The San Diego Immunization Survey: A Model for Local Vaccination Coverage Assessment

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SYNOPSIS

Objectives. Assessing vaccination coverage as part of a comprehensive intervention has been demonstrated to result in increased coverage rates. The National Immunization Survey provides coverage estimates at the national level and selected urban areas. However, it is important for other localities to understand vaccination coverage in their areas. The San Diego Immunization Branch conducts the San Diego Immunization Survey (SDIS) to gather vaccination coverage information in San Diego County. This article describes the methodology and results of the SDIS.

Methods. The SDIS is a two-phase immunization survey. The first phase is a random-digit-dialing survey in which vaccination information is obtained by phone. The second phase involves the verification of this information and/or obtaining vaccination information via the registry or the child's provider(s).

Results. In 2005, the sample size included 839 respondents. From 1995 to 2005, coverage for the following individual vaccines increased: diphtheria and tetanus toxoids, and acellular pertussis (92.0% to 96.5% for ≥ 3 doses, and 75.0% to 89.0% for ≥ 4 doses), polio (83.0% to 94.7%), measles-mumps-rubella (85.0% to 95.8%), *Haemophilus influenzae* type b (87.0% to 93.2%), and hepatitis B (67.0% to 93.6%).

Conclusion. The results of the SDIS demonstrate that San Diego County has exceeded the Healthy People 2010 goal to reach at least 80% coverage for the series of universally recommended vaccinations.

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Evidence suggests that assessing vaccination coverage, as part of a comprehensive approach, leads to increased vaccination coverage levels.¹⁻³ The Advisory Committee on Immunization Practices and the Task Force on Community Preventive Medicine have identified assessment as an important tool toward increasing immunization coverage.^{4,5} To understand improvement toward reaching the Healthy People 2010 goal of achieving and sustaining effective coverage for universally recommended vaccines, the Centers for Disease Control and Prevention (CDC) has monitored vaccination coverage using the National Immunization Survey (NIS) for the 50 states, District of Columbia, and selected large urban areas since 1994.⁶ However, vaccination coverage estimates from the large geographic areas surveyed by the NIS may not be representative of certain areas within the state because coverage may vary among a state's localities. Therefore, it is important for local health departments to be aware of other methods to estimate their own coverage.

The San Diego Immunization Survey (SDIS) is conducted annually by the County of San Diego Health and Human Services Agency's Immunization Branch (SDIB). Since 1995, the SDIS has provided annual vaccination coverage estimates for 19- to 35-month-old children living in San Diego County, California. The SDIS uses a combination of parental input, registry data, and provider verification to estimate coverage in San Diego. San Diego County uses annual estimates of vaccination coverage obtained from the SDIS to monitor and improve immunization services in its community.

This survey could be used by other localities to assess coverage to improve immunization services and vaccination rates. The resources a locality would need to dedicate to performing such a survey may be validated by the benefit it can have toward decreasing the risk of vaccine-preventable diseases in the community.

METHODS

The methodology of the SDIS is a modification of the methods used by the NIS.⁶ Data obtained from the SDIS are collected in two phases: a telephone survey followed by verification of immunization information when necessary.

In the first phase, a random-digit-dialing (RDD) telephone survey is conducted annually between March and June. The RDD methodology is used to identify households in San Diego that have a 19- to 35-month-old child. When a household with an appropriately aged child is identified, demographic information about the household is obtained from the RDD

respondent. Eighty-five percent (711/839) of the 2005 SDIS respondents were the mothers of the age-eligible children identified in the household. If the respondent has a state-issued written immunization record for the child, he/she is asked to read from that record the dates when the child received doses of diphtheria, tetanus toxoids, and acellular pertussis (DTaP), polio, measles-mumps-rubella (MMR), Haemophilus influenzae type b (Hib), hepatitis B (HepB), varicella (VAR), pneumococcal conjugate vaccine (PCV), hepatitis A (HepA), and influenza (flu) vaccine. The respondent is also asked to read the name and contact information for the provider that administered each dose. If the written immunization record used during the RDD interview indicates that the child was fully vaccinated, the SDIB considers the report to be a sufficient documentation of immunization history and further information is not requested from either the child's vaccination provider or the registry.

If an immunization record is not available, then the number of doses is recorded from the respondent's memory. In the 2005 SDIS, a child was considered to be fully vaccinated if information from the immunization record showed that the child had received doses approximately at the recommended ages and intervals of ≥ 4 doses of DTaP, ≥ 3 doses of polio, ≥ 1 dose of MMR, ≥ 3 doses of Hib, ≥ 3 doses of HepB, ≥ 1 dose of VAR (or history of varicella disease), ≥ 3 doses of PCV, 1 dose of HepA if the child was ≥ 24 months of age or 2 doses of HepA if the child was ≥ 30 months of age and more than six months had passed since his/her first dose, and ≥ 1 dose of flu vaccine. If the immunization record did not indicate that one dose of flu vaccine was administered, then the respondent's recall was accepted. Surveys in years prior to 2004 do not include all of these vaccines. As new vaccines become available and recommended, the SDIB adds them to the list of vaccines that it monitors through the SDIS.

The second phase of data collection is conducted if the RDD respondent's report of the child's vaccination history is not read from an immunization record or if data from the immunization record do not show that the child is fully vaccinated. Consent to contact the child's provider is requested verbally from all respondents during the telephone interview. If consent is obtained and second-phase data collection is warranted, the San Diego Regional Immunization Registry (SDIR) is queried to verify the child's vaccination history. If a complete immunization record cannot be acquired using SDIR, then it is requested from the child's medical provider(s). The SDIB attempts to contact local, out-of-state, and out-of-country providers for verification. Although providers typically

comply with the request for verification, some ask for documentation. In these situations, SDIB sends a form with the interviewer's signature on it stating that verbal consent was received from the respondent during the telephone interview. If the provider insists on receiving written consent from the respondent, SDIB is not able to obtain the information necessary to verify immunization status.

Survey data collected by the SDIS are weighted to represent the target population of children 19 to 35 months of age living in San Diego County. The statistical weighting methods account for the probability of being sampled, households that do not have a telephone, and nonresponse from medical providers. Initial weights are constructed using poststratification so that the distribution of the weighted sample with respect to the selected demographic characteristics is identical to the same distribution in the population in San Diego. Nonresponse from medical providers is handled in the same way it is handled in the NIS.⁷

RESULTS

The interview completion rate for the SDIS is the number of RDD interviews completed divided by the total number of households identified with an age-eligible child. This rate ranged from 70.0% in 2002 to 89.1% in 1995; in 2005, it was 79.2%. An interview was considered complete if the majority of the questions were answered. The final 2005 unweighted sample size of completed interviews was 839; from 1995 to 2004, it ranged from 400 to 902. Among the 839 children for whom completed RDD interviews were obtained in 2005, vaccination histories that could be used to estimate vaccination coverage were obtained for 714 (85.1%) of the children. Provider-reported vaccination histories were not sought for 159 children because they were considered fully vaccinated based on their household written immunization records.

Estimates of vaccination coverage from the SDIS indicate that the estimated percentage of children who received at least the recommended number of doses for DTaP, MMR, polio, Hib, and HepB increased from 1995 to 2005 (Table 1). In 2005, coverage estimates for the 4:3:1 series (≥ 4 doses DTaP, ≥ 3 doses polio, ≥ 1 dose MMR), 4:3:1:3:3 series (≥ 4 doses DTaP, ≥ 3 doses polio, $1 \geq$ dose MMR, ≥ 3 doses Hib, ≥ 3 doses HepB), and 4:3:1:3:3:1 series (≥ 4 doses DTaP, ≥ 3 doses polio, ≥ 1 dose MMR, ≥ 3 doses Hib, ≥ 3 doses HepB, ≥ 1 dose VAR) were 87.8%, 84.9%, and 82.8%, respectively. Children >24 months of age had higher coverage rates than children ≤ 24 month of age. From 2002 to 2005, coverage for ≥ 1 dose of VAR exceeded

90% annually. Additionally, a substantial increase from 68% to 86% for ≥ 3 doses of PCV from 2004 to 2005 was observed.

Differences in 2005 SDIS coverage estimates between Hispanic and non-Hispanic white respondents were not significant for ≥ 3 doses of DTaP, ≥ 4 doses of DTaP, ≥ 1 dose of MMR, 2 doses of flu, the 4:3:1 series, and the 4:3:1:3:3 series (Table 2). Coverage estimates for ≥ 3 doses of polio, ≥ 3 doses of Hib, ≥ 3 doses of HepB, ≥ 1 dose of VAR, HepA, and the series 4:3:1:3:3:1 were significantly higher for Hispanic compared with non-Hispanic white respondents. Hispanic children had significantly lower coverage for PCV and 1 dose flu vaccine than non-Hispanic white children.

DISCUSSION

Our findings indicate that vaccination coverage in San Diego County is improving and exceeds the Healthy People 2010 goal to increase immunization coverage of all vaccines that have been universally recommended for at least five years (4 DTaP, 3 polio, 1 MMR, 3 Hib, and 3 HepB; 4:3:1:3:3) to exceed 80% in 19- to 35-month-old children.⁸ Additionally, the traditional gaps in vaccination coverage attributed to Hispanic ethnicity appear to be mostly eliminated in this age group, in San Diego County. Given that about 43.2% of births in San Diego County are Hispanic,⁹ this is an important finding.

Because the SDIS accepts a complete, valid immunization history read by the respondent from an immunization record as proof of immunization status, it relies less on obtaining vaccination histories from providers than the NIS. As a result, the SDIS is less resource intensive compared with the NIS.

Because the NIS is a survey that collects data monthly, it collects data on more birth cohorts than the survey conducted by San Diego, which collects data only from March through June. Therefore, the coverage estimates from these surveys are only approximately comparable with respect to the cohorts included in their samples. In 2000, 2002, 2003, and 2004, the estimated 4:3:1:3:3 coverage rates for the San Diego survey were significantly higher by 11.6%, 9.2%, 6.4%, and 5.7%, respectively, than national estimates produced by the NIS, while there was no significant difference in 2004.¹⁰

Limitations

The findings in this article are subject to several biases. The SDIS is a landline telephone survey that may not be representative of the entire population. Although weighted to be representative, the statistical

Table 1. Weighted immunization coverage with individual vaccines and selected vaccination series, children aged 19–35 months in San Diego County, San Diego Immunization Survey, 1995–2005

Year	Unweighted sample size	Antigens and selected series ^a												
		3+DTaP ^b	4+DTaP ^c	3+Polio ^d	1+MMR ^e	3+Hib ^f	3+HepB ^g	1+Var ^h	3+PCV ⁱ	1+HepA ^j	1Flu ^k	2Flu ^l	4:3:1:3:3 ^m	4:3:1:3:3:1 ⁿ
1995	400	92.0 ±3.4	75.0 ±5.7	83.0 ±5.0	85.0 ±4.7	87.0 ±4.6	67.0 ±5.8	NA	NA	NA	NA	NA	69.0 ±6.0	NA
1996	419	88.5 ±4.1	77.0 ±5.2	87.1 ±4.3	91.9 ±3.6	85.8 ±4.4	83.8 ±4.7	NA	NA	NA	NA	NA	73.6 ±5.4	NA
1997	622	95.9 ±2.4	84.8 ±4.2	92.3 ±3.2	92.7 ±3.1	90.9 ±3.4	86.9 ±4	NA	NA	NA	NA	NA	79.6 ±4.6	NA
1998	780	91.8 ±3.2	81.0 ±4.4	87.7 ±3.8	89.2 ±3.6	90.3 ±3.4	86.2 ±3.9	64.1 ±4.9	NA	NA	NA	NA	77.1 ±4.7	NA
1999	812	98.6 ±1.1	91.2 ±2.5	96.2 ±1.7	93.6 ±2.2	95.6 ±1.8	94.3 ±2.0	82.6 ±3.2	NA	NA	NA	NA	87.0 ±3.0	NA
2000	795	96.3 ±1.8	90.1 ±2.7	93.4 ±2.3	93.3 ±2.3	93.0 ±2.4	95.3 ±1.9	87.9 ±2.8	NA	NA	NA	NA	86.4 ±3.0	83.8 ±3.2
2001 ^p		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	764	97.0 ±2.0	87.3 ±3.7	94.4 ±2.7	93.1 ±2.9	95.3 ±2.6	93.8 ±2.7	90.7 ±1.7	NA	39.2 ±4.3	NA	NA	84.8 ±4.0	83.3 ±4.1
2003	902	97.6 ±1.3	91.5 ±2.2	96.4 ±1.5	94.6 ±1.9	95.0 ±1.8	94.8 ±1.9	94.3 ±2.0	NA	60.1 ±3.8	NA	NA	88.9 ±2.5	85.6 ±2.8
2004	899	94.0 ±2.3	88.6 ±2.9	92.1 ±2.5	92.8 ±2.3	91.4 ±2.6	90.1 ±2.7	93.1 ±2.2	68.2 ±3.8	65.6 ±3.8	16.0 ±2.4	7.4 ±1.7	85.7 ±3.1	82.9 ±3.3
2005	839	96.5 ±1.2	89.0 ±2.0	94.7 ±0.8	95.8 ±1.3	93.2 ±1.6	93.6 ±1.5	93.7 ±1.5	86.1 ±2.2	70.4 ±3.7	29.9 ±3.2	8.9 ±2.0	87.8 ±2.1	84.9 ±2.2
														82.8 ±2.4

^a% ± 95% confidence interval

^bThree or more doses of any diphtheria and tetanus toxoids and pertussis vaccines including diphtheria and tetanus toxoids, and any acellular pertussis vaccine (DTP/DTaP/DT)

^cFour or more doses of any diphtheria and tetanus toxoids and pertussis vaccines including diphtheria and tetanus toxoids, and any acellular pertussis vaccine (DTP/DTaP/DT)

^dThree or more doses of any poliovirus vaccine

^eOne or more doses of measles-mumps-rubella (MMR) vaccine at or after the child's first birthday; previous reports of vaccination coverage were for measles-containing vaccine

^fThree or more doses of Haemophilus influenzae type b (Hib) vaccine

^gThree or more doses of hepatitis B (HepB) vaccine

^hOne or more doses of varicella, adjusted for history of varicella disease

ⁱThree or more doses of pneumococcal conjugate vaccine

^jOne or more doses of hepatitis A vaccine for children aged ≥24 months

^kOne or more doses of influenza vaccine given between October 1 and May 30, in the survey year

^lTwo or more doses of influenza vaccine given between October 1 and May 30, in the survey year

^mFour or more doses of DTP, three or more doses of poliovirus vaccine, and one or more doses of any MMR

ⁿFour or more doses of DTP, three or more doses of poliovirus vaccine, one or more doses of any MMR, three or more doses of Hib, and three or more doses of HepB

^oFour or more doses of DTP, three or more doses of poliovirus vaccine, one or more doses of any MMR, three or more doses of Hib, three or more doses of HepB, and one or more doses of varicella, adjusted for history of varicella disease

^pSurvey not conducted in 2001 due to lack of funding

DTaP = diphtheria, tetanus toxoids, and acellular pertussis

MMR = measles-mumps-rubella

Hib = Haemophilus influenzae type b

HepB = hepatitis B

VAR = varicella

PCV = pneumococcal conjugate vaccine

HepA = hepatitis A

Flu = influenza vaccine

NA = not available

Table 2. Weighted immunization coverage with individual vaccines and selected vaccination series, children aged 19–35 months in San Diego County, San Diego Immunization Survey, 2005

Race/ethnic group ^b	Antigens and selected series ^a												
	3+DTaP ^c	4+DTaP ^d	3+Polio ^{e,f}	1+MMR ^g	3+Hib ^{fh}	3+HepB ^{hi}	1+Var ^{ij}	3+PCV ^{ik}	1+HepA ^{li}	1 Flu ^{lm}	2 Flu ⁿ	4:3:1:3:3 ^o	4:3:1:3:3:1 ^q
Hispanic	96.8 ±1.7	91.5 ±2.6	96.4 ±1.8	96.2 ±1.8	96.3 ±1.8	96.4 ±1.8	94.9 ±2.1	82.7 ±3.6	79.3 ±2.1	23.1 ±1.9	8.0 ±0.8	89.3 ±2.9	88.1 ±3.1
Non-Hispanic white	96.7 ±1.9	90.6 ±3.1	93.0 ±2.7	95.9 ±2.1	93.4 ±2.1	92.2 ±2.9	93.3 ±2.7	90.8 ±3.2	66.7 ±1.7	30.1 ±1.4	8.1 ±1.2	87.8 ±3.5	85.4 ±3.8
% ±95% confidence interval													
Other race/ethnic groups other than Hispanic and non-Hispanic white are omitted from the table due to insufficient sample size.													
Three or more doses of any diphtheria and tetanus toxoids and pertussis vaccines including diphtheria and tetanus toxoids, and any acellular pertussis vaccine (DTP/DTaP/DT)													
Four or more doses of any diphtheria and tetanus toxoids and pertussis vaccines including diphtheria and tetanus toxoids, and any acellular pertussis vaccine (DTP/DTaP/DT)													
Three or more doses of any poliovirus vaccine													
Hispanic coverage estimate was significantly different from non-Hispanic white at the $\alpha=0.05$ level.													
One or more doses of measles-mumps-rubella (MMR) vaccine at or after the child's first birthday; previous reports of vaccination coverage were for measles-containing vaccine													
Three or more doses of <i>Haemophilus influenzae</i> type b (Hib) vaccine													
Three or more doses of hepatitis B (HepB) vaccine													
One or more doses of varicella, adjusted for history of varicella disease													
Three or more doses of pneumococcal conjugate vaccine													
One or more doses of hepatitis A vaccine for children aged ≥ 24 months													
One or more doses of influenza vaccine given between October 1 and May 30, in the survey year													
Two or more doses of influenza vaccine given between October 1 and May 30, in the survey year													
Four or more doses of DTP, three or more doses of poliovirus vaccine, and one or more doses of any MMR													
Four or more doses of DTP, three or more doses of poliovirus vaccine, one or more doses of any MMR, three or more doses of Hib, and three or more doses of HepB													
Four or more doses of DTP, three or more doses of poliovirus vaccine, one or more doses of any MMR, three or more doses of Hib, three or more doses of HepB, and one or more doses of varicella, adjusted for history of varicella disease													
DTaP = diphtheria, tetanus toxoids, and acellular pertussis													
MMR = measles-mumps-rubella													
Hib = <i>Haemophilus influenzae</i> type b													
HepB = hepatitis B													
VAR = varicella													
PCV = pneumococcal conjugate vaccine													
HepA = hepatitis A													
Flu = influenza vaccine													

adjustments may not accurately account for nonselected households, nonresponders, and households lacking a landline telephone. These adjustments make the assumption that nonresponding households are similar to responding households. Because the data from nonresponding households are not observed, this assumption cannot be confirmed.

CONCLUSION

The SDIS has been used to evaluate vaccination coverage in San Diego County since 1995. Results from the SDIS can be used to better understand what true vaccination coverage is in San Diego County. Additionally, it has been used to measure other age groups and to improve programmatic planning. The SDIS has posed questions that are of particular interest to San Diego, such as parents' attitudes toward and knowledge of vaccines. Data on those issues can be useful to better target areas of low coverage.

The information obtained by this survey has been used to improve immunization services and thus increase vaccination coverage in San Diego County. By decreasing the risk of children acquiring vaccine-preventable diseases, the cost of this study may be justified. Another benefit of the SDIS is that the data are collected in one quarter as opposed to a full year for the NIS. The shorter time frame allows the results to be available in a more timely fashion. These benefits suggest that the SDIS is a useful model of a county-level immunization survey that other health departments may wish to adopt.

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