

# Successful Use of Interventions in Combination to Improve Human Papillomavirus Vaccination Coverage Rates Among Adolescents—Chicago, 2013 to 2015

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## ABSTRACT

In 2013, National Immunization Survey-Teen data indicated that >40% of female adolescents had not initiated the human papillomavirus (HPV) vaccine series and >60% had not completed the series, documenting vaccination rates much lower than those for other vaccines recommended for adolescents. The Chicago Department of Public Health (CDPH) was 1 of 22 jurisdictions nationwide to receive a Prevention and Public Health Fund award through the Centers for Disease Control and Prevention to improve HPV vaccination rates among adolescents. The CDPH implemented 5 interventions targeting the public, clinicians and their staff, and diverse immunization

and cancer prevention stakeholders. Compared with 2013 jurisdiction-specific HPV vaccination rates among all adolescents, Chicago's HPV vaccination rates were increased significantly in 2014 and 2015. This article details the methods and results of Chicago's successful interventions, the particular strengths as well as barriers encountered, and future steps necessary for sustaining improvement.

**KEYWORDS:** adolescents; Assessment, Feedback, Incentives, eXchange; human papillomavirus; intervention; vaccination

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AFTER STAGNATION FROM 2011 to 2012,<sup>1</sup> the 2013 revised national human papillomavirus (HPV) vaccination coverage estimates among female adolescents aged 13 to 17 years increased only modestly to 56.7% for  $\geq 1$  HPV vaccine dose and 36.8% for  $\geq 3$  HPV vaccine doses,<sup>2</sup> showing that >40% of female teens had not initiated the vaccine series and >60% had not completed it. Because 2011 to 2012 HPV vaccination coverage estimates indicated that many adolescents were unnecessarily vulnerable to vaccine-preventable HPV-associated cancers, the Centers for Disease Control and Prevention (CDC) solicited applications in 2013 from 64 eligible state and local immunization programs with the purpose of increasing HPV vaccination coverage among adolescents through the use of 5 specified interventions in combination. During 2013 to 2014, the Chicago Department of Public Health (CDPH) was 1 of 22 public health jurisdictions to apply for and receive federal funding through CDC and the Prevention and Public Health Fund.<sup>3,4</sup> To the authors' knowledge, this article represents the first published, peer-reviewed description related to the completion and

evaluation of this combination of interventions in a public health jurisdiction.

In serving the third largest US city, CDPH supports a diverse population of >2.7 million Chicago residents; of these, 23.1% are aged younger than 18 years.<sup>5</sup> In 2013,  $\geq 1$  HPV dose vaccination coverage among Chicago female teens aged 13 to 17 years was 57.6%,<sup>3</sup> similar to the 2013 revised national estimate.<sup>2</sup> Before receipt of this award in late September 2013, the CDPH Immunization Program (CDPH-IP) had initiated efforts to increase HPV vaccination among Chicago youth. CDPH-IP's routine work included enrolling and supporting >600 clinics that participate in the federal Vaccines for Children Program (VFC). The VFC provides vaccines at no purchase cost to clinicians serving children who might not otherwise have access to vaccines.<sup>6</sup> The CDPH-IP facilitated educational opportunities for VFC providers including multiple local and regional meetings, and successfully piloted clinician-to-clinician educational enhancement of a federal quality improvement program known as AFIX (Assessment, Feedback, Incentives, eXchange).<sup>7</sup> The synergies

between preaward activities, award interventions, and postaward planning are described.

## METHODS

To increase HPV vaccination rates among adolescents, the 22 awardees implemented 5 prespecified interventions.<sup>3,8</sup> In addition to funding, the CDC provided awardees medical, technical, and communications support through individual teleconference calls (monthly and as needed),  $\geq 18$  all-awardee conference calls and, in November, 2014, an all-awardee onsite meeting at CDC. Some interventions' implementations varied according to jurisdiction, on the basis of available infrastructure, capacity, staffing, political factors, and past/ongoing programmatic experiences and activities. Because initial project periods were only 15 months, awardees also varied in extents of evaluation plans. Two awardees completed interventions in 15 months; 19 awardees, including the CDPH, received 12-month no-cost extensions and completed interventions in 27 months, and 1 awardee will complete interventions in 39 months. The timelines for implementation of interventions in Chicago are shown in Figure 1. The five interventions included: developing a jurisdiction-wide collaborative initiative with stakeholders, implementing education and skill-building strategies targeting immunization providers, using immunization information system (IIS)-based reminder/recall, conducting a comprehensive communication campaign targeting the public, and using AFIX visits to evaluate and improve immunization providers' performance in HPV vaccine series administration.

AFIX visits on the basis of federal guidelines entail "assessment" through quantitative and qualitative evaluation of immunization data to determine the immunization coverage rate for a defined age cohort of patients at the clinician or practice level.<sup>9</sup> The aims of AFIX "feedback" include review of vaccination coverage rates, discussion of current service delivery practices, and identification of quality improvement strategies for implementation.<sup>8,9</sup> AFIX "incentives" recognize improvement, and "exchange" of information with providers facilitates longitudinally monitoring progress.<sup>9</sup> Notably, the CDPH

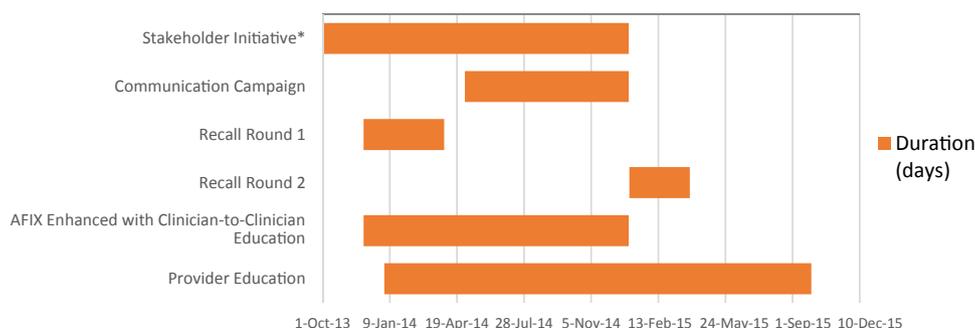
enhanced the AFIX process through individualized clinician-to-clinician feedback and education for all AFIX visits conducted as part of this award.

### INTERVENTION 1: DEVELOPING A JURISDICTION-WIDE COLLABORATIVE INITIATIVE WITH STAKEHOLDERS (OCTOBER 2013 TO DECEMBER 2014)

To coordinate and convene a jurisdiction-wide HPV Advisory Committee, the CDPH used an existing contract to fund EverThrive Illinois, a robust immunization coalition. EverThrive invited participation of diverse stakeholders including a cancer coalition, 4 cancer medical centers, a health insurance company, a retail pharmacy chain, multiple community groups serving racial and ethnic minorities, the Illinois Caucus for Adolescent Health, professional organizations (eg, Illinois Chapter of the American Academy of Pediatrics [ICAAP], Illinois Academy of Family Physicians), and the American Cancer Society. The HPV Advisory Committee was charged with 3 tasks: 1) reviewing national, state, and local HPV vaccination coverage levels, 2) providing input on educational materials/messaging, and 3) committing to disseminating final products to target audiences (eg, community, clinicians).

### INTERVENTION 2: IMPLEMENTING EDUCATION AND SKILL-BUILDING STRATEGIES TARGETING PROVIDERS (JANUARY 2014 TO SEPTEMBER 2015)

The CDPH and ICAAP collaboratively developed a comprehensive HPV education curriculum tailored for primary care providers, with input from the HPV Advisory Committee and local content experts. Content included HPV epidemiology, HPV-attributable diseases, vaccination coverage rates, vaccine safety and efficacy, and strategies to improve vaccination within practice settings. Materials were delivered via multiple formats including in-person training, dinner seminars, grand rounds lectures, and webinars. In-person formats were hosted in Chicago venues; webinars were available statewide. Continuing education credits were available for physicians, nurses, nurse practitioners, and medical assistants. After every program, the ICAAP conducted evaluations to measure participant knowledge, attitudes, and practices regarding HPV vaccination, and collected feedback. Evaluation results from



**Figure 1.** Timelines for implementation of 5 interventions in combination—Chicago, 2013 to 2015. \*The HPV Stakeholder Group continues to meet quarterly, but formal grant-related activities ended in December 2014. AFIX indicates Assessment, Feedback, Incentives, eXchange, a federal quality improvement program.<sup>9</sup>

each intervention were disseminated to HPV Advisory Committee members, CDPH staff, CDC staff, and other public health partners.

Although educational opportunities were broadly available to clinicians, the CDPH evaluated vaccine-ordering information to identify VFC clinics that ordered <1:1 ratio of HPV vaccine to tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) vaccine. Low ratios suggested clinics were delivering Tdap vaccines to adolescents without also administering HPV vaccines; therefore, the CDPH targeted clinicians at such clinics to participate in educational opportunities and AFIX visits (described in the Intervention 3 section).

### **INTERVENTION 3: CONDUCTING AFIX ENHANCED WITH INDIVIDUALIZED CLINICIAN-TO-CLINICIAN FEEDBACK (DECEMBER 2013 TO DECEMBER 2014)**

The CDPH-IP retrieved vaccination data for AFIX visits from the statewide IIS (Illinois Comprehensive Automated Immunization Registry Exchange [I-CARE]) or an electronic medical record (EMR) for those practices without data in I-CARE. The CDPH-IP performed initial assessments of HPV vaccination rates ( $\geq 1$  HPV vaccine dose) at 80 VFC-enrolled clinics that were selected using 3 criteria: 1) vaccination data were entered daily or weekly into I-CARE or an EMR, 2)  $\geq 200$  adolescent patient records existed, and 3) the clinic ordered <1:1 ratio of HPV:Tdap vaccines. The CDPH-IP imported vaccination coverage data into a CDC tool.<sup>10</sup> For each clinic, the CDPH-IP created an Immunization Coverage Report Card (Supplementary Appendix 1) including local and clinic coverage data for comparisons, a summary of immunization recommendations, and HPV-related talking points for clinicians. Using the CDC tool, report cards included baseline clinic-specific coverage assessments of recommended vaccines (ie, quadrivalent meningococcal vaccine, HPV, Tdap, and others); also discussed were missed vaccination opportunities (ie, visits at which any vaccine was administered, but an eligible adolescent did not receive the HPV vaccine).

Historically, the AFIX process occurred between clinic staff (often nonclinicians including clinic managers) and CDPH-IP staff. Although the CDPH-IP had previously successfully piloted adding clinician-to-clinician discussions to AFIX visits in 25 clinics,<sup>7</sup> routine AFIX visits before 2013 did not include this. In this intervention, AFIX feedback provided by CDPH-IP staff for each participating practice was enhanced with in-person clinician-to-clinician discussion. The CDPH-IP and ICAAP collaborated to enlist as consultants 7 clinicians (4 physicians; 3 nurse practitioners), all of whom were ICAAP members and had attended an HPV training session. One physician was a retired obstetrician/gynecologist who was well established in the community; because of his time and passion, he participated in approximately half of the intervention visits.

Feedback sessions were nonpunitive tailored dialogues on the basis of individual clinician or clinic's needs and

barriers. Discussions involved reviewing Immunization Coverage Report Cards, identifying unique clinic characteristics (eg, patient demographic characteristics, staffing ratios) and perceived HPV vaccination barriers that might affect vaccination practices, and then collaboratively developing strategies to improve vaccination rates. Consistent messaging regarding a simple HPV vaccine recommendation was emphasized with a "less is more" strategy (Supplementary Appendix 2), which encourages a strong HPV vaccination recommendation and approaching HPV vaccine similarly to other universally recommended vaccines when talking to families.<sup>11</sup> Surveys regarding the value of enhanced AFIX visits were administered at each visit's conclusion.

Approximately 4 to 6 months after initial feedback sessions, CDPH-IP staff contacted each clinic to inquire about progress in implementing strategies to improve vaccination rates. The CDPH-IP completed follow-up vaccination coverage assessments 6 to 13 months after initial feedback sessions and sent respective assessments to each practice. CDPH-IP staff called providers to discuss results and inquire about system-based practice changes.

CDPH-IP staff tracked variables including the following: clinic site; date and duration of initial assessment, feedback session, and follow-up assessments; coverage levels at initial and follow-up assessment; number of providers attending feedback sessions; and number of providers practicing in clinics.

### **INTERVENTION 4: IMPLEMENTING IIS-BASED RECALL (DECEMBER 2013 TO MARCH 2015)**

Reminders and recalls are interventions used to remind patients that vaccinations are due (reminder) or late (recall).<sup>12</sup> To promote HPV vaccination series completion, the CDPH-IP sent 2 rounds of recall notices in December 2013, and January 2015, for adolescent patients overdue for second or third doses. For round 1, the CDPH-IP used I-CARE to generate letters regarding adolescents affiliated with 5 CDPH walk-in immunization clinics and 25 federally qualified health centers (FQHCs) belonging to a single network in Chicago and suburban Cook County; 17 (68%) of the FQHC clinics also received an AFIX visit enhanced with clinician-to-clinician education. For round 2, the CDPH-IP undertook changes. With the goal of improving recall effectiveness and decreasing return rates, 29 clinics affiliated with 4 large FQHCs provided information for recalls using EMR data. For CDPH walk-in immunization clinic recalls, the CDPH-IP continued I-CARE use (because EMRs are not used). To improve on the time-intensive process of creating/mailing letters and the large number of returned letters from round 1, CDPH-IP developed folded postcards and revised inclusion criteria for round 2 of recall (ie, no duplicate records,  $\geq 1$  HPV vaccine dose documented in previous 2 years). Using folded postcards presented unanticipated challenges, including ensuring Health Insurance Portability and Accountability Act compliance, fulfilling US Postal Service sealing wafer number and placement requirements, and wafer shipment

delays. The CDPH-IP expedited postcard dissemination by stuffing postcards into manila envelopes. Letters and postcards informed parents/guardians that CDPH records indicated their child “might have missed” an HPV vaccine dose and encouraged contacting their child’s clinic. For both rounds, returned notices (either with unknown or updated addresses) were collected; any with forwarding addresses were resent. The CDPH-IP intended to evaluate the effect of the intervention by monitoring and tracking numbers of returned notices, assessing clinic level HPV vaccination coverage among participating FQHCs, and monitoring ordering patterns.

#### **INTERVENTION 5: CONDUCTING A COMPREHENSIVE COMMUNICATION CAMPAIGN TARGETING THE PUBLIC (MAY 2014 TO DECEMBER 2014)**

Using CDC-prepared materials and resources, the CDPH Public Information Office developed a comprehensive public communication campaign with >15 media vendors. The HPV Advisory Committee provided regular input on messaging, draft material, and dissemination strategies. The campaign started with a CDPH press release and the CDPH-IP Medical Director’s radio media tour with 4 local stations. The 4 main methods of communication were broadcast, print, outdoor, and digital platforms. Broadcast media included airing CDC public service announcements on 2 television networks and 3 local radio stations. Print media included public service announcements in local newspapers, magazines, and professional sports advertisement spaces. Digital messages were disseminated as advertisements on 2 radio Web sites, a social media toolkit that included sample posts on Facebook and Twitter as well as images for stakeholders to use, and an HPV-focused interactive page on the CDPH Web site. Outdoor advertisement included 6 billboards placed in areas with high traffic and on Chicago Transit Authority services (ie, bus and train panels, train platforms).

The CDPH evaluated the campaign’s effect using a standardized assessment ([Supplementary Appendix 3](#)) at 19 clinics. The CDPH-IP selected clinics through convenience sampling aimed to create a diverse overall sample from predominantly Hispanic, African American, and Caucasian neighborhoods, respectively. Participant eligibility included informants being aged older than 18 years, English- or Spanish-speaking, and accompanying a child aged 11 to 17 years. Clinic administrative staff recruited respondents after health care visits were complete and provided written forms in English or Spanish; forms ascertained demographic information, reason for clinic visit, awareness of the communication campaign elements, informant’s report of adolescent’s HPV vaccination history, and influence of campaign messages on HPV vaccination status. Participants deposited forms in confidential boxes in each clinic.

A Microsoft Access (Access 2010; Redmond, Wash) database was created and analysis was completed using SAS (version 9.3 and SUDAAN 11.0.1; SAS Institute Inc, Cary, NC) to measure distribution of raw data, fre-

quency distribution of variables, and measures of central tendency. Logistic regression analysis was conducted to examine the association between respondent awareness of the campaign and an adolescent’s reported HPV vaccination status.

#### **EFFECT OF COMBINATION OF INTERVENTIONS**

To assess further the early effects of the interventions, we compared 2014 and 2015 National Immunization Survey-Teen (NIS-Teen) vaccination coverage data in Chicago with revised 2013 estimates. We used *t* tests on weighted data to account for the complex survey design. We considered differences to be statistically significant at  $P < .05$ .

After CDC human subjects review, the interventions conducted by all 22 award recipients, including the CDPH, were designated as public health nonresearch.

## **RESULTS**

#### **INTERVENTION 1: DEVELOPING A JURISDICTION-WIDE COLLABORATIVE INITIATIVE WITH STAKEHOLDERS**

The HPV Advisory Committee, maintained by EverThrive, consisted of 44 volunteer members representing 29 organizations. Six meetings were held between December 2013 and December 2014. The committee provided input and guidance throughout this period and sponsored 34 HPV educational events that reached >1200 people at community engagement activities including health fairs, school-based health centers, a farmer’s market, and other health events.

#### **INTERVENTION 2: IMPLEMENTING EDUCATION AND SKILL-BUILDING STRATEGIES TARGETING PROVIDERS**

A total of 39 provider educational sessions were conducted including 9 webinars, 3 dinner seminars, 4 hospital grand rounds, 2 medical assistant trainings, 4 regional provider meetings, 12 VFC regional meetings, and 5 conferences. These sessions were attended by >3500 health care professionals. Additionally, 44% of educational sessions offered continuing education credits to physicians, nurses, and medical assistants.

#### **INTERVENTION 3: CONDUCTING AFIX ENHANCED WITH INDIVIDUALIZED CLINICIAN-TO-CLINICIAN FEEDBACK**

Enhanced AFIX visits occurred at 80 sites including 37 FQHCs, 30 private practice clinics, 12 school-based clinics, and 1 public clinic; each visit lasted 30 to 60 minutes. All sites had at least 1 clinician participate during feedback sessions (mean = 3 clinicians per session).

First and third HPV vaccine dose completion rates were measured before and after AFIX sessions. Of 80 clinics, 76 (95%) documented an increase in  $\geq 1$  dose completion among adolescents (range, 1%–30%; mean, 11%), whereas 77 (96%) showed an increase in  $\geq 3$  dose completion among adolescents (range, 1%–30%; mean, 7%; [Table 1](#)).

**Table 1.** Number of Clinics With HPV Vaccine Coverage Level Increases After AFIX Peer-to-Peer Feedback Sessions (n = 80)

Coverage Level Increases (%)	Number of Clinics With Increases in Coverage for $\geq 1$ HPV Vaccine Dose		Number of Clinics With Increases in Coverage for $\geq 3$ HPV Vaccine Doses	
	All Adolescents	Female Adolescents Only	All Adolescents	Female Adolescents Only
0	4	8	3	10
1 to 5	24	17	32	34
6 to 10	23	16	31	27
11 to 20	14	24	11	7
21 to 30	15	15	3	2

AFIX indicates Assessment, Feedback, Incentives, eXchange; and HPV, human papillomavirus.

Of 80 clinics participating in enhanced AFIX visits, clinicians from 59 (74%) completed evaluations regarding the value of clinician-to-clinician feedback sessions. More than 70% of responding clinicians agreed or strongly agreed that discussion with a peer educator added value to the visit, and 76% responded that it would be beneficial at future AFIX visits. Nearly 90% reported peer educators were able to answer HPV-related questions adequately.

#### INTERVENTION 4: IMPLEMENTING IIS-BASED RECALL

The CDPH sent out 2 rounds of recall notices. During round 1 in December 2013, 2001 letters were mailed; 591 (29.5%) were returned. During round 2 in January 2015, 4485 postcards were mailed; 1218 (27%) were returned, of which 1082 (90%) were from FQHC EMR data and 125 from CDPH vaccination clinics' I-CARE data. For each round, most reasons for returned notices were "Attempted Not Known" followed by "No Such Number." Although postcards did not improve efficiency to the extent anticipated, staff preferred sending postcards in envelopes compared with letter-stuffing. Because of methodology changes between rounds, high proportions of returned notices, and other factors, the CDPH-IP determined that it could not evaluate the effect of reminder/recall on vaccination coverage or ordering patterns.

#### INTERVENTION 5: CONDUCTING A COMPREHENSIVE COMMUNICATION CAMPAIGN TARGETING THE PUBLIC

The comprehensive public campaign resulted in nearly 150 million estimated interactions between content and consumers (Table 2). A total of 589 surveys were completed by adult respondents accompanying adolescent patients at 19 VFC clinics from August through October, 2014. Of respondents, 373 (63%) indicated that they had read or heard messages or advertisements regarding HPV vaccination in the past 30 days (Fig. 2). Among 164 adolescents aged 9 to 18 years who reportedly had no previous HPV vaccines, those with an accompanying adult who reported exposure to the campaign messaging (see Supplementary Appendix 3) were more likely to report HPV vaccine receipt during that clinic visit ( $P = .0486$ ). Among 79 adults accompanying female adolescents aged 11 to 18 years who had not completed the 3-dose series, those who reported exposure to the campaign messaging were more likely to report the patient had received an HPV vaccine that visit ( $P = .0139$ ). On the basis of estimated interactions as well as survey results, Chicago Transit Authority ads appeared highly effective (Table 2; Fig. 2).

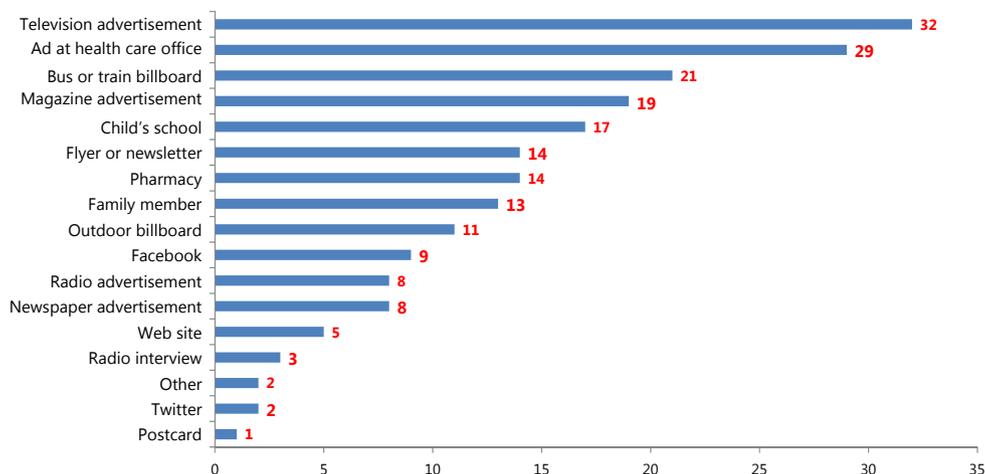
#### EFFECT OF COMBINATION OF INTERVENTIONS

NIS-Teen 2014 data indicated that Chicago HPV vaccine coverage rates among 13- to 17-year-old female

**Table 2.** Media Type, Estimated Reach, Frequency, and Run Date Range of Public Information Campaign

Media Vendor	Media Type	Frequency of Media Run	Run Date Range	Reach (Estimated Interactions Between Content and Consumers)
Comcast	TV	Daily	May 26 to October 26, 2014	1,279,634
WGN	TV	Daily	July 7 to August 31, 2014	475,974
Radio-WBBM	Radio	Daily	June 6 to July 26, 2014	884,200
Radio 97.1	Radio	Daily	June 2 to July 27, 2014	304,900
Univision 106.7	Radio	Daily	June 1 to August 30, 2014	299,400
Chicago Tribune	Print	Weekly	June 5 to July 22, 2014	224,000
RedEye	Print	Weekly	June 5 to July 22, 2014	459,000
Hoy	Print	Weekly	June 5 to July 22, 2014	181,250
Sun-Times	Print	Weekly	June 6 to July 28, 2014	1,369,532
Chicago Parent	Print	Monthly	June 2 to August 31, 2014	100,000
Family Time Magazine	Print	Monthly	June 2 to August 31, 2014	65,000
Chicago Defender	Print	Weekly	June 4 to July 1, 2014	16,000
Bears Game Program	Print	Home Game	August 8 to December 31, 2014	63,000
Bulls In-Game	Print	Home Game	October 1 to November 1, 2014	22,011
CTA ads	Outdoor	Daily	June 2 to August 31, 2014	134,579,433
ClearChannel	Outdoor	Daily	June 2 to September 23, 2014	7,277,876
Pandora	Online	Daily	June 2 to August 30, 2014	1,366,210
Batanga	Online	Daily	June 2 to August 30, 2014	982,360

CTA indicates Chicago Transit Authority.



**Figure 2.** Percentage of adult survey respondents who reported seeing or hearing campaign messaging according to type ( $n = 373$ ).

adolescents significantly increased to 78.1% for  $\geq 1$  dose and 52.6% for  $\geq 3$  doses, up from revised 2013 rates (57.6% and 36.5%, respectively; Table 3).<sup>2</sup> Similarly, among male adolescents there were significant increases in  $\geq 1$ -dose and  $\geq 2$ -dose coverage estimates. Among all adolescents (female and male combined) there were increases in estimates for  $\geq 1$ ,  $\geq 2$ , and  $\geq 3$  doses (Table 3), and these increases were sustained in NIS-Teen 2015 data.

## DISCUSSION

The CDPH was one of 22 jurisdictions to receive federal funding through the Prevention and Public Health Fund to implement 5 interventions to promote HPV vaccination. Implementation in Chicago had several key strengths which likely led to increasing HPV vaccination rates among Chicago's adolescents. Interventions implemented in combination have a strong evidence base for success. The Guide to Community Preventive Services documents that coordinated interventions increase community demand, enhance access to vaccination services, and reduce missed vaccination opportunities.<sup>14</sup> Available data and experience from this award's implementation indicate that interventions synergistically promoted HPV vaccination and increased awareness at multiple levels across Chicago. The CDPH-IP fostered a collaborative effort that leveraged strong existing relationships with diverse community organizations and health care providers; this resulted in a successful HPV Advisory Committee, that was critical to all interventions' implementations. Additionally, the public information campaign content and format appears to have effectively engaged adolescents' caregivers, as evidenced by assessment results indicating adolescents were significantly more likely to receive a dose of HPV vaccine if campaign messages had reached accompanying adults. The interventions' effect on jurisdiction-specific vaccination coverage was observed earlier than expected.<sup>2,3</sup> In addition, the rapid and coordinated implementation of

interventions likely facilitated increases in vaccination coverage not only in Chicago, but also in Illinois, which had not yet begun implementing state-wide award activities, yet had large increases in 2014 in vaccination coverage among female adolescents.<sup>2,3</sup> The availability of combined HPV vaccination coverage estimates for male and female adolescents (nationally, beginning with publication of 2015 data,<sup>2</sup> and for Chicago's 2014 and 2015 estimates, published for the first time in this report) facilitates evaluation of these interventions, which targeted both sexes.

The CDPH's 20-year history of developing and refining AFIX visits for Chicago providers created a strong foundation for enhanced AFIX visits. Individualized clinician-to-clinician feedback sessions, which were well received by clinicians, provided meaningful and actionable AFIX experiences. Enhanced AFIX visits addressed systems-level vaccination barriers and highlighted the importance of a strong clinician HPV vaccination recommendation. On the basis of session evaluations, trust quickly developed during feedback sessions because of individualized approaches with peers. In cases in which established relationships existed between CDPH-IP staff and community clinicians, AFIX visits were more efficient, showing benefits of establishing longitudinal relationships with vaccine providers.

Although HPV vaccination coverage improvements were observed, ensuring continued progress is important. HPV remains a significant contributor to cancer, particularly in Illinois. Illinois has a higher incidence of HPV-attributable cervical, vaginal, and oropharyngeal cancers compared with the nation.<sup>15</sup> This is particularly salient for the large black and Hispanic populations in Chicago facing substantial cancer-related disparities in detection as well as treatment outcomes.<sup>16</sup>

## BARRIERS ENCOUNTERED AND PLANNING FOR SUSTAINABILITY

Several notable barriers were encountered during this award. Although AFIX visits' enhanced feedback was

**Table 3.** National and Chicago Vaccination Coverage Estimates, Adolescents Aged 13 to 17 Years, NIS-Teen 2013 to 2015\*

	HPV											
	All Adolescents				Female Adolescents				Male Adolescents			
	≥1 Tdap	≥1 MenACWY	≥1 Dose	≥2 Doses	≥3 Doses	≥1 Dose	≥2 Doses	≥3 Doses	≥1 Dose	≥2 Doses	≥3 Doses	≥3 Doses
Chicago												
2013	84.8 (±6.4)	78.1 (±7.2)	51.7 (±8.5)	37.0 (±7.8)	27.5 (±7.0)	57.6 (±12.6)	46.5 (±12.2)	36.5 (±11.4)	45.8 (±11.5)	27.5 (±9.9)	18.5 (±7.8)	
2014	84.6 (±5.8)	83.4 (±5.9)	71.4 (±6.5)†	56.3 (±7.4)†	39.1 (±7.4)†	78.1 (±8.1)†	68.8 (±9.5)†	52.6 (±10.7)†	64.9 (±10.0)†	44.3 (±10.8)†	26.1 (±9.3)	
2015	87.2 (±4.7)	82.8 (±5.1)	69.4 (±6.1)†	57.9 (±6.7)†	44.6 (±6.8)†	70.8 (±8.2)	62.1 (±9.0)†	47.7 (±9.6)	68.1 (±9.0)†	53.9 (±9.7)†	41.6 (±9.7)†	
United States												
2013	84.7 (±1.0)	76.6 (±1.1)	44.9 (±1.3)	34.5 (±1.3)	24.8 (±1.2)	56.7 (±1.9)	46.9 (±1.9)	36.8 (±1.9)	33.6 (±1.8)	22.6 (±1.6)	13.4 (±1.3)	
2014	87.6 (±0.9)†	79.3 (±1.1)†	50.6 (±1.3)†	40.7 (±1.3)†	30.4 (±1.2)†	60.0 (±1.9)†	50.3 (±1.9)†	39.7 (±1.9)†	41.7 (±1.8)†	31.4 (±1.7)†	21.6 (±1.6)†	
2015	86.4 (±1.0)†	81.3 (±1.0)†	56.1 (±1.3)†	45.4 (±1.3)†	34.9 (±1.2)†	62.8 (±1.8)†	52.2 (±1.8)†	41.9 (±1.8)†	49.8 (±1.8)†	39.0 (±1.7)†	28.1 (±1.6)†	

NIS-Teen indicates National Immunization Survey-Teen; HPV, human papillomavirus; Tdap, tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine; and MenACWY, quadrivalent meningococcal conjugate vaccine.

Tdap, MenACWY, and HPV vaccines are routinely recommended for adolescents aged 11 to 12 years. Estimates with 95% confidence interval half-widths >10 might not be reliable.

\*Some estimates in this table have been previously published.<sup>2,3,13</sup>

†Statistically significant ( $P < .05$ ) increase from revised 2013 estimates.

‡Statistically significant ( $P < .05$ ) increase from 2014 estimates.

critical for success, coordinating schedules for practice clinicians, AFIX-enlisted clinicians, and CDPH-IP staff was challenging. The CDPH-IP was fortunate to have a retired physician available to attend nearly half of the sessions. Differences among clinics in duration of I-CARE use potentially affected immunization data collection. Furthermore, follow-up phone calls and visits were coordinated by 1 AFIX staff member, resulting in some delays. These delays might have affected follow-up quality and relationship strength with clinics. Creating recall letters required substantial time and labor. Although using folded postcards for round 2 lessened administrative burden, fulfilling requirements for postcard seals to ensure confidentiality took more time than anticipated. Other challenges included the inability of the CDPH-IP to use tools to ensure correctness of recipients' addresses because the state public health department administers I-CARE. Recall return rates were high in both rounds. EMR data use for patients affiliated with FQHCs did not appear to improve return rates; this might be because of frequent address changes for populations served, but future evaluations might be useful. Circumstances did not permit evaluation of centralized reminder/recall effects when coupled with AFIX enhanced with clinician-to-clinician education, but this could also be considered for future assessments. Although conducting a communications campaign locally was effective, a single coordinating vendor might have been helpful. Finally, the CDPH did not have administrative capacity to hire a coordinator to oversee the 5 interventions, resulting in extra burden on existing CDPH staff.

Because all 22 Prevention and Public Health Fund awards were intended to entail implementation of the 5 interventions in combination, it is not feasible in Chicago to identify which intervention had the most effect on coverage. Interventions that continued post award have included using the campaign's social media toolkit, delivering sustained messaging to clinicians regarding HPV vaccination (eg, VFC news bulletin, provider meetings), continuing quarterly HPV Advisory Committee meetings and, until April 2017, presenting the HPV-focused page on the CDPH Web site. To further progress, the CDPH-IP applied for additional federal funding to increase HPV vaccination coverage by strengthening AFIX activities. Through implementation scheduled for October 2016 to October 2018, the CDPH-IP will use funding to increase AFIX visits, improve visit quality by increasing visits enhanced with clinician-to-clinician education, incorporate webinar-based follow-up sessions, provide enhanced immunization report cards, increase medical assistants' roles, and offer health care providers continuing education credits for AFIX visit participation.

**CONCLUSION**

Through receipt of a Prevention and Public Health Fund award and associated technical support from the CDC, Chicago successfully implemented 5 interventions in combination during September 2013 through December 2015 with the goal of improving HPV vaccination coverage

among adolescents city-wide. A significant increase in HPV vaccination coverage rates among Chicago adolescents occurred during this project, correlating with the implementation of interventions. These award interventions further strengthened Chicago's foundation for HPV vaccination promotion, but planned and sustained efforts are critical to increase HPV vaccination still more to ensure reductions in vaccine-preventable HPV-associated cancers.

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## SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <https://doi.org/10.1016/j.acap.2017.09.016>.

## REFERENCES

1. Curtis CR, Yankey D, Jeyarajah J, et al. National and state vaccination coverage among adolescents aged 13–17 years—United States. *MMWR Morb Mortal Wkly Rep.* 2012;2013:685–693.
2. Reagan-Steiner S, Yankey D, Jeyarajah J, et al. National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 Years—United States. *MMWR Morb Mortal Wkly Rep.* 2014;2015:784–792.
3. Curtis CR. Progress update: programmatic strategies to increase HPV vaccination coverage among U.S. Adolescents. Presented at the Advisory Committee on Immunization Practices (ACIP) Meeting, 21 October 2015; Atlanta, GA. Available at: <http://www.cdc.gov/vaccines/acip/meetings/live-mtg-2015-10.html>. Accessed December 2, 2016.
4. HHS.gov. Prevention and Public Health Fund. Available at: <http://www.hhs.gov/open/prevention/index.html>. Accessed December 2, 2016.
5. United States Census Bureau. QuickFacts. Chicago city, Illinois. Available at: <http://www.census.gov/quickfacts/table/PST045215/1714000>. Accessed December 7, 2016.
6. CDC. Centers for Disease Control and Prevention. Vaccines for Children Program (VFC). About VFC. Available at: <https://www.cdc.gov/vaccines/programs/vfc/about/index.html>. Accessed December 7, 2016.
7. Morita J, Chavez-Torres M, Levin M, et al. Increasing HPV vaccination rates using the 'Less Is More' strategy, March-December 2013. Paper presented at: Chicago Department of Public Health Executive Team Meeting; October 29, 2014; Chicago, Ill.
8. Washburn T, Wold AD, Raymond P, et al. Current initiatives to protect Rhode Island adolescents through increasing HPV vaccination. *Hum Vaccin Immunother.* 2016;12:1633–1638.
9. CDC. Centers for Disease Control and Prevention. AFIX (Assessment, Feedback, Incentives, and eXchange). Available at: <https://www.cdc.gov/vaccines/programs/afix/index.html>. Accessed December 7, 2016.
10. CDC. Centers for Disease Control and Prevention. CoCASA (Comprehensive Clinic Assessment Software Application). Available at: <https://www.cdc.gov/vaccines/programs/cocasa/index.html>. Accessed December 7, 2016.
11. Caskey R, Andes S, Walton SM. HPV vaccine: less is more. *Vaccine.* 2016;34:1863–1864.
12. The Community Guide. Vaccination programs: client reminder and recall systems. Available at: <https://www.thecommunityguide.org/findings/vaccination-programs-client-reminder-and-recall-systems>. Accessed December 7, 2016.
13. Reagan-Steiner S, Yankey D, Jeyarajah J, et al. National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 years—United States. *MMWR Morb Mortal Wkly Rep.* 2015;2016:850–858.
14. The Community Guide. Vaccination programs: health care system-based interventions implemented in combination. Available at: <https://www.thecommunityguide.org/findings/vaccination-programs-health-care-system-based-interventions-implemented-combination>. Accessed December 5, 2016.
15. Viens LJ, Henley SJ, Watson M, et al. Human papillomavirus-associated cancers—United States, 2008–2012. *MMWR Morb Mortal Wkly Rep.* 2016;65:661–666.
16. Burger EA, Lee K, Saraiya M, et al. Racial and ethnic disparities in human papillomavirus-associated cancer burden with first-generation and second-generation human papillomavirus vaccines. *Cancer.* 2016;122:2057–2066.