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Factors Associated With Provider Reporting of Child and Adolescent Vaccination History to Immunization Information Systems: Results From the National Immunization Survey, 2006-2012

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Abstract

Context: Use of Immunization information systems (lISs) by providers can improve vaccination rates by identifying missed opportunities. However, provider reporting of children's vaccination histories to lISs remains suboptimal.

Objective: To assess factors associated with provider reporting to an IIS.

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Design: Analysis of 2006–2012 National Immunization Survey (NIS) and NIS-Teen data. NIS and NIS-Teen are ongoing random-digit-dial telephone surveys of households with children and adolescents, respectively, followed by a mail survey to providers to obtain the patient's vaccination history.

Setting and Participants: A total of 115 285 children aged 19 to 35 months and 83 612 adolescents aged 13 to 17 years and their immunization providers in the United States.

Main Outcome Measures: The percentage of children and adolescents with 1 or more providers reporting to or obtaining vaccination information from their local IISs. Multivariable logistic regression was used to examine patient and provider factors associated with provider reporting to IISs and adjusted prevalence of children and adolescents with 1 or more providers reporting to IISs.

Results: In 2012, 79.4% of children and 77.4% of adolescents had 1 or more providers report any of their vaccination data to an IIS, and 41.9% of children and 51.5% of adolescents had providers who obtained any of their vaccination histories from an IIS. During 2006–2012, children and adolescents were more likely to have any of their vaccination data reported to an IIS if they received care from all public versus all private providers (children: 84.4% vs 69.6%, $P < .0001$; adolescents: 84.6% vs 66.4%, $P < .0001$), had 1 or more providers who ordered vaccines from a state or local health department (children: 76.7% vs 59.5%, $P < .0001$; adolescents: 77.0% vs 55.6%, $P < .0001$), or had 1 or more providers obtain vaccination information from the IIS (children: 86.1% vs 71.2%, $P < .0001$; adolescents: 83.7% vs 64.6%, $P < .0001$).

Conclusions: Health department staff should target providers less likely to use IIS services, including private providers, and providers not ordering vaccines from health departments to ensure they use IIS services.

Keywords

immunization information systems; immunization registries; National Immunization Survey (NIS); NIS-Teen

Immunization information systems (IISs), also known as immunization registries, are confidential, computerized information systems that are used to collect and consolidate vaccination data from multiple health care providers.[1] Core IIS functions include providing point-of-care consolidated immunization histories and immunization forecasts and providing population-level data for use in surveillance and program operations and to guide public health action to improve vaccination rates and reduce vaccine preventable diseases.[2] A recent systematic review found strong evidence for IISs to increase vaccination rates and reduce vaccine-preventable disease.[3] The evidence from this review informed the Task Force on Community Preventive Services, which recommends use of IISs for improving vaccination coverage through reminder recall notifications, use during outbreaks, and as an aid in determining missed opportunities, invalid dose administrations, disparities, and appropriate vaccine management.[4]

To realize the full benefits of IISs, immunization providers would need to report to the IIS, for every patient, every vaccination the patient receives. However, past studies indicated that

not all providers are doing so.[5–7] A Centers for Disease Control and Prevention survey of 56 immunization grantees found that the percentage of children in the United States with records in an IIS has been steadily increasing over the past few years, and by 2012, 86% of children younger than 6 years participated in IISs, defined as having 2 or more immunizations documented in an IIS.[1] However, only 54% of adolescents aged 11 to 17 years participated in IISs.[8] In addition, in 2005, 75% of public vaccination provider sites and 44% of private provider sites submitted data to an IIS.[7] More recent data indicate that while the number of both public and private provider sites participating in IISs has increased across the United States from 2006 to 2010, many provider sites are still not submitting vaccination data to IISs.[9] In local studies, wide variations in IIS provider site participation rates have been documented.[10,11]

Identification of factors that are associated with provider use of IISs was determined to be a top research priority to increase provider participation,[12] but to our knowledge, only a few studies have examined this to date.[6,10,11,13] Data from the National Immunization Survey (NIS) provides an opportunity to examine factors that are associated with provider reporting to IISs in a nationally representative sample of children over several years. Our objectives were to (1) determine the frequency of vaccination provider use of IISs in children aged 19 to 35 months and 13 to 17 years, by state and by year from 2006 to 2012, and (2) identify factors associated with provider use of IISs. The results will assist in determining strategies for increasing provider participation in IISs in the United States.

Methods

Data from the 2006 to 2012 NIS and NIS-Teen were analyzed. In this article, we use the term ″children″to refer to those 19 to 35 months old at the time of the NIS telephone interview with their parent/guardian and use the term ″adolescents″to refer to those who were 13 to 17 years old at the time of the NIS-Teen telephone interview with their parent/guardian. The NIS is an ongoing, national, random-digit-dial telephone survey of households with children 19 to 35 months old at the quarter of the interview (NIS) and adolescents 13 to 17 years old at the time of the interview (NIS-Teen).[14,15] The household telephone survey is followed by a survey mailed to all of the child's or adolescent's immunization providers identified during the telephone survey and for which permission was granted. The mailed survey to immunization providers (the Immunization History Questionnaire) was used to collect provider characteristics as well as the vaccination histories of the children and adolescents. The Immunization History Questionnaire included the following IIS questions:

1. Did you or your facility report any of this child′s/adolescent′s immunizations to your community or state registry?
2. Was any of the immunization information for this child/adolescent obtained from your community or state registry?

This study includes only children and adolescents with provider-reported vaccination data. Of these with provider-reported data, we excluded children and adolescents who moved out of their birth state by the time of the survey (8% children and 22% adolescents) since provider behavior regarding IISs may be impacted by whether the patient moved. Children

who lived in New Hampshire were also excluded (1% of children and 1% of adolescents), since New Hampshire did not have an IIS. Children and adolescents with providers who responded ″Don't know″ or left the answer blank were excluded when information from that specific question was required for analyses. From 2006 to 2012, these included 21% of children and 26% of adolescents with providers who replied ″Don't know″ for reporting data to the IIS and 40% of children and 41% of adolescents with providers who replied ″Don't know″ for obtaining data from the IIS.

The landline household response rates for survey years 2006–2012 as defined by the Council of American Survey Research Organizations[16] were 64.5%, 64.9%, 63.2%, 63.9%, 63.8%, 61.7%, and 64.7% for the NIS, respectively, and 56.2%, 55.9%, 58.7%, 58.0%, 58.0%, 57.2%, and 55.1% for the NIS-Teen, respectively.[14,15,17–28] Beginning in 2011, NIS changed from sampling only landline telephones to a dual-frame sampling scheme, with interviews conducted via landline or cellular telephone. The response rate for the 2011 and 2012 NIS for the cellular telephone sample was 25.2% and 30.6%, respectively, and for the 2011 and 2012 NIS-Teen was 22.4% and 23.6%, respectively.[14,15,17,23] Adequate provider vaccination records were obtained for 70.4% of children with completed landline household interviews in 2006 (n = 21044), 68.6% in 2007 (n = 17017), 71.0% in 2008 (n = 18430), 70.7% in 2009 (n = 17313), 71.2% in 2010 (n = 17004), 71.6% in 2011 (n = 17309), and 67.6% in 2012 (n = 8603).[14,18–23] Adequate provider vaccination records were obtained for 71.6% of children with completed cellular telephone interviews in 2011 (n = 2225) and 63.9% in 2012 (n = 8313).[14,23] Adequate provider vaccination records were obtained for 52.7% of adolescents with completed landline house-hold interviews in 2006 (n = 2882), 53.8% in 2007 (n = 2947), 58.1% in 2008 (n = 17835), 57.2% in 2009 (n = 20399), 59.2% in 2010 (n = 19488), 61.5% in 2011 (n = 20848), and 62.0% in 2012 (n = 14 133).[15,17,24–29] Adequate provider vaccination records were obtained for 54.6% of adolescents with completed cellular telephone interviews in 2011 (n = 2716) and 56.4% in 2012 (n = 5066).[15,17] Methodological details of the NIS and NIS-Teen have been previously published.[30–33]

At the provider level, this study included whether providers obtained data from the IIS or ordered vaccine from a health department. The following child-and adolescent-level factors were also included in the study: facility type visited for vaccinations (self-reported by providers as only private providers, only public providers [providers at a federally qualified health center], public health department–operated clinic, or Women, Infant and Child [WIC]), only hospital, only military, or a mixture of facility types if the child or teen had more than 1 providers of different types), receipt of WIC benefits, race/ethnicity, Vaccines for Children (VFC) eligibility, Metropolitan Statistical Area (MSA) (MSA central-city [urban], MSA noncentral city [suburban], and non-MSA [rural]), number of vaccination providers, number of visits to providers in the past 12 months, state of residence, maternal education, and maternal income level. The state of the child ´s or adolescent ´s residence was used as a proxy for the state of the provider ´s practice to determine percentages of children and adolescents with at least 1 provider reporting data to, or obtaining data from, IISs in 2012, to provide the most recent estimates of provider IIS use by state.

We combined all years of data from 2006 to 2012 for children aged 19 to 35 months and for adolescents aged 13 to 17 years into 2 data sets. We then performed Wald χ^2 tests to test for

any association by year, and of provider and child and adolescent factors, with provider reporting data to, or obtaining data from, an IIS. Likewise, data from 2006 to 2012 were combined by age group and multivariable logistic regression analyses were conducted to assess factors associated with vaccination data reported to IISs while controlling for other variables in the model. Variables were assessed for collinearity and removed from the model if high collinearity existed. Interaction terms were included in the model, and backward elimination was used to determine the final model. Predictive margins were used to calculate an adjusted prevalence of children with 1 or more providers reporting to the IIS when controlling for all other independent variables. Adjusted prevalence ratios based on predictive margins from the logistic regression model are also reported.[34,35] All tests were 2-sided with a significance level of .05 adopted. All reported percentages are weighted and reported with 95% confidence intervals (95% CI), whereas reported sample sizes are unweighted. All analyses were weighted to population totals and to adjust for house-holds having multiple telephones, nonresponse, and noncoverage of households without telephones. All analyses were performed using SAS (version 9.3; SAS Institute, Cary, North Carolina) and SUDAAN (version 11.0.0; Research Triangle Institute, Research Triangle Park, North Carolina) to account for the complex survey sample design.[36]

Results

From 2006 to 2012, there were a total of 184 903 children and 185 410 adolescents with completed interviews. Of these, 115 285 children and 83 612 adolescents were included in this study after excluding those patients with-out adequate provider data, those who did not remain in the birth state at the time of the survey, and those who lived in New Hampshire.

The percentage of children and adolescents with 1 or more providers who reported to, or obtained data from, IISs from 2006 to 2012 are presented in Figure 1. In 2006, 61.9% (95% CI, 60.5–63.3) of children had 1 or more providers report to IISs, and in 2012, this increased to 79.4% (95% CI, 77.7–81.1) ($P < .0001$). In 2006, 23.1% (95% CI, 21.8–24.5) of children had 1 or more providers obtain any of their vaccination information from IISs, and this increased in 2012 to 41.9% (95% CI, 40.1–45.5) ($P < .0001$). In 2006,58.5% (95% CI, 55.4–61.7) of adolescents had 1 or more providers report to IISs, and this increased to 77.4% (95% CI, 76.0–78.7) by 2012 ($P < .001$). In 2006, 33.6% (95% CI, 30.4–36.8) of adolescents had 1 or more providers obtain any of their vaccination information from IISs, and this increased to 51.5% (95% CI, 49.6–53.4) by 2012 ($P < .001$). The percentages of children and adolescents with 1 or more providers who reported to, or obtained data from, IISs from 2006 to 2012 by state are shown in Supplemental Digital Content Appendices Table 1 (available at: http://links.lww.com/JPHMP/A161) and 2 (available at: http://links.lww.com/JPHMP/A162).

The percentages of children and adolescents with at least 1 provider reporting vaccination records to an IIS in 2012 by state are presented in Figure 2A and B. In 13 states, less than 80% of children surveyed had 1 or more providers reporting to IISs, whereas in 26 states, 90% or more of children surveyed had 1 or more providers reporting to IISs. In 16 states, less than 80% of adolescents surveyed had 1 or more providers reporting to IISs, whereas in 22 states, 90% or more of adolescents surveyed had 1 or more providers reporting to IISs.

On the basis of the multivariable model, significant factors associated with reporting of a child′s vaccinations to an IIS included having 1 or more providers versus no provider who obtained vaccination histories from an IIS (86.1% vs 71.2%, $P < .0001$), having 1 or more providers versus no provider who ordered vaccine from a state or local health department (76.7% vs 59.5%, $P < .0001$), receiving care from mixed, all public, and all hospital facilities versus all private providers (mixed: 92.5%, all public: 84.4%, all hospital: 79.9%, all private: 69.6%, $P < 0.0001$) current receipt of WIC benefits versus never receipt of WIC benefits (77.8% vs 71.2%, $P < 0.001$), childś rural versus suburban residence (76.8% vs 73.1%, $P < 0.002$), and having 2 or more providers versus 1 provider (76.1% vs 73.6%, $P = .0021$; Table 1). For adolescents, the multivariable model resulted in the following factors being significantly associated with reporting an adolescentś vaccination records to an IIS: having 1 or more providers who obtained vaccination histories from an IIS (83.7% vs 64.6%, $P < .0001$), having 1 or more providers who ordered vaccine from a state or local health department (77.0% vs 55.6%, $P < .0001$), receiving care from mixed, all public and all hospital facilities versus all private facilities (mixed: 89.4%, all public: 84.6%, all hospital: 73.7%, all private: 66.4%, $P < 0.001$) having VFC eligibility versus not having VFC eligibility (75.8% vs 72.5%, $P < .0001$), and having 8 or more visits in the past 12 months to providers (75.1% vs 70.7%, $P < .0001$; Table 2).

Discussion

Provider use of IISs increased from 2006 to 2012 for both children and adolescents, but it varies by state and remains suboptimal in some localities. The proportion of children with providers obtaining vaccination data from IISs was much lower than for those reporting data to IISs. Several factors were associated with decreased likelihood of the provider reporting that they had submitted child and adolescent vaccination records to the IIS, including if children or adolescents did not have their vaccination history obtained from an IIS by any providers, did not have any providers who ordered vaccine from a state/local health department, and received their vaccinations from only private providers.

Maximum provider participation in obtaining data from IISs, and reporting immunizations to IISs, is needed to fully realize the benefits of IISs. Providers who obtain vaccination histories from IISs are able to verify a patientś immunization records and obtain a vaccination forecast to support clinical decision making, identify missed opportunities, and reduce unnecessary duplicate vaccinations. Reporting vaccinations to IISs allows other providers who may see patients subsequently to view their immunization history. In addition, population-based measures using IIS data will be more accurate, including immunization coverage analyses within a geographic area, sending reminder-recall notices, facilitating vaccine recalls,[37] and identifying additional opportunities for vaccination during outbreaks and vaccine shortages.[38,39] In this study, particularly notable is the low proportion of providers obtaining information from IISs, the association between lack of obtaining records and decreased reporting to IISs, and the fact that private providers were least likely to report immunizations to IISs. As a majority of vaccines administered are delivered in the private sector,[40,41] private providers are an essential group to fully populate IISs with immunization information. While low private provider participation in IISs has been described previously,[6,42,43] few studies have examined reasons for provider

participation[6,10,11,13]; those that have found barriers to participation include perceived high cost, too much staff time, and that the practice has its own system for recording and monitoring immunizations. For those providers who have their own system for immunization record keeping, either paper-based or electronic, they may not feel the need to verify patientś immunizations with their local IISs but a practicés immunization histories could be incomplete if the child receives any vaccinations else-where. This is a key opportunity for additional outreach regarding the utility and benefits of the IIS to private providers.

The fact that certain providers are more likely to report to IISs suggests that there is a dichotomy in the type of provider and patient population that is associated with reporting to IISs. Children and adolescents with mixed providers or all public providers, with providers who order vaccines from their state/local health department (from the VFC program), children who are in the WIC program, adolescents who are VFC eligible, children with 2 or more providers, and adolescents with 8 or more visits to their provider in the 12 months before the survey were more likely to have their immunization records reported to the IIS. Some states with legal mandates required entry of immunization history and other vaccine management practices into the IIS as part of provider enrollment in the VFC program,[44] which may in part account for the association with higher reporting to IISs. Nonetheless, the results demonstrate room for improvement. For example, while it is encouraging that children with 2 or more providers were more likely to have their records reported to IISs than children with 1 provider, the difference was relatively small and both groups had substantial room for progress. If the child has had multiple providers in the past resulting in scattered records, the ability to access a consolidated record at the point of clinical care is indispensable. Approximately 30% of children aged 19 to 35 months in the United States have records scattered among 2 or more providers,[45] and previous studies have shown that underserved childreńs immunization histories are more likely to be fragmented among several providers.[45–47] Immunization record scattering can also lead to problems in measuring vaccination coverage at both the provider and population levels, particularly for underserved populations.[45] A fully populated IIS with maximum client and provider participation and completeness of records could mitigate or eliminate these issues.[37]

Provider participation in IISs is further complicated by the diverse and numerous immunization reporting laws in the United States.[48–50] In 2012, 31 of 53 jurisdictions (59%) mandated at least 1 type of provider or entity to report immunizations, an increase from 12 jurisdictions in 2000.[48,50] However, these mandates varied in age requirement, vaccine type, or provider type for reporting, and only 21 jurisdictions mandated all immunization providers to report.[50] Enforcement of these mandates also varied by locality, with some exacting financial penalties or limiting vaccine purchase order whereas others did not enforce the mandates.[50] These differing laws, requirements, and penalties, sometimes interacting with and contradicting each other in 1 locality, have the potential to confuse providers and health authorities about their legal IIS obligations and liability, which could serve as a barrier to participation.[5,13,48–50] At the same time, some programs have been able to successfully leverage policy changes and reporting requirements, including mandatory provider reporting and submission of VFC doses administered reports using IISs, which have resulted in population-based IISs that serve a variety of diverse functions for providers,

health departments, and other users, as well as increases in reporting of administered doses.[51,52]

Advances in interoperability, the use of Health Level 7 (HL7) messaging, and new technology such as 2-dimensional bar codes on vaccine vials[53] also have the potential to improve both reporting to and obtaining immunization data from IISs. All IISs now receive at least some immunization information through interfacing with electronic health record (EHR) systems, versus traditional methods including direct entry or paper record submission that are still used by some IISs; however, the proportion of records received via EHRs varies.[50] One study reported improvement in provider satisfaction and registry reporting in a California hospital after the introduction of visual integration of external registries into a vendor EHR system that included nightly uploading of hospital immunization data to the statewide registry via HL7.[54] Nationally, implementation of stage 2 Meaningful Use criteria for the Medicare and Medicaid EHR incentive program,[55] emphasizing use of HL7 (version 2.5.1) and promotion of successful, ongoing submission from providers to IISs, is expected to increase participation in IISs.[1] In addition, the expansion of a pilot program with 2-dimensional bar codes on vaccine vials containing vaccine manufacturer, lot number, and expiration date is expected to improve the completeness and accuracy of vaccination information submitted by providers to IISs.[53] Implementation of these initiatives and their impact on IIS participation will depend on a number of factors, including specific EHR capabilities, which may include immunization forecasting tools, as well as provider adoption of EHRs with bidirectional interoperability. Pediatricians, for example, are some of the main immunization providers, yet they have lagged behind other specialties in adoption of fully bidirectional EHRs.[56,57] At the same time, EHR use among office-based physicians is increasing rapidly.[58,59] These technological advances have the potential to reduce staff time reporting to IISs, as well as improve quality of care if vaccination information is directly transmitted from the point of care to the IIS without requiring duplicate or manual uploading of information, which, in turn, should incentivize provider participation in IISs.

This study is subject to limitations. First, data from the NIS provider questionnaire were reported by a staff member in the provideŕs office who may or may not be fully aware of the IIS reporting practices. The high percentage of respondents who chose ″Doṅt know″ for provider reporting to, or obtaining data from, IISs could be a reflection of this limitation; as a result, the percentages of providers who reported data to, or obtained data from, IISs could be over- or underestimated. Second, since the data were analyzed at the child and adolescent levels, one must be cautious in drawing inferences at the provider level. Third, the state where a child or adolescent resides was used as a proxy measure for the provider and IIS location in 2012. Fourth, the NIS and NIS-Teen were not intended to measure IIS functionality and therefore did not collect information on provider use of EHRs, HL7 messaging, or mandatory reporting to IISs. This prevented us from directly examining how these factors could have affected provider participation. Finally, the NIS and NIS-Teen did not include households without a landline phone prior to 2011. Although the data were weighted for nonresponse and noncoverage bias, some bias may remain, although it is likely to be small.[60]

This study also has several strengths. First, this is the first study to examine provider use of IISs in a provider-verified, nationally representative survey of children and adolescents. Second, it provides state-level data to better observe and understand variations in provider use of IISs across jurisdictions. Third, the ability to examine trends in provider use of IISs over 7 years of the NIS allows for a more complete picture of provider participation over time. Fourth, in 2011 and 2012, the NIS included both landline and wireless phone households.

In this nationally representative survey of children and adolescents, we found that children and adolescents with providers who did not receive vaccines from the health department or were in private practice were less likely to have their vaccinations reported to an IIS. To increase IIS use by providers, state health departments should target these providers who are less likely to report to IISs. In addition, state health departments should target those providers whose patient populations have characteristics that are associated with decreased provider reporting to IISs, such as children who have never received WIC benefits, children living in suburban areas, children with only 1 provider, and adolescents who are not VFC eligible and who have fewer visits to providers. Increasing provider use of IISs will assist in fully realizing the benefits of IISs, including increasing vaccination rates and reducing vaccine-preventable diseases.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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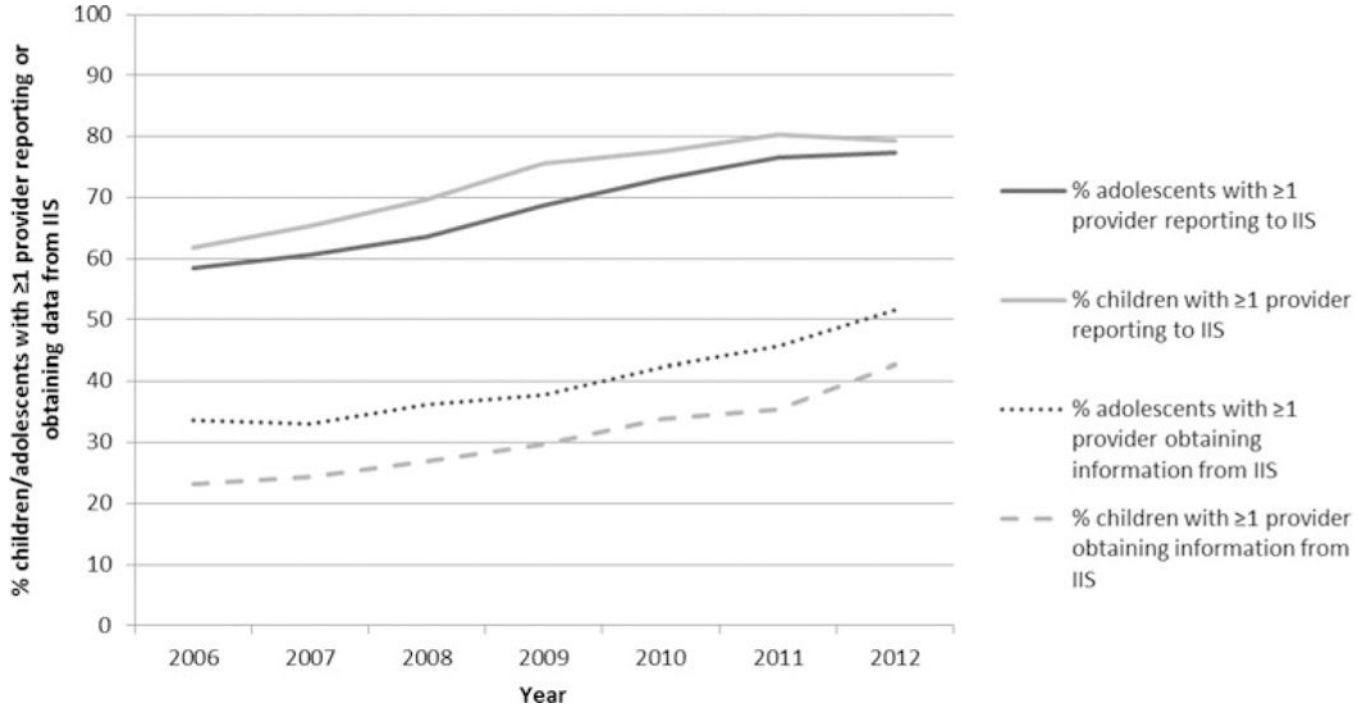

FIGURE 1 ●.

Percentage of Children Aged 19 to 35 Months and Adolescents Aged 13 to 17 Years With 1 or More Providers Reporting to, or Obtaining Data From IISs, National Immunization Survey-Child and National Immunization Survey-Teen, 2006–2012

Abbreviations: IIS, immunization information system; NIS, National Immunization Survey.

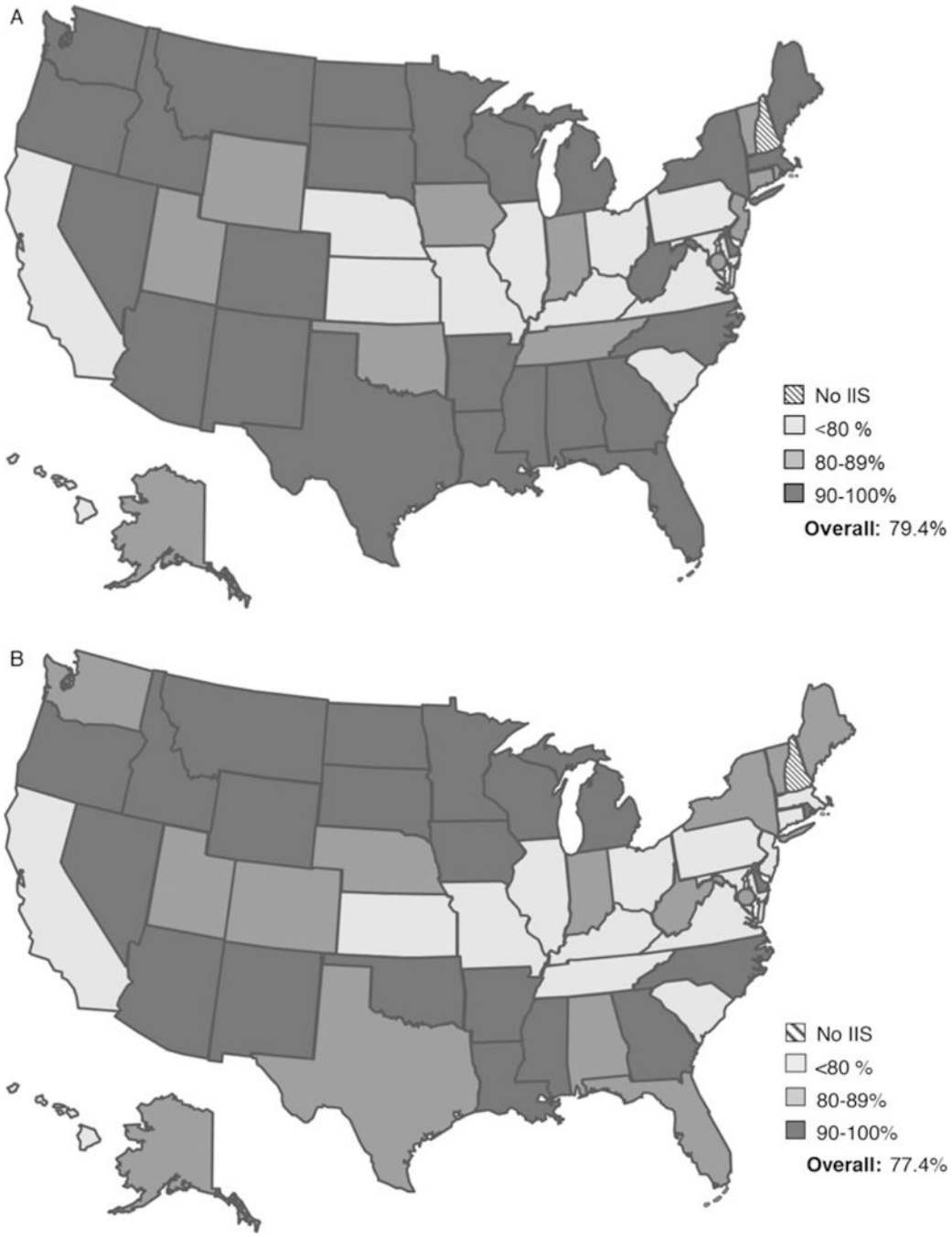

FIGURE 2 ●.

(A) Percentage of Children Aged 19 to 35 Months With 1 or More Providers Reporting Vaccination Records to an IIS, National Immunization Survey-Child, United States, 2012

(B) Percentage of Adolescents Aged 13 to 17 Years With 1 or More Providers Reporting Vaccination Records to an IIS, National Immunization Survey-Teen, United States, 2012

Abbreviation: IIS, immunization information system.

TABLE 1

Factors Associated With 1 or More Providers Reporting Vaccination Records to an IIS Among Children Aged 19 to 35 Months, National Immunization Survey-Child, United States, 2006–2012[a]

Variable	Adjusted Prevalence (95% CI)	*P* Value for Adjusted Prevalence	Adjusted Prevalence Ratio (95% CI)
Provider obtained vaccination information from IISs		<.0001	
Yes, ≥1 providers	86.1 (84.58–87.44)		1.21 (1.19–1.23)[b]
No	71.2 (70.30–72.02)		Referent
Provider-ordered vaccine from state/local health department		<.0001	
Yes, ≥1 providers	76.7 (75.92–77.50)		1.29 (1.25–1.33)[b]
No	59.5 (57.49–61.39)		Referent
Type of provider facility		<.0001	
Mixed	92.5 (90.71–94.04)		1.33 (1.30–1.36)[b]
All public facilities	84.4 (82.61–85.96)		1.21 (1.18–1.24)[b]
All hospital facilities	79.9 (77.57–81.97)		1.15 (1.11–1.18)[b]
All military/other facilities	72.2 (67.60–76.29)		1.04 (0.97–1.10)
All private facilities	69.6 (68.64–70.61)		Referent
Children received WIC benefits		<.0001	
Yes, currently	77.8 (76.47–78.99)		1.08 (1.05–1.11)[b]
Yes, but not currently	76.9 (75.19–78.52)		1.09 (1.07–1.11)[b]
No	71.2 (70.23–72.17)		Referent
Child's residence		0.002	
Rural	76.8 (75.17–78.35)		1.05 (1.03–1.08)[b]
Urban	74.7 (73.62–75.74)		1.02 (1.00–1.04)[b]
Suburban	73.1 (72.06–74.14)		Referent
Number of providers per child		0.021	
≥2	76.1 (74.70–77.45)		1.04 (1.01–1.06)[b]
1	73.6 (72.74–74.47)		Referent

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Variable	Adjusted Prevalence (95% CI)	*P* Value for Adjusted Prevalence	Adjusted Prevalence Ratio (95% CI)

Abbreviations: CI, confidence interval; IIS, immunization information system; WIC, Women's, Infants and Children.

[a]Variables given are those that remained in the final model based upon backward elimination logistic regression modeling. The final model was based on a subset of 38 373 respondents who had complete data for all variables included in the model.

[b]Estimates are statistically significantly different from the referent.

TABLE 2

Factors Associated With 1 or More Providers Reporting Vaccination Records to an IIS Among Adolescents Aged 13 to 17 Years, National Immunization Survey-Teen, United States, 2006–2012[a]

Variable	Adjusted Prevalence (95% CI)	*P* Value for Adjusted Prevalence	Adjusted Prevalence Ratio (95% CI)
Provider obtained vaccine information from IISs		<.0001	
Yes, ≥1 providers	83.7 (82.30–84.98)		1.22 (1.19–1.24)[b]
No	64.6 (63.34–65.80)		Referent
Provider-ordered vaccine from state/local health department		<.0001	
Yes, ≥1 providers	77.0 (76.07–77.86)		1.38 (1.32–1.45)[b]
No	55.6 (53.12–58.06)		Referent
Type of provider facility		<.0001	
Mixed	89.4 (87.77–90.76)		1.35 (1.31–1.38)[b]
All public facilities	84.6 (82.51–86.40)		1.27 (1.24–1.31)[b]
All hospital facilities	73.7 (70.42–76.66)		1.11 (1.06–1.16)[b]
All STD/school/teen clinic/other	69.4 (64.31–73.99)		1.05 (0.97–1.12)
All private facilities	66.4 (65.15–67.55)		Referent
Number of visits to providers in the past		<.0001	
12 mo			
0–7	70.7 (69.32–72.12)		Referent
≥8	75.1 (74.12–76.04)		1.06 (1.04–1.09)[b]
Teen VFC eligible		<.0001	
Yes	75.8 (74.38–77.16)		1.05 (1.01–1.06)[b]
No	72.5 (71.50–73.42)		Referent

Abbreviations: CI, confidence interval; IIS, immunization information system; STD, sexually transmitted disease; VFC, Vaccines for Children.

[a]Variables given are those that remained in the final model based upon backward elimination logistic regression modeling. The final model was based on a subset of 34 031 respondents who had complete data for all variables included in the model.

[b]Estimates are statistically significantly different from the referent.

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