginal, manual screening and re-screening under physician supervision
88147	Cytopathology smears, cervical or vaginal, screening by automated system under physician supervision
88148	Cytopathology smears, cervical or vaginal, screening by automated system with manual re-screening under physician supervision
88150	Cytopathology, slides, cervical or vaginal, manual screening under physician supervision
88152	Cytopathology, slides, cervical or vaginal, manual screening and computer-assisted re-screening under physician supervision
88153	Cytopathology, slides, cervical or vaginal, with manual screening and re-screening under physician supervision
88154	Cytopathology, slides, cervical or vaginal, manual screening, computer-assisted re-screening using cell selection, under physician supervision
88164	Cytopathology, slides, cervical or vaginal (Bethesda System), manual screening under physician supervision
88165	Cytopathology, slides, cervical or vaginal (Bethesda System), manual screening and re-screening under physician supervision
88166	Cytopathology, slides, cervical or vaginal (Bethesda System), manual screening and computer-assisted re-screening under physician supervision
88167	Cytopathology, slides, cervical or vaginal (Bethesda System), manual screening & computer-assisted re-screening using cell selection under physician supervision
88174	Cytopathology, cervical or vaginal, collected in preservative fluid, automated thin layer preparation, screening by automated system, under physician supervision
88175	Cytopathology, cervical or vaginal, collected in preservative fluid, automated thin layer preparation, with screening by automated system and manual re-screening or review, under physician supervision
HCPCS code	
G0123	Screening cytopathology, cervical or vaginal, collected in preservative fluid, automated thin layer preparation, screening by cytotech under physician supervision
G0124	Screening cytopathology, cervical or vaginal, collected in preservative fluid, automated thin layer preparation, requiring interpretation by physician
G0141	Screening cytopathology smears, cervical or vaginal, performed by automated system, with manual re-screening, requiring interpretation by physician
G0143	Screening cytopathology, cervical or vaginal, collected in preservative fluid, automated thin layer preparation, with manual screening and re-screening by cytotechnologist under physician supervision
G0144	Screening cytopathology, cervical or vaginal, collected in preservative fluid, automated thin layer preparation, with screening by automated system under physician supervision
G0145	Screening cytopathology, cervical or vaginal, collected in preservative fluid, automated thin layer preparation, with screening by automated system and manual re-screening under physician supervision
G0147	Screening cytopathology smears, cervical or vaginal, performed by automated system under physician supervision
G0148	Screening cytopathology smears, cervical or vaginal, performed by automated system with manual re-screening
P3000	Screening papanicolaou smear, cervical or vaginal, up to three smears, by technician under physician supervision
P3001	Screening papanicolaou smear, cervical or vaginal, up to three smears, requiring interpretation by physician
Q0091	Screening papanicolaou smear, obtaining, preparing and conveyance of cervical or vaginal smear to laboratory
ICD-9 code	
91.46	Microscopic examination of specimen from female genital tract; cell block and Pap smear
UB revenue code	
923	Pap smear

References

[1] F.X. Bosch, A.N. Burchell, M. Schiffman, A.R. Giuliano, S. de Sanjose, L. Bruni, et al., Epidemiology and natural history of human papillomavirus infections and type-specific implications in cervical neoplasia, Vaccine 26 (August (19) Suppl. (10)) (2008) K1–K16.

[2] D. Saslow, C.D. Runowicz, D. Solomon, A.B. Moscicki, R.A. Smith, H.J. Eyre, et al., American Cancer Society guideline for the early detection of cervical neoplasia and cancer, CA: Cancer J. Clin. 52 (November–December (6)) (2002) 342–362.

[3] S. Hariri, E.R. Unger, S.E. Powell, H.M. Bauer, N.M. Bennett, K.C. Bloch, et al., The HPV vaccine impact monitoring project (HPV-IMPACT): assessing early evidence of vaccination impact on HPV-associated cervical cancer precursor lesions, Cancer Causes Control: CCC 23 (February (2)) (2012) 281–288.

[4] J. Cuzick, O. Myers, W.C. Hunt, M. Robertson, N.E. Joste, P.E. Castle, et al., A population-based evaluation of cervical screening in the United States: 2008–2011. Cancer epidemiology, biomarkers & prevention: a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology 23 May (5) (2014) 765–773.

[5] N. Breen, D.K. Wagener, M.L. Brown, W.W. Davis, R. Ballard-Barbash, Progress in cancer screening over a decade: results of cancer screening from the 1987, 1992, and 1998 National Health Interview Surveys, J. Natl. Cancer Inst. 93 (22) November (21) (2001) 1704–1713.

[6] D.K. Blackman, E.M. Bennett, D.S. Miller, Trends in self-reported use of mammograms (1989–1997) and Papanicolaou tests (1991–1997)—Behavioral Risk Factor Surveillance System. MMWR CDC surveillance summaries: Morbidity and mortality weekly report CDC surveillance summaries/Centers for Disease Control 48 (6) October (8) (1999) 1–22.

[7] D.E. Nelson, E. Powell-Griner, M. Town, M.G. Kovar, A comparison of national estimates from the National Health Interview Survey and the Behavioral Risk Factor Surveillance System, Am. J. Publ. Health 93 (August (8)) (2003) 1335–1341.

[8] O.T. Thornberry, J.T. Massey, Trends in United States telephone coverage across time and subgroups, in: R.M. Groves, P.P. Biemer, L.E. Lyberg, J.T. Massey, W.L. Nicholls, J. Waksberg (Eds.), Telephone Survey Methodology, John Wiley & Sons Inc., New York, NY, 1988, pp. 25–49.

[9] R.P. Insinga, A.G. Glass, B.B. Rush, Diagnosis and outcomes in cervical screening: a population-based study, Am. J. Obstetr. Gynecol. 191 (2004) 1005–1013.

[10] R.P. Insinga, A.G. Glass, B.B. Rush, Pap screening in a U.S. health plan. Cancer Epidemiology, Biomarkers & Prevention: a Publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology 13 March (3) (2004) 355–360.

[11] U.S. Census Bureau, Census Factfinder (2010) http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml (accessed March 2015).

[12] American Community Survey (ACS) (2015) https://www.census.gov/programs-surveys/acs/ (accessed October 2015).

[13] Oregon Health Care Quality Corporation, Information for a Healthy Oregon: Statewide report on health care quality, February (2011) http://www.q-corp.org/reports/statewide-reports.

[14] BRFSS Results-Results by Year (2011) http://public.health.oregon.gov/BirthDeathCertificates/Surveys/AdultBehaviorRisk/brfssresults/Pages/2011-BRFSS-Results.aspx (accessed March 2015).

[15] E. Powell-Griner, J.E. Anderson, W. Murphy, State-and sex-specific prevalence of selected characteristics-behavioral risk factor surveillance system, 1994 and 1995, MMWR CDC surveillance summaries: Morbidity and Mortality Weekly Report CDC Surveillance Summaries, 46 August (3, Centers for Disease Control, 1997, pp. 1–31.

[16] G. Kalton, Compensating for missing survey data, in: G. Kalton (Ed.), Compensating for Missing Survey Data, Survey Research Center, Institute for Social Research, the University of Michigan, Ann Arbor, MI, 1983.

[17] ACOG issues revised cervical cancer screening guidelines, http://www.medscape.com/viewarticle/712840 (accessed October 2015).

[18] D. Saslow, D. Solomon, H.W. Lawson, M. Killackey, S.L. Kulasingam, J. Cain, et al., American Cancer Society, American Society for Colposcopy and Cervical Pathology, and American Society for Clinical Pathology screening guidelines for the prevention and early detection of cervical cancer, Am. J. Clin. Pathol. 137 (April (4)) (2012) 516–542.

[19] L.E. Markowitz, E.F. Dunne, M. Saraiya, H.W. Lawson, H. Chesson, E.R. Unger, et al., Quadrivalent Human Papillomavirus Vaccine: Recommendations of the Advisory Committee on Immunization Practices (ACIP), MMWR Recommendations and Reports: Morbidity and Mortality Weekly Report Recommendations and Reports, 56 (RR-2) March (23, Centers for Disease Control, 2007, pp. 1–24.