Quality Improvement to Immunization Coverage in Primary Care Measured in Medical Record and Population-Based Registry Data

Valerie S. Harder, PhD, MHS, Sara E. Barry, MPH; Bridget Ahrens, MPH; Wendy S. Davis, MD; Judith S. Shaw, EdD, MPH, RN

From the Department of Pediatrics and Psychiatry (Dr Harder), Department of Pediatrics (Ms Barry and Dr Davis), Department of Pediatrics and Nursing (Dr Shaw), Vermont Child Health Improvement Program, University of Vermont; and Vermont Department of Health (Ms Ahrens), Burlington, Vt
The authors have no conflicts of interest to disclose.
Address correspondence to Valerie S. Harder, PhD, MHS, Vermont Child Health Improvement Program, University of Vermont, 1 S Prospect St, Burlington, VT 05401 (e-mail: valerie.harder@med.uvm.edu).
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Abstract

Objectives: Despite the proven benefits of immunizations, coverage remains low in many states, including Vermont. This study measured the impact of a quality improvement (QI) project on immunization coverage in childhood, school-age, and adolescent groups.

Methods: In 2013, a total of 20 primary care practices completed a 7-month QI project aimed to increase immunization coverage among early childhood (29–33 months), school-age (6 years), and adolescent (13 years) age groups. For this study, we examined random cross-sectional medical record reviews from 12 of the 20 practices within each age group in 2012, 2013, and 2014 to measure improvement in immunization coverage over time using chi-squared tests. We repeated these analyses on population-level data from Vermont's immunization registry for the 12 practices in each age group each year. We used difference-in-differences regressions in the immunization registry data to compare improvements over time between the 12 practices and those not participating in QI.

Results: Immunization coverage increased over 3 years for all ages and all immunization series ($P \le .009$) except one, as measured by medical record review. Registry results aligned partially with medical record review with increases in early childhood and adolescent series over time ($P \le .012$). Notably, the adolescent immunization series completion, including human papillomavirus, increased more than in the comparison practices ($P = .037$).

Conclusions: Medical record review indicated that QI efforts led to increases in immunization coverage in pediatric primary care. Results were partially validated in the immunization registry particularly among early childhood and adolescent groups, with a population-level impact of the intervention among adolescents.

Keywords: childhood immunization; immunization registry; medical record review; quality improvement; vaccination

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What's New

This quality improvement project improved immunization coverage in primary care and was associated with population-level increases in adolescent immunization coverage.

Vaccines are one of the most important public health interventions available, as indicated by the dramatic reduction in the morbidity and mortality associated with diseases for which widespread vaccine uptake has occurred.[1–4] The United States set a goal for Healthy People 2020 of achieving 80% coverage on the full series of Centers for Disease Control and Prevention (CDC)-recommended vaccines in 19- to 35-month-olds (44% in 2009), 80% for adolescents receiving a booster of tetanus, diphtheria, and acellular pertussis (Tdap; 47% in 2008), and 80% of female adolescents receiving 3 doses of human papillomavirus (HPV).[5] In 2010, Vermont had 41% coverage for 19- to 35-month-olds and 83% of Tdap booster for adolescents.[6] The 2015 halfway report for Healthy People 2020 indicated that 76% of 19- to 35-month-olds in Vermont completed the recommended series, 96% of adolescents had at least one Tdap booster, but only 48% of female adolescents completed the HPV series.[7] Immunization rates in Vermont have lagged behind other states in the Northeast among all age groups.[8–11]

To increase pediatric immunizations, the National Vaccine Advisory Committee developed best practice strategies that included continuous quality improvement (QI) and maintenance of congruency between practice and registry records.[12] QI within the primary care setting has been successful in initiating change in the provision of pediatric preventive services.[13–18] Previous investigations support increasing practice-level immunization rates by targeting specific techniques: avoiding missed opportunities,[19–21] improving access to clinic services and providing standing orders,[22] using reminder recall,[23] and coaching providers on communication with parents.[24,25] States with policies that mandate immunization assessment as part of QI have higher immunization rates than states that do not have these policies in place, demonstrating that QI can make a difference in public health outcomes.[13,26]

The Vermont Child Health Improvement Program (VCHIP), a public–private improvement partnership founded in 1999, conducts statewide QI initiatives, research studies, and program evaluations to inform health policy in the state.[15] VCHIP works to engage physicians and practice teams in voluntary QI projects, offering Part 4 Maintenance of Certification (MOC) through the American Board of Pediatrics. The implementation of MOC-approved QI projects has been demonstrated to lead to improvements in care, efficiency, and patient involvement.[27] In order to obtain evidence of the impact of QI interventions, VCHIP conducts medical record reviews, and this reference standard technique can be costly.

In 2012–2013, VCHIP conducted a statewide immunization QI project for pediatric and family medicine practices in Vermont, modeled after the Institute for Healthcare Improvement Breakthrough Series.[28] This QI project was conducted in collaboration with the Vermont Department of Health, which manages the immunization information system, referred to as the immunization registry (IMR), a database of immunizations administered by practitioners and accessible by primary care, school nurse, and other medical professionals. The availability of IMR and other registry data may allow VCHIP to measure the impact of QI projects, potentially reducing the need for costly medical record reviews.

Continual use of immunization registries can assist in keeping patients up to date on vaccination, help prevent overvaccination, and monitor public health coverage.[29] While there has been increased use of registries nationally, the IMR-related impact of a QI project is unknown. The overall goal of VCHIP's immunization QI project was to increase immunization coverage among children and adolescents at practices. The goal of this study was to validate medical record review results with IMR data and to assess the population-level impact of VCHIP's immunization QI project against a comparison group.

METHODS

SELECTION AND DESCRIPTION OF PARTICIPANTS

In 2012, VCHIP formed a voluntary network of pediatric-serving primary care practices to increase the quality of the state's health care delivery system. This Child Health Advances Measured in Practice (CHAMP)[30] network engaged health care professionals at primary care practices in collaborative activities to meet the needs of children and families and to address state priorities. In exchange for participation, CHAMP practices received opportunities to join QI projects approved for Part 4 MOC. The first CHAMP project was to improve immunization coverage among children and adolescents in 3 age groups (early childhood, school age, and adolescence). Figure 1 illustrates that of 29 practices participating in the CHAMP network, 20 were actively involved in the immunization QI, and 12 practices each year were included in the final sample.

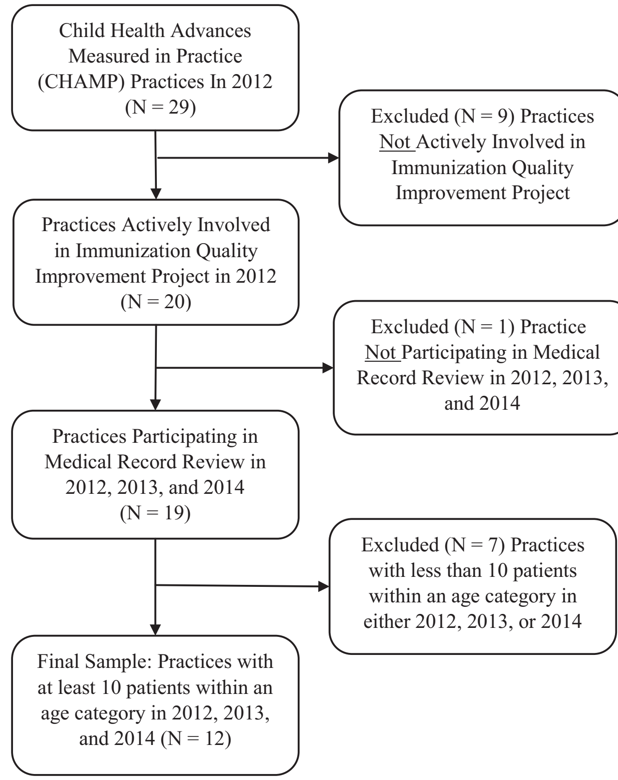

Figure 1. *Selection of practices actively participating in immunization quality improvement project.*

TECHNICAL INFORMATION

QI ACTIVITIES

CHAMP staff supported practices to improve immunization coverage across all 3 age groups. Practices participating in the QI project provided patient lists and immunization records of children and adolescents in their practices for preliminary QI data review. These data were used as a baseline for the percentage of patients up to date and missing antigens from the CDC recommended series. Because of the short, intensive nature of the QI project, and for ease of reporting back to VCHIP, practices were advised to select 3 antigens to concentrate improvement efforts on, but practices were not limited to working on only 3 antigens; nor did they indicate an age group for their focus. Practices collected monthly data and met in small teams within their sites to design and test changes to improve immunization coverage rates using Plan–Do–Study–Act (PDSA) cycles. Practices submitted data to the CHAMP project staff monthly on their tests of change and antigen-specific coverage rates. CHAMP project staff reviewed the data and compiled monthly feedback reports, and they provided coaching for each practice on evidence-based strategies to improve immunization coverage. Training included attendance at a daylong learning session, review of the individual practice and aggregate baseline immunization data, the latest recommendations for pediatric health supervision visits, a primer on Vermont's current immunization coverage rates and opportunities for improvement, evidence-based change strategies, and human papillomavirus (HPV) vaccines. Over the course of the project, CHAMP staff led 4 all-site, collaborative, 1-hour calls to share knowledge and address barriers to immunization delivery. Physicians participating for Part 4 MOC credit were required to attend at least 3 of the 4 calls, and the number of participants per practice ranged from 1 to 6 per call. Call topics included "getting the most out of the IMR," "the science of immunizations," "health literacy relationship to immunizations," and "adolescent immunizations." On each call, CHAMP staff shared a few announcements; physicians and staff reported on their progress, challenges, or barriers encountered to date; attendance was taken; the call topic was presented; and the call ended with discussions of each practices' next PDSA cycle. Peer-to-peer feedback was encouraged throughout the calls by the CHAMP project staff.

MEDICAL RECORD REVIEW

CHAMP project staff randomly sampled 50 medical records from practice-generated lists (or all records if fewer than 50 children) from 3 age groups: early childhood (29- to 33-month-olds), early school age (6-year-olds), and early adolescence (13-year-olds). Patients were selected if they had been seen in practice within the last 3 years, had at least one health supervision visit at the practice, and had no documentation of transferring out or having inactive status at the practice. Using these lists, medical record reviewers collected immunization coverage data at all CHAMP practices. Each age group included data on 12 of the 20 participating practices (Fig. 1) each year because they had at least 10 patients for all 3 years. So within an age group, the 12 practices were the same over 3 years, and 11 of the 12 practices were the same across the 3 age groups.

Medical record reviewers recorded immunization coverage on the CDC-recommended series of immunizations. For early childhood, the CDC series 4:3:1:4:3:1:4 included 4 doses of Tdap, 3 doses of polio, 1 dose of measles, mumps, and rubella, 4 doses of *Haemophilus influenzae* type B, 3 doses of hepatitis B, 1 dose of varicella, and 4 doses of pneumococcal conjugate vaccines. In addition to the CDC series, medical record reviewers recorded coverage of 2 doses of hepatitis A (hepA) and 2 doses of rotavirus vaccines. For early school age, the CDC series 5:4:2:2 included the fifth Tdap, fourth polio, second measles, mumps, and rubella, and second varicella. The CDC series for early adolescence included all 3 HPV vaccines, as well as a first booster for Tdap and the first meningococcal vaccine. Given the relatively recent inclusion of HPV recommended by CDC, this study also examined the series excluding the 3 HPV vaccines.

VERMONT IMMUNIZATION REGISTRY

Practitioners administering vaccines are required to report immunizations to the IMR. Eighty-nine percent of Vermont medical provider sites serving children reported to the IMR at the time of the data extraction. More than half of these (55%) had direct connection from the electronic health record to the IMR, while the others either entered data into the IMR or sent a monthly import file. Under a data use agreement with the Vermont Department of Health, we obtained 3 data sets (2012, 2013, and 2014) of deidentified IMR data from all pediatric-serving practices for the 3 age groups. These population data sets consisted of patient-level immunization series completion indicators for each vaccine for all individuals in these 3 age groups for all practices. Patients in the IMR were associated with the practice where the last immunization was provided, and practices were encouraged to update the patient lists in the IMR annually to indicate instances where patients were no longer in their care. Table 1 shows the demographics and total sample sizes included in analyses by age group in the CHAMP and IMR data sets for the 12 participating CHAMP practices each year.

STATISTICAL ANALYSIS

To examine our primary research question, whether the CHAMP QI project resulted in increased immunization coverage from baseline (2012) over the next 2 years (2013 and 2014), we analyzed the data obtained from the medical record

Table 1. Demographics of Children and Adolescents at Same Practice From CHAMP Medical Record Reviews and Vermont Immunization Registry Over 3 Years

	CHAMP Data Collection Year			Registry Data Collection Year		
Age Group	2012	2013	2014	2012	2013	2014
Early childhood (29–33 mo)						
No. of subjects	503	497	501	873	783	813
Female, n (%)	252 (50.1)	224 (45.1)	264 (52.7)	428 (49.03)	383 (48.91)	396 (48.71)
Medicaid, n (%)	254 (50.5)	232 (46.7)	251 (50.1)	…	…	…
Transferred in, n (%)	104 (20.7)	103 (20.8)	106 (21.2)	…	…	…
Gestational age, mean (SD)	39.2 (1.9)	39.1 (1.8)	38.9 (1.9)	…	…	…
Early school age (6 y)						
No. of subjects	528	551	513	1294	1226	1243
Female, n (%)	277 (52.46)	287 (52.09)	250 (48.73)	639 (49.38)	634 (51.71)	625 (50.28)
Medicaid, n (%)	226 (42.8)	251 (45.55)	259 (50.49)	…	…	…
Transferred in, n (%)	135 (25.71)	165 (29.95)	137 (26.71)	…	…	…
Early adolescence (13 y)						
No. of subjects	513	527	526	1031	1007	1035
Female, n (%)	252 (49.12)	254 (48.2)	506 (48.65)	494 (47.91)	491 (48.76)	505 (48.79)
Medicaid, n (%)	191 (37.23)	184 (34.91)	208 (39.54)	…	…	…
Transferred In, n (%)	123 (23.98)	127 (24.24)	77 (14.64)	…	…	…

CHAMP indicates Child Health Advances Measured in Practice quality improvement project on immunizations.

review and the IMR data from the same 12 practices each year to determine whether gains in immunization coverage in the CHAMP data set were mirrored at the population level. We used chi-squared tests in both analyses to compare the proportion completing the immunization series over the 3 years within each age group. Mixed-effects logistic regression of immunization coverage on calendar year controlled for the correlation between patients nested within practices. Because of the random selection of patients from each practice, and because the same practices were sampled over 3 years, patient-level and practice-level demographics were not included as confounders.

Our second research question was whether immunization coverage at the 12 participating CHAMP practices was greater than that of nonparticipating (comparison) pediatric and family medicine practices. Our comparison group included all nonparticipating pediatric-serving practices for each age group that had data in the IMR for both years being compared. We used a difference-in-differences linear regression approach (Equation 1) to compare the difference in immunization coverage between CHAMP and comparison practices 2012–2013 and 2012–2014.

$$Equation\ 1: Y_{i,t} = \beta_0 + \beta_1(CHAMP_i) + \beta_2(year_t) + \beta_3(CHAMP_i * year_t) + e_{i,t}$$

The dependent variable ($Y_{i,t}$) measured the average percentage of immunization coverage and was estimated as a function of an indicator for being at a CHAMP practice, an indicator for the year, and the interaction between CHAMP and year. From Equation 1, β_1 was the estimated mean difference in percentage completed immunization series between the CHAMP and comparison groups before intervention (2012). β_2 was the expected mean change in percentage completed immunization series from before to after invention (2013 or 2014) among the comparison group only. β_3 was the difference between the mean changes in CHAMP practices' percentage completed immunization series from before to after the intervention compared to the comparison practices' percentage completed over the same time period. This method tested whether the improvement in immunization coverage at CHAMP practices over time was significantly larger than at comparison practices. We used Stata 14 software (StataCorp, College Station, Tex) to conduct all statistical analyses, and $P < .05$ was used to indicate statistical significance.

RESULTS

The randomly sampled cross sections of children each year in CHAMP were comparable in demographics to the IMR data. The CHAMP medical record review data sample was approximately half the size of the population data of children in the IMR in each age group and calendar year, and both had approximately 50% girls in each age group (Table 1). The additional demographics available in the CHAMP data showed consistency across the 3 years on measures of mean gestational age, percentage transferring into the practice, and percentage with Medicaid (Table 1).

Examining the CHAMP data, results indicated that the QI project increased immunization coverage over 3 years within each age group (Table 2), except for a borderline nonsignificant ($P = .06$) increase in the proportion completing the CDC-recommended series in early childhood. When hepA and rotavirus were included in the early childhood VCHIP series, the increase was significant in 2012–2014 but not 2012–2013. Among early school age, the increase was significant in 2012–2013 but not 2012–2014, and among early adolescents, the increases were significant for both pairwise comparisons of years (2012–2013 and 2012–2014).

IMR results for the same 12 practices partially aligned with CHAMP data results. Similarly, the IMR data indicated no increase over time in the completed CDC series in early childhood, but there was an increase when hepA and rotavirus vaccines were included (Table 2). Another similarity was evident in the early adolescent data, where

Table 2. Children and Adolescents with Completed Immunizations at 12 Practices Over 3 Years From CHAMP Medical Record Review and Immunization Registry Data

	CHAMP Data Collection Year				Registry Data Collection Year			
Age Group	2012	2013	2014	P*	2012	2013	2014	P*
Early childhood (29–33 mo)								
No. of subjects	503	497	501		873	783	813	
Completed CDC recommended, n (%)	376 (74.8)	392 (78.9)	405 (80.8)	.059	646 (74.0)	599 (76.5)	616 (75.8)	.474
Completed CDC recommended and hepA and Rotavirus, n (%)	277 (55.1)	301 (60.6)	323 (64.5)	.009	446 (51.1)	430 (54.9)	474 (58.3)	.012
Early school age (6 y)								
No. of subjects	528	551	513		1294	1226	1243	
Completed CDC recommended, n (%)	428 (81.1)	487 (88.4)	435 (84.8)	.004	966 (74.7)	931 (75.9)	916 (73.7)	.436
Early adolescence (13 y)								
No. of subjects	512	527	526		1031	1007	1035	
Completed CDC recommended, n (%)	97 (19.0)	151 (28.7)	164 (31.2)	<.0005	152 (14.7)	218 (21.7)	259 (25.0)	<.0005
Completed CDC recommended, without HPV, n (%)	408 (79.8)	448 (85.0)	462 (87.8)	.002	758 (73.5)	783 (77.8)	835 (80.7)	<.0005

CDC indicates Centers for Disease Control and Prevention; CHAMP, Child Health Advances Measured in Practice quality improvement project on immunizations; hepA, hepatitis A; and HPV, human papillomavirus.

*Reported *P* is overall significance test across 3 years within each data source.

Table 3. Vermont Immunization Registry Data on Percentage Coverage of Recommended Immunizations Among CHAMP Participating and Comparison Practices Over 3 Years

Age Group	% Coverage for: 2012	2013	2014	*P* for:† 2012–13	2012–14
Early childhood—CDC series				.631	.617
Participating	74.0	76.5	75.8		
Comparison	57.4	63.6	62.2		
Early childhood—CDC plus hepA and rotavirus				.552	.690
Participating	51.1	54.9	58.3		
Comparison	34.5	43.7	47.0		
Early school age—CDC series				.980	.959
Participating	74.7	75.9	73.7		
Comparison	50.8	54.4	56.0		
Early adolescence—CDC series				.257	.037*
Participating	14.7	21.7	25.0		
Comparison	9.5	11.4	13.4		
Early adolescence—CDC excluding HPV				.987	.561
Participating	73.5	77.8	80.7		
Comparison	52.4	56.7	56.4		

CDC indicates Centers for Disease Control and Prevention; CHAMP, Child Health Advances Measured in Practice quality improvement project on immunizations; and hepA, hepatitis A.

*$P < .05$.

†*P* was calculated by difference-in-differences statistical method.

increases were significant over time from the CDC-recommended series with and without HPV (Table 2). In contrast, the IMR early school-age data indicated no improvement in the completed CDC-recommended series. IMR immunization completion was lower across all age groups and years, ranging from 1 to 12 percentage points lower (Table 2).

Within IMR data, the average percentage coverage of recommended immunizations was markedly lower in 2012 at comparison practices for all age groups than participating CHAMP practices (Table 3). These differences in baseline immunization coverage led to the difference-in-differences statistical analysis to see if the increases over time seen at CHAMP practices were larger than increases at comparison practices in the IMR. Results (β_1) from the difference-in-differences models for research question 2 indicate that the baseline immunization rates were significantly lower ($P < .005$; Supplementary Table) for all immunization series, except the early adolescent CDC recommended series (including HPV).

Although the comparison practices showed trends in increasing coverage over time for all 3 age groups (Table 3), results (β_2) indicated only the early childhood series with hepA and rotavirus significantly increased for comparison practices in 2012–2013 and in 2012–2014 ($P < .02$; Supplementary Table). Early school-age and early adolescent comparison practices did not increase significantly over time for any immunization series ($P > .05$; Supplementary Table).

For the early childhood and school-age populations in the IMR, the difference-in-differences effects (β_3) of participation in QI did not reach statistical significance ($P > .05$; Table 3). For early adolescents in the IMR, participating practices had an increase of 10.3 percentage points from 2012 to 2014 for the series including HPV, whereas comparison practices had an increase of 3.9 percentage points (Table 3). This 6.4 difference-in-differences was statistically significant ($P = .037$), as depicted graphically in Figure 2.

Discussion

Our study is novel in that we have access to both randomly sampled medical record review data and population-level IMR data for the same practices. Overall, within the medical record review data, immunization coverage increased over time within all 3 age groups. However, not all pairwise year comparisons and not all immunization series reached statistical significance within each age group. For example, in the early childhood medical record review data, while clinically significant increases (6%) in immunization coverage were observed in the CDC series, they did not reach statistical significance, except when hepA and rotavirus were included in the analysis. Other studies have reported increases in immunization coverage for hepA and rotavirus over time,[31,32] likely as a result of the low nationwide coverage, thus leading to a push for more immunizations,[31] as well as increased use of immunization registries.[33] Nationwide, it was shown that rotavirus vaccination increased 4% in 19- to 35-month-olds between 2012 and 2013 and that hepA vaccination increased 1.6%.[31]

Our medical record review conclusion that improvements were made in early childhood and adolescent immunization coverage was supported in the IMR analyses. Our ability to isolate the same 12 practices in the IMR population-level data provided a unique opportunity to replicate and validate our findings. Neither the medical record review nor the IMR data showed a statistically significant increase in the immunization coverage for the CDC early childhood series from 2012 to 2014. When including hepA and rotavirus immunizations, both the medical record review and the IMR analyses confirmed a statistically significant improvement in immunization coverage over time in early childhood.

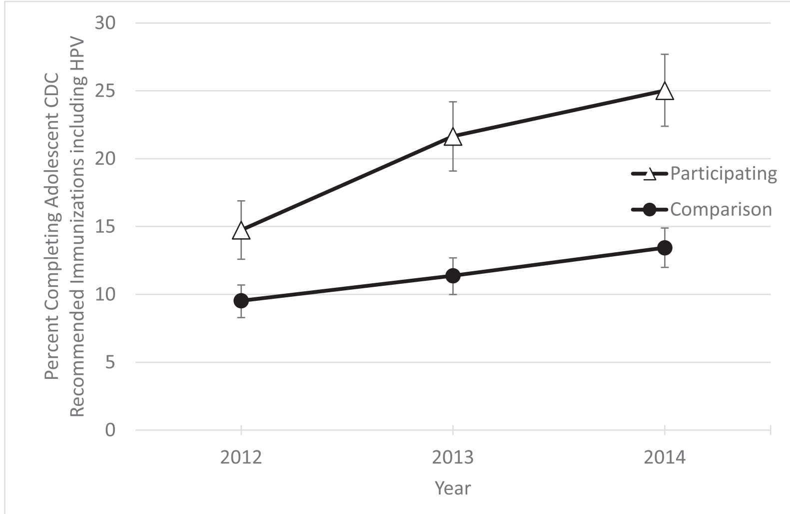

Figure 2. *Change over time in percentage completing Centers for Disease Control and Prevention–recommended early adolescent immunizations including human papillomavirus among participating and comparison practices, with 95% confidence intervals around point estimates.*

The medical record review and IMR data did not agree on improvements to early school-age immunization coverage. The IMR data did not show significant improvement over time, while the medical record review did. It is notable that immunization coverage in the IMR was lower across all age groups, with the largest difference among early school-age children. There are differences between the CHAMP and IMR data sets, such as practices not knowing which patients have changed practices, the IMR not knowing if a patient has moved out of Vermont, or the IMR associating each patient with the most recent practice that recorded an immunization rather than the practice where the vaccine was given. The IMR data were queried in early 2016 and the CHAMP data queried in 2012–2014, resulting in a potential for more migration leading to differences. If practices reviewed and updated the IMR patient lists more frequently, some of these difference may be reduced. Differences were not likely due to duplicate records, as the Vermont IMR matched and merged records nearly every day.

Discrepancies similar to those found in our early school-age group have been seen between the Washington State Immunization Information System and an integrated health care organization.[34] The Washington immunization registry reported fewer immunizations than the health care organization for the same population.[34] Interestingly, by 2015 in Wisconsin, the opposite effect was found. Vaccine records in the Wisconsin registry reported greater vaccination rates and more complete vaccination histories than medical records from primary care practices alone.[35] The researchers suggested this may have been because Wisconsin consolidated information from primary practices and other sources, while the medical records contained only those vaccinations given at a provider's office.[35] Vermont's IMR contains consolidated information from hospitals, primary care practices, insurers, and other sources, like Wisconsin's system. It also has mandated reporting, unlike the Washington system. Like both of these systems, the IMR is challenged by the issue of outmigration; only a medical practice can determine when a patient is no longer in its care, and it takes resources to manage this information.

Within the IMR, both CHAMP practices and comparison practices exhibited increases in immunization rates over the 3-year comparison period. While our differences-in-differences approach between participating and nonparticipating practices did not reach significance for early childhood and early school-age groups, CHAMP participants displayed consistently higher immunization completion than the comparison group across all age groups throughout the study. Completion of the CDC-recommended series including HPV in early adolescence did achieve statistical significance over comparison practices within the 3-year period. Focusing just on early adolescence, immunization increases were statistically significant within CHAMP practices, within the IMR data, and against comparison practices. These results provide evidence that participation in the QI project was a supportive factor in increasing adolescent immunizations. Before 2012, although the HPV vaccination coverage was greater in Vermont girls than the national average, it was still lower than that of other teen vaccines in Vermont, leading the Vermont Department of Health to begin educational campaigns for parents and primary care providers.[11] These improvements may have been influenced by both the health department's campaigns and by VCHIP's specific curriculum components on HPV, including focused calls on adolescent immunizations, where practitioners discussed effective approaches to messaging HPV vaccination to parents and adolescents. In the final quarter of 2014, the IMR began providing practices with quarterly reports of immunization coverage, including HPV.

Several factors may have influenced the outcomes of this QI project. The short duration and tight focus of the QI project allowed physicians to work in teams with practice staff on practice-level improvements to immunization coverage. In addition, data visualization through preparation of run charts and QI coaching provided monthly by the CHAMP project staff provided accountability and support to maintain focus on the project. A peer-to-peer learning community was formed through in-person training and was sustained through regular conference calls; this created both accountability for reporting on progress and friendly competition among professionals. Though it is evident that participation in a QI project can result in increased immunization coverage, the changes to office systems and workflow processes put in place during such a project require ongoing attention and commitment from staff and providers to sustain improvements. Practice systems need regular repeat evaluation to accommodate changes in CDC immunization recommendations, clinical practice, staffing, and patient expectations and experience of care. Further, practice staff require initial training and continuous use of the IMR to maintain competency.

Limitations

We experienced limitations in matching CHAMP practices with nonparticipating practices to compare immunization coverage over time. We did not have access to practice demographic information, such as overall size, so it was not possible to conduct an exact matching strategy. With an exact matching strategy, we may have been able to make more conclusive statements regarding the effects on immunization coverage at practices participating in CHAMP versus matched nonparticipating practices. Another limitation was that the IMR updated the patient's practice on the basis of the most recent immunization in early 2016. This may have resulted in children being assigned to a different practice in the IMR data than in the CHAMP data collected in 2012–2014. We are unaware of a reason why there would be differential movement across our 3 age groups, so this likely would not explain the differences in the inferences drawn from school-age CHAMP and IMR data, or the lower overall completion rates in the IMR data across all years and age groups. Finally, CHAMP practices self-selected to participate in QI and therefore may have been higher-performing practices overall. Within our IMR data, this self-selection may explain some of the difference in baseline immunization completion rates between participating and comparison practices.

Conclusions

Across pediatric practices in Vermont, a focused QI project resulted in improvements in immunization coverage, as evidenced by medical record review over time. Results were partially validated in the IMR, particularly among early childhood and adolescent groups, with a population-level impact of our intervention among adolescents. Continued efforts are needed to align practice and IMR data to inform effective practice panel management and statewide population health management strategies.

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Supplementary Data

Supplementary data related to this article can be found online at https://doi.org/10.1016/j.acap.2018.01.012.

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