



Summary of Methods and Primary Results
Expanded Kindergarten Retrospective Survey - 2011
San Francisco Department of Public Health
Communicable Disease Control and Prevention Section

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INTRODUCTION

The Expanded Kindergarten Retrospective Survey (EKRS) is conducted every three years by the San Francisco Department of Public Health (SFDPH) to assess retrospectively immunization coverage at key benchmark ages of kindergarten children in registered public and private San Francisco schools. The analysis focused on immunizations of these kindergartners, who were primarily born in 2004-2006, when they were aged 24 months (in 2006-2008). These estimates can be used by community, health and advocacy groups to improve opportunities for and systems pertaining to pediatric immunizations.

METHODS

Sample

A cluster sampling methodology was chosen, because sampling school kindergartens to assess retrospectively immunizations among children aged 24 months was the most economical method of obtaining a sample. A simple random 25% sample of all San Francisco schools that provide registered kindergarten education (n=145) was taken without stratification on type of school (i.e., public or private), race/ethnicity, or class size. Sampling was performed using a modified syntax program for a commercially available statistical software product (SAS Inc., Cary, NC), provided by California Department of Public Health (CDPH) Immunization Branch. The final 2011 sample consisted of 18 public schools and 19 private schools. These represent 24.7% (18/73) of public kindergartens and 26.4% (19/72) of private kindergartens in San Francisco. The ratio of children in private and public kindergartens is similar to the 2008, 2005 and 2002 EKRS samples. Every child in kindergarten at the sampled school was included in the sample.

The initial sample consisted of 1810 students. After cleaning the data, 6 were removed from the sample because they were duplicate entries, 5 were removed because the California School Immunization Record (i.e. blue card) was incomplete (i.e., name or all immunization information was missing), and 33 were removed because the students were not in kindergarten. The final sample contained 1766 students.



Data Collection

Data were collected by two research assistants. For kindergartens with fewer than 30 students, school staff were asked to ensure completion of the California School Immunization Record (i.e. blue card), with particular attention to ethnicity and place of birth, and to fax them to the SFDPH. For kindergartens with at least 30 students, the research assistants reviewed immunization records in person. Because ethnicity and place of birth information was typically not present on the blue card, the researchers also reviewed the child's cumulative education files for this information, as needed. Immunization records were photocopied at the school and data were entered in a locally developed Microsoft Access database at SFDPH. Researchers reviewed records in the California Automated Immunization Registry (CAIR) for any missing information, including information about Hib vaccination, which is not required to be completed on the blue card. The data were analyzed using SAS 9.2.

Data Definitions

In some instances, only the month and year of the vaccination were known. For such dates, the day was designated as 15; if the 15th day of the month was before the date of birth, the date of birth was used.

Ethnicity was simplified into seven categories for analysis: Black, White, Hispanic, Chinese, Other Asian or Pacific Islander, Other, and Unknown. Ethnicity categories were mapped from their original database values according to the scheme below. There were 127 (7.2%) children with multiple ethnicity designations on their blue cards or cumulative records. Multiethnic children marked as having Hispanic or Latino ethnicity were classified as Hispanic, regardless of other "race" categories listed for the child. For example, a child designated as Hispanic and Black would be reclassified as Hispanic. Multiethnic students who were not identified as having any Hispanic or Latino ethnicity were reclassified as the single ethnicity least represented in the San Francisco general population, according to the 2008 California Department of Finance population estimates. For example, a child designated as both White and Chinese was classified as Chinese because the proportion of Chinese residents in San Francisco is less than the proportion of White residents.

<i>Original California School Immunization Record</i>	<i>Original KRS Database Value Options</i>	<i>Categories Used for Analysis</i>
Black	Black	=Black
White/non-Hispanic	White	=White
Hispanic	Hispanic/Latino	=Hispanic
Other (specified)	Chinese	=Chinese
Other (specified)	Filipino, Japanese, Korean, Samoan, SE Asian, or Other Asian*	=Other Asian or Pacific Islander
Other (specified)	Arabic, Am Indian, Middle Eastern, or Other non-White	=Other
Other (specified)	Missing, Declined to State, or Unknown	=Unknown

* Other Asian (e.g. Mongolian or Asian Indian) was not an original value option in the database. Rather it was used as an intermediate classification for race/ethnicity designation during data cleaning.

The following vaccinations were assessed: diphtheria, tetanus and pertussis (DTP, DTaP, DT, Td); polio (OPV, IPV); measles, mumps and rubella (MMR); *Haemophilus influenzae* type b (Hib); hepatitis B



(HepB); and varicella (Var). Hepatitis A, pneumococcal conjugate, and rotavirus vaccines are not required and were not assessed.

Up-to-date (UTD) status for MMR or varicella vaccinations, for which the recommended first dose is at or after 12 months of age, or MMR- and varicella-containing vaccination series (e.g., series 4:3:1, series 4:3:1:3:3:1), was assessed only at 15 months, 18 months, 24 months, 27.5 months, 36 months, and 48 months. UTD status for all other individual vaccines was assessed at 2 months, 4 months, 6 months, 12 months, 15 months, 18 months, 24 months, 27.5 months, 36 months, and 48 months. Benchmarks within the recommended primary immunization schedule (i.e., 2 through 18 months) were defined by the end of the month (i.e., a valid vaccination was one given *through* the end of the recommended month: 2, 4, 6, 12, 15, or 18), whereas benchmarks *after* the primary schedule were defined by the beginning of the month (i.e., a valid vaccination was one given prior to the actual benchmark date: 24, 27.5, 36 or 48 months of age). Days were determined by multiplying the number of months by 30.25. Any twelve month period was equal to 365 days. Therefore, the number of days at 18 months was calculated from the sum of 365 and 212 (i.e., 6 multiplied by 30.25). Based on the 2011 recommended schedule for childhood vaccinations (<http://www.cdc.gov/vaccines/recs/schedules/downloads/child/0-6yrs-schedule-pr.pdf>), children were considered UTD for each vaccination according to the following scheme:

Benchmark Age	Vaccination Required to Be UTD					
	DTP	Polio	MMR	Hib	HepB	Var
2 months ≤ 91 days	DTP1	Polio1	n/a	Hib1	HepB1	n/a
4 months ≤ 152 days	DTP2	Polio2	n/a	Hib2	HepB2	n/a
6 months ≤ 212 days	DTP3	Polio3	n/a	Hib3	HepB3	n/a
12 months ≤ 396 days	DTP3	Polio3	n/a	Hib3	HepB3	n/a
15 months ≤ 486 days	DTP4	Polio3	MMR1	Hib3	HepB3	Var1
18 months ≤ 577 days	DTP4	Polio3	MMR1	Hib3	HepB3	Var1
24 months ≤ 730 days*	DTP4	Polio3	MMR1	Hib3	HepB3	Var1
27.5 months ≤ 836 days*	DTP4	Polio3	MMR1	Hib3	HepB3	Var1
36 months ≤ 1095 days*	DTP4	Polio3	MMR1	Hib3	HepB3	Var1
48 months ≤ 1460 days*	DTP4	Polio3	MMR1	Hib3	HepB3	Var1

na = not applicable; MMR1 and Var1 not recommended before 12 months of age.

* Benchmark ages through 18 months included the full month, whereas at 24 months of age and later, the benchmarks were set at the beginning of the month. For example, a child was considered UTD for a particular vaccination schedule at 6 months of age if the vaccination was given at age 212 days or before. A child considered UTD for a particular vaccination schedule at 24 months of age, however, was one given the vaccination at 730 days of age or before. Vaccinations required for UTD status for vaccine series at these benchmark ages are implicit in their naming (e.g. UTD for series 4:3:1 required that the child had received DTP4, Polio3, and MMR1 at the given age).

For determining the age at which the first MMR dose was administered early, the following ages in days were used:

1 month ≤ 31 days	7 months ≤ 212 days
2 months ≤ 61 days	8 months ≤ 242 days
3 months ≤ 91 days	9 months ≤ 273 days
4 months ≤ 121 days	10 months ≤ 303 days



5 months ≤ 152 days
6 months ≤ 182 days

11 months ≤ 333 days
12 months ≤ 360 days*

* A 4-day grace period from the first birthday is allowed for the first MMR.

The first MMR was considered valid at a particular benchmark age if it was administered after 360 days of age (there is a 4 day grace period) and on or before the benchmark age. If the first MMR was administered at or prior to 360 days of age, then the valid date for the first MMR was substituted by the date of the second MMR, if available. If the first MMR was administered early and a valid second MMR was not given, then the child was not considered to have had a valid MMR.

Data Validation

At the time of data entry, research assistants reviewed the immunization records for logical errors. Additionally, dates for serial immunization schedules were later validated during data cleaning for consistency to ensure each shot in a scheduled vaccine series was administered sequentially (e.g., the date of the second DTP administration was before that of the third DTP; the date of the third DTP administration was before that of the fourth DTP). When necessary and available, a photocopy of the child's blue card was consulted for the correct dates. Frequently, however, data entry errors were not identified as the source of the error. Transcription errors to month or year date parts made by school clerical staff could sometimes be corrected by comparison to other vaccination dates for the same child.

Outcomes of Interest

The primary outcome of interest was whether children were up-to-date for recommended childhood immunizations at 24 months of age. The proportion of children UTD at 24 months of age and other critical age benchmarks for individual vaccinations and five vaccine series were calculated; the 95% exact confidence limits were also calculated. The outcomes included

- UTD with the 4:3:1 series (DTP4 + Polio3 + MMR1);
- UTD with the 4:3:1:3:3 (DTP4 + Polio3 + MMR1 + Hib3 + HepB3);
- UTD with the 4:3:1:3:3:1 series (DTP4 + Polio3 + MMR1 + Hib3 + HepB3 + Var1);
- UTD for the 4:3:1:-:3 (DTP4 + Polio3 + MMR1 + HepB3);
- UTD for the 4:3:1:-:3:1 (DTP4 + Polio3 + MMR1 + HepB3 + Var1); and
- UTD with the vaccination schedules for DTP, Polio, MMR, Hib, HepB, and Varicella individually.

UTD proportions for the series omitting Hib (4:3:1:-:3 and 4:3:1:-:3:1) were calculated for comparison with the 2011 Kindergarten Retrospective Study conducted by the California Department of Public Health, which omitted Hib from their UTD rates.

UTD status for individual vaccinations was assessed at 2, 4, 6, 12, 15, and 18 months of age. UTD status for the 4:3:1, 4:3:1:3:3, 4:3:1:3:3:1, 4:3:1:-:3, and 4:3:1:-:3:1 series were evaluated at 15 and 18 months of age. Late UTD (catch-up) status for all individual vaccinations and series was assessed at 27.5, 36, and 48 months of age.



Series Name	Meaning
4:3:1	4 DTP, 3 Polio, 1 MMR: Four or more doses of DTaP, three or more doses of Polio, and one or more doses of MMR
4:3:1:3:3	4 DTP, 3 Polio, 1 MMR, 3 Hib, 3 HepB: Four or more doses of DTaP, three or more doses of Polio, one or more doses of MMR, and three or more doses of Hep B
4:3:1:3:3:1	4 DTP, 3 Polio, 1 MMR, 3 Hib, 3 HepB, 1 Varicella: Four or more doses of DTaP, three or more doses of Polio, one or more doses of MMR, three or more doses of Hib, three or more doses of Hep B, and one or more doses of varicella
4:3:1:-:3	4 DTP, 3 Polio, 1 MMR, 3 HepB: Four or more doses of DTaP, three or more doses of Polio, one or more doses of MMR, and three or more doses of Hep B.
4:3:1:-:3:1	4 DTP, 3 Polio, 1 MMR, 3 HepB, 1 Varicella: Four or more doses of DTaP, three or more doses of Polio, one or more doses of MMR, three or more doses of Hep B, and one or more doses of varicella

School records also provided sex, ethnicity, place of birth, and exemption status information. The proportion UTD for all vaccinations and series was analyzed by these demographics, as well as school type (i.e., public or private). Univariate and multivariate regression was performed to elucidate the relationship between being UTD for the 4:3:1 vaccination series at 24 months of age (the dependent variable) and sex, ethnicity, place of birth and type of school (the independent variables).

RESULTS

Sampled Population Characteristics

Ethnicity. The 2011 EKRS study sample consisted of 121 (6.9%) Black children; 294 (16.6%) White children; 318 (18.0%) Hispanic children; 403 (22.8%) Chinese children; 151 (8.6%) Other Asian or Pacific Islander children; 114 (6.5%) children with Other ethnicity; and 365 (20.7%) children with Unknown ethnicity.

The 2011 EKRS ethnic classifications were adjusted to combine all Asian children into one category to allow for comparison with the 2002, 2005, and 2008 EKRS samples and Census estimates. The ethnic profile for the 2011 EKRS sample is similar to the 2008 EKRS and Census estimates for all ethnicities, except White children. The percentage of students in the Other and Unknown categories in the 2011 EKRS sample make direct comparison difficult.

Ethnic breakdowns differed by type of school. In the 2011 EKRS sample, the majority of Asian (93.1%), Black (90.1%), and Hispanic (69.5%) kindergarten students attended a public school; 46.3% of sampled White children attended a public school. These trends are similar to those observed in the 2008 and 2005 EKRS samples.

Ethnicity	2011 KRS*			2008 KRS			2005 KRS			2002 KRS
	All (%)	Public	Private	All (%)	Public	Private	All (%)	Public	Private	All (%)



	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
Asian	554 (31.4)	516 (40.3)	38 (7.8)	472 (30.2)	356 (34.7)	116 (21.5)	560 (38.2)	406 (40.7)	154 (32.9)	658 (40.1)
Black	121 (6.9)	109 (8.5)	12 (2.5)	142 (9.1)	119 (11.6)	23 (4.3)	151 (10.3)	127 (12.7)	24 (5.1)	155 (9.4)
Hispanic	318 (18.0)	221 (17.3)	97 (20.0)	327 (20.9)	265 (25.9)	62 (11.5)	292 (19.9)	243 (24.4)	49 (10.5)	311 (18.9)
White	294 (16.6)	136 (10.6)	158 (32.5)	440 (28.1)	180 (17.6)	260 (48.2)	311 (21.2)	111 (11.1)	200 (42.7)	283 (17.2)
Other	114 (6.5)	70 (5.5)	44 (9.1)	115 (7.4)	58 (5.7)	57 (10.6)	63 (4.3)	41 (4.1)	22 (4.7)	102 (6.2)
Unknown	365 (20.7)	228 (17.8)	137 (28.2)	68 (4.4)	47 (4.6)	21 (3.9)	89 (6.1)	70 (7.0)	19 (4.1)	133 (8.1%)

		Type of school attended by ethnicity					
		Asian	Black	Hispanic	White	Other	Unknown
		<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
		(%)	(%)	(%)	(%)	(%)	(%)
<i>2011 KRS</i>							
Public		516 (93.1)	109 (90.1)	221 (69.5)	136 (46.3)	70 (61.4)	228 (62.5)
Private		(6.9)	(9.9)	(30.5)	(53.7)	(38.6)	(37.5)
<i>2008 KRS</i>							
Public		356 (75.4)	119 (83.8)	265 (81.1)	180 (40.9)	58 (50.4)	47 (69.1)
Private		(24.6)	(16.2)	(19.0)	(59.1)	(49.6)	(30.9)
<i>2005 KRS</i>							
Public		406 (72.5)	127 (84.1)	243 (83.2)	111 (35.7)	41 (65.1)	70 (78.7)
Private		(27.5)	(15.9)	(16.8)	(64.3)	(34.9)	(21.3)

Population estimates for San Francisco Residents Ages 0-4 Years, 2008 California Department of Finance		
Ethnicity	N	%
Asian	13688	32.3
Black	3331	7.9
Hispanic	8023	18.9
White	16741	39.5

* The 2008 California Department of Finance figures for San Francisco children ages 0-4 years reflect the sampled cohort of kindergarten students when they were of the key benchmark ages for which immunization coverage was assessed.

Sex. There were 832 (47.1%) male and 929 (52.6%) female children in the 2011 KRS sample, resulting in a male to female ratio of 0.896. The sex of 5 children was unknown. The male to female ratio of children ages ≤ 5 years in San Francisco was 1.02, according to the 2010 American Community Survey of the U.S. Census Bureau. The sampled proportions for the 2002, 2005, 2008, 2011 EKRS were similar, with the 2008 sample approaching equal numbers of male and female children. Though the 2002, 2005, and 2011 appear to have slightly oversampled



female children, its impact on the overall coverage rates is negligible because there is no difference in vaccination coverage between sexes.

	Sex of Sampled Children			
	<u>2011 KRS</u>	<u>2008 KRS</u>	<u>2005 KRS</u>	<u>2002 KRS</u>
Male	832 (47.1%)	766 (49.0%)	696 (47.5%)	802 (48.8%)
Female	929 (52.6%)	792 (50.6%)	765 (52.2%)	840 (51.2%)
Unknown	5 (0.3%)	6 (0.4%)	5 (0.3%)	0

Place of Birth. Place of birth was classified into four regions: San Francisco, elsewhere in California, elsewhere in the United States, and Foreign-Born. Among children sampled in the 2011 EKRS, 878 (49.7%) were born in San Francisco; 138 (7.8%) were born elsewhere in California; 276 (15.6%) were born in other U.S. states; and 98 (5.5%) were born in a foreign country. The birth place for 376 (21.3%) children was unknown. The proportion of children born outside the United States was similar between the 2002, 2005, 2008, and 2011 EKRS samples. However, compared to the 2002, 2005, and 2008 EKRS, fewer children were born in San Francisco in the 2011 sample, and more children had an unknown birthplace.

	Birthplace of Sampled Children			
	<u>2011 KRS</u>	<u>2008 KRS</u>	<u>2005 KRS</u>	<u>2002 KRS</u>
San Francisco	878 (49.7%)	998 (63.8%)	756 (51.6%)	1146 (69.8%)
California	138 (7.8%)	117 (7.5%)	219 (14.9%)	148 (9.0%)
United States	276 (15.6%)	105 (6.7%)	182 (12.4%)	37 (2.2%)
Foreign Born	98 (5.5%)	137 (8.8%)	126 (8.6%)	154 (9.4%)
Unknown	376 (21.3%)	207 (13.2%)	183 (12.5%)	157 (9.6%)

Public or Private School. Among the 1766 children sampled in the 2011 EKRS, 486 (27.5%) attended private kindergartens and 1280 (72.5%) attended public kindergartens. These proportions are similar to previous samples. According to the California Department of Education, 4739 (72.3%) kindergarten students attended public school in 2010-2011 school year and 1820 (27.7%) kindergarten students attended private school in the 2010-2011 school year.

	Public or Private School Attended by Sampled Children			
	<u>2011 KRS</u>	<u>2008 KRS</u>	<u>2005 KRS</u>	<u>2002 KRS</u>
Public	1280 (72.5%)	1025 (65.5%)	998 (68.1%)	1,070 (65.2%)
Private	486 (27.5%)	539 (34.5%)	468 (31.9%)	572 (34.8%)

Exemptions

There were 59 (3.3%) students with exemptions from vaccination (5 for permanent medical reasons, 2 for temporary medical reasons, and 52 for personal beliefs) in the 2011 EKRS, compared with 19 (1.2%) exemptions from vaccination (4 for permanent medical reasons and 15 for personal beliefs) in the 2008 EKRS. Of the 59 exempted children, 38 (64.4%) were White; 2 (3.4%) Hispanic; 4 (6.8%) Asian; 1 (1.7%) Black; and 6 (10.2%) Other ethnicity. The 2011 EKRS sample of exempted children contained a slightly higher proportion of White children than the 2008 EKRS sample (64.4% vs. 57.9%).



Of those with exemptions, 36 (61.0%) were born in San Francisco; 4 (6.8%) were born elsewhere in California, 11 (18.6%) were born elsewhere in the United States; and 2 (3.4%) were foreign-born. This distribution was similar to the 2008 EKRS results. A majority of children with exemptions attended private kindergarten (76.3%). Of the 59 2011 EKRS children with an exemption, 22 received no vaccinations, while 11 were UTD for various series (11 were UTD at 24 months for the 4:3:1 series, 7 were UTD at 24 months for the 4:3:1:-:3 series, 5 were UTD at 24 months for the 4:3:1:3:3 series, 3 were UTD for the 4:3:1:-:3:1 series, and 2 were UTD for the 4:3:1:3:3:1 series).

Of the 52 2011 EKRS children with a personal belief exemption, 18 received no vaccinations, while 9 were UTD for various series (9 were UTD at 24 months for the 4:3:1 series, 6 were UTD at 24 months for the 4:3:1:-:3 series, 5 were UTD at 24 months for the 4:3:1:3:3 series, 3 were UTD for the 4:3:1:-:3:1 series, and 2 were UTD for the 4:3:1:3:3:1 series); 25 other children received at least one vaccination, but did not receive enough vaccinations to be UTD for any series analyzed.

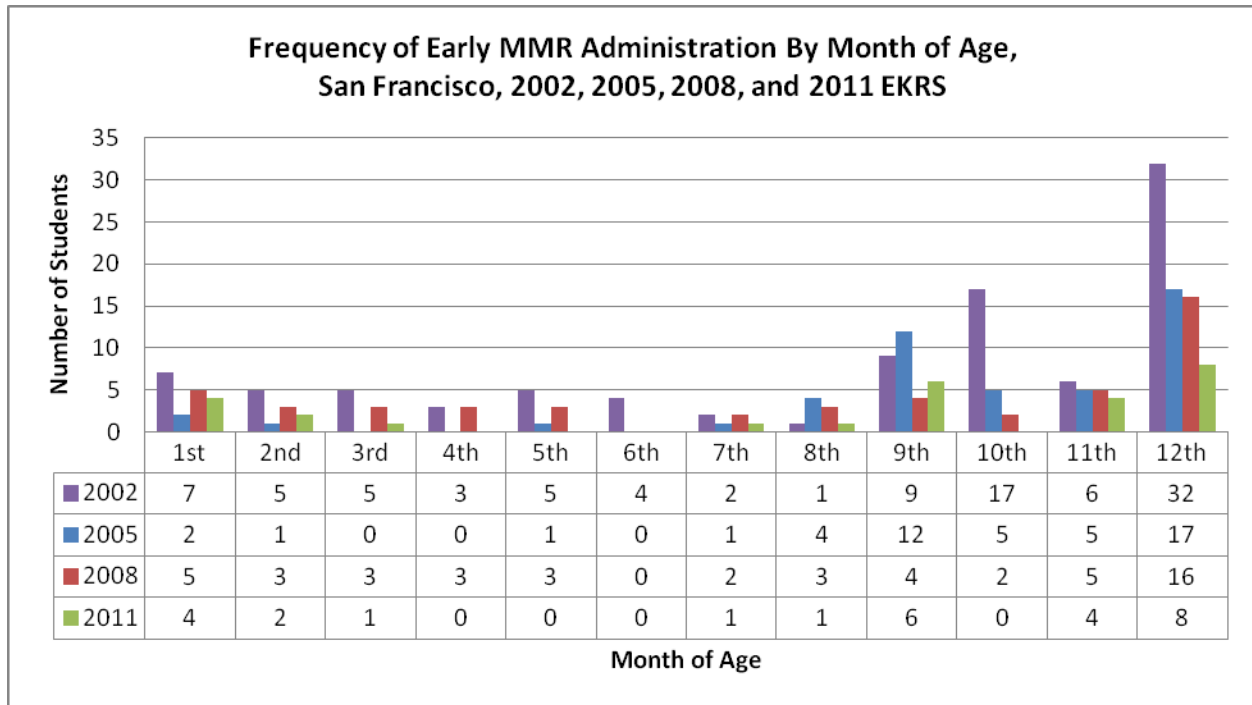
Varicella Disease

Children with a record of natural immunity to varicella are exempt from the varicella vaccination requirement. Evidence of a history of chickenpox disease was recorded on the blue card of 19 (1.1%) children, about the same number with documented varicella disease in the 2008 EKRS sample.

Early Administration of First MMR Dose

The first dose of MMR is not considered valid unless administered on or after the first birthday (allowing for a 4-day grace period, the first age at which MMR1 is considered valid is 361 days). Invalid early first dose of MMR was recorded for 27 (1.5%) children, about half the frequency seen in the 2008 KRS (n=49, 3.1%). In 2011, 29.6% of children received their early shot in the month before their first birthday, which was similar to the 2008 EKRS (32.6%).





Coverage for Single Vaccinations: Selected Observations

DTP. Similar to the 2005 and 2008 EKRS, the overall coverage for the single DTP vaccination climbed from 73.5% (95%CI 69.5-77.6) at 18 months of age to 92.0% (95%CI 87.6-96.6) at 48 months of age.

At 24 months:

- The proportion of children UTD for DTP was 84.4% (95%CI 80.1-88.8).
- UTD status was not significantly different between males and females.
- UTD status was not significantly different between ethnicities. UTD status at 24 months was lowest for Black children (70.2% 95%CI 56.1-86.9) and highest among Chinese children (93.8%; 95%CI 84.6-100.0) when compared to all children (84.4% 95%CI 80.1-88.8); these differences were not significant.
- UTD status was not significantly different by place of birth. A lower proportion of foreign-born children were UTD at 24 months (76.5% 95%CI 60.2-95.9) compared to those born in the United States (85.1% 95%CI 74.6-96.8), California (81.2% 95%CI 66.8-97.7) or San Francisco (87.2% 95%CI 81.2-93.6), but this was not significant.
- UTD status was not significantly different between public school students and private school students.

Polio. The proportion of children UTD for Polio vaccine was higher compared to other vaccines. The overall coverage for the single polio vaccination increased from 80.8% (95%CI 76.7-85.1) at 15 months of age [significantly higher than the 2008 (69.5%, 95%CI 65.4-73.8) or 2005 EKRS (62.1%, 95%CI 58.1-66.2)] to 96.0% (95%CI 91.5-100.0) at 48 months of age. The proportion of all children UTD for polio at 24 months was 92.3% (95%CI 87.9-96.9). At 24 months, the percentage of children covered was highest among Chinese children (97.3%, 95%CI 87.9-100.0)



and lowest among White children (83.7%, 95%CI 73.5-94.8), but this difference was not significant. Coverage did not differ significantly when stratified by other factors.

MMR. Similar to the 2008 and 2005 EKRS, 94.6% (95%CI 90.1-99.2) of children were UTD at 48 months of age.

At 24 months:

- The proportion of all children UTD for MMR was 89.6% (95%CI 85.3-94.2).
- UTD status was not significantly different between males and females. The percentage of male children UTD at 24 months (89.5%, 95%CI 83.2-96.2) was very similar to the percentage of female children UTD at 24 months (89.9%, 95%CI 83.9-96.2).
- UTD status was not significantly different between ethnicities. A smaller proportion of white children (83.3% 95%CI 73.2-94.4) were UTD compared to children of other ethnicities at 24 months, but this was not significant.
- UTD status was not significantly different by place of birth. The percentage of children UTD for MMR at 24 months who were born in San Francisco (92.1%, 95%CI 85.9-98.7) was higher than those born outside the United States (74.5%, 95%CI 58.4-93.7), but this was not significant.
- UTD status was not significantly different between public school students (91.6, 95%CI 86.5-97.0) and private school students (84.4%, 95%CI 76.4-92.9).

Hib. The proportion of children who were UTD for Hib was markedly lower than for other vaccines at all age benchmarks. The proportion of all children UTD for Hib at 24 months was 76.9% (95%CI 72.9-81.1). At 48 months of age, 78.1% (95%CI 74.1-82.4) of children were UTD. This is significantly higher than the percentage of children UTD at 48 months in 2008 (63.5%, 95%CI 59.6-67.6), but similar to 2005 EKRS findings (78.4%, 95%CI 73.9-83.0).

UTD status was not significantly different between males and females at all age benchmarks.

By ethnicity, the lowest percentage of children UTD for Hib at 24 months was among children of non-Chinese Asian or Pacific Islander descent (68.9%, 95%CI 56.3-83.5) and highest among Hispanic children (88.1%, 95%CI 78.0-99.0), but the difference was not significant. At 48 months, the percentage of non-Chinese Asian or Pacific Islander children vaccinated for Hib was only 70.2% (95%CI 57.5-84.9), but this was not significantly less than that for other ethnicities.

When assessed by place of birth, the percentage of children vaccinated with Hib was significantly lower for children born outside the United States at all age benchmarks than for children born in San Francisco, California, or the United States; the percentage of foreign-born children vaccinated with Hib by 48 months was only 44.9% (95%CI 32.6-60.3). Univariate logistic regression analysis revealed that children born outside of the United States are at significant risk for Hib undervaccination at both 15 and 24 months of age.



Hib coverage at 24 months is not significantly different in children attending private schools (82.1%, 95%CI 74.2-90.6) compared to those attending public schools (74.9%, 95%CI 70.3-79.8).

HepB. The overall coverage for the single HepB vaccination increased significantly from 79.2% (95%CI 75.1-83.4) at 12 months of age to 93.7% (95%CI 89.2-98.3) at 48 months of age.

At 24 months:

- The proportion of all children UTD for HepB was 90.3% (95%CI 85.9-94.8).
- UTD status was not significantly different between males and females.
- UTD status was not significantly different between ethnicities. A higher proportion of Asian children (94.4%, 95%CI 86.5-100.0) were UTD on HepB vaccination than children of other ethnicities at the 24 month benchmark, but this was not significant.
- UTD status was not significantly different by place of birth. The percentage of foreign born children UTD for HepB vaccination at 24 months (84.7%, 95%CI 67.5-100.00) was lower than those born in the United States (92.0%, 95%CI 81.1-100.0), California (91.3%, 95%CI 76.1-100.0), or San Francisco (91.0%, 95%CI 84.8-97.5), but not significantly lower.
- The percentage of children in private kindergarten UTD for HepB at 24 months (82.5%, 95%CI 74.6-91.0) was lower than that for children in public kindergarten (93.1%, 95%CI 87.9-98.6), but this was not significant.

Varicella. Coverage rates for the single varicella shot required prior to school entry improved from 66.1% (95%CI 62.3-70.0) at 15 months of age (similar to the 2008 EKRS 69.0% , 95%CI 64.9-73.2) to 92.1% (95%CI 87.7-96.7) at 48 months of age.

At 24 months:

- The proportion of all children UTD for varicella vaccine was 84.8% (95%CI 80.5-89.2).
- UTD status was not significantly different between males and females.
- UTD status was not significantly different between ethnicities.
- A significantly lower proportion of foreign-born children (50.0%, 95%CI 37.0-66.1) were UTD with varicella vaccination at 24 months compared with children born in the United States (85.1%, 95%CI 74.6-96.8), California (86.2%, 95%CI 71.4-100.0), and San Francisco (88.7%, 95% CI 82.6-95.2); rates were still lower at the 48 month benchmark for foreign-born children compared to those born in the United States, California, and San Francisco, but this was not significant.
- The proportion of public school children (86.5%, 95%CI 81.5-91.7) vaccinated for single varicella shot was similar to private school children (80.2%, 95%CI 72.5- 88.6).

Coverage for Series 4:3:1

Primary Schedule (15 to 24 Months of Age)

Of the 1766 children sampled in the 2011 EKRS, 1,399 or 79.3% (95%CI 75.2-83.5) were completely immunized with the 4:3:1 series of DTP4, Polio3, and MMR1 at 24 months of age.



The proportion UTD rose significantly from 38.4% (95%CI 35.5-41.4) at 15 months to 67.6% (95%CI 63.9-71.6) at 18 months. Series 4:3:1 coverage in the 2011 EKRS did not differ significantly from coverage in the 2008 EKRS (79.3%, 95%CI 75.0-83.9), the 2005 EKRS (77.4%, 95%CI 72.9-82.0) or the 2002 EKRS (81.5%, 95%CI 79.6-83.4).

At 24 months, UTD status was not significantly different between males and females or between ethnicities.

Place of Birth. Children born in California and the United States had UTD rates similar to those born in San Francisco at 15 months and 18 months of age. Children born in a foreign country had significantly lower UTD rates than children born in San Francisco: 19.4% (95%CI 11.7-30.3) at 15 months and 38.8% (95%CI 27.4-53.2) at 18 months, similar to results from the 2008 EKRS (16.1%, 95%CI 10.1-24.3 at 15 months and 43.1%, 95%CI 32.8-55.6 at 18 months). Rates at 24, 27.5, 36, and 48 months were lower among foreign-born children when compared with children born in San Francisco, but this was not significant.

Public or Private School. The proportion UTD among private school students was similar to public school students at all age benchmarks. This is different from previous years of data (2005 and 2008) when the proportion UTD at 15 months of age among private school students was significantly greater than that for public school students; that difference persisted at later benchmarks, but was not significant.

Late (27.5 to 48 Months of Age)

The status of children becoming UTD on required vaccinations later than recommended was also assessed. The proportion of all children UTD for the 4:3:1 series rose to 83.2% (95%CI 79.0-87.6) at 27.5 months of age, to 86.4% (95%CI 82.1-90.9) at 36 months of age, and to 89.3% (95%CI 84.9-93.8) at 48 months of age. These trends were similar to the ones observed in the 2008 and 2005 EKRS.

At 48 months of age, rates for foreign born students were not significantly lower (76.5%, 95%CI 60.2-95.9) than for students born in the United States (88.4, 95%CI 77.7-100.0), California (90.6%, 95%CI 75.4-100.0), and San Francisco (91.3%, 95%CI 85.1-97.9).

Race/Ethnicity-Adjusted Proportion UTD Series 4:3:1 at 24 Months of Age

The racial/ethnic classifications for San Francisco kindergarteners were known prior to sampling for public school students. Because children attend public or private schools differentially by racial/ethnic groups in San Francisco and immunization coverage differs among races/ethnicities, the cluster sampling method applied to the 2011 EKRS may have inadequately ascertained a racially/ethnically representative survey population.

Race/ethnicity-adjusted UTD rates were constructed using the standard population proportions obtained from the 2008 California Department of Finance data for San Francisco children ages 0-4 years: Asian (0.323); Black (0.079); Hispanic (0.189); White (0.395); Other (0.015). Sampled children with unknown race/ethnicity were excluded from the adjusted rate calculation. The



2011 KRS adjusted rate of children UTD for 4:3:1 series at 24 months of age was 78.4% (95%CI 69.1-88.6). This rate does not significantly differ from the adjusted UTD rate from the 2008, 2005 or 2002 EKRS (80.4% [95%CI 71.6-90.0] and 78.4% [95%CI 74.0-82.9] and 83.3% [95%CI 79.4-87.3], respectively).

Logistic Regression (UTD Series 4:3:1 at 24 Months of Age)

Four major characteristics were analyzed according to the 4:3:1 outcome at 24 months of age: sex, race/ethnicity, place of birth, and public or private school (Table 1). There were no statistically significant differences by sex (OR=1.072, 95%CI 0.84-1.37). Significant differences in complete immunization coverage were observed across some of the ethnicity groups when compared to White children. Compared with White children, Black children were significantly less likely to be UTD at 24 months of age (OR=0.54, 95%CI 0.38-0.77), who were also a risk group in the 2008 and 2005 EKRS. Chinese children were significantly more likely to be UTD (OR=1.84, 95%CI 1.32-2.58) compared to White children, which was similar to the 2008 EKRS, but not seen in the 2005 EKRS.

Compared to being born in San Francisco, foreign-born children were significantly less likely to be UTD at 24 months of age (OR=0.33 95%CI 0.25-0.43). The odds of being UTD for children born elsewhere in California or the United States were not significantly different than those for children born in San Francisco. Children with unknown birthplace were significantly less likely to be UTD at 24 months for Series 4:3:1 than those children born in San Francisco (OR=0.54 95%CI 0.40-0.73)

Children in public schools did not have lower immunization levels than children attending private schools (OR=1.059 95%CI 0.76-1.47), which was different from the 2008 EKRS when children attending public schools had a significantly lower immunization coverage level than children attending private schools (OR=0.68, 95%CI 0.50-0.93).

A multivariate logistic model was constructed with the independent variables that were significantly associated with UTD status at 24 months of age in the univariate analysis (Table 2). The sex variable and public versus private school designation was excluded from the adjusted model. The associations observed in the multivariate analysis were similar to those in the univariate analysis (Table 2).

Coverage for Series 4:3:1:3:3, 4:3:1:3:3:1 , 4:3:1:-:3, and 4:3:1:-:3:1

The coverage rate for the 4:3:1:3:3 series at 24 months of age was 62.3% (95%CI 58.7-66.1).

Coverage in 2011 for the 4:3:1:3:3 series was significantly higher than detected in the 2008 EKRS 52.2% (95%CI 48.7-55.9), but similar to the 2005 EKRS at 61.0% (95% CI 57.0-65.1%). Similar to the 4:3:1 series, the proportion of children UTD for the 4:3:1:3:3 series increased at the 15 months and 18 month benchmarks.



By 48 months of age, the proportion UTD for the 4:3:1:3:3 was 70.7% (95%CI 66.8-74.7), which is significantly higher than that observed in the 2008 EKRS (58.1%; 95%CI 54.4-62.0). The 2011 proportion is similar to that observed in the 2005 EKRS (70.3%; 95% CI 66.0-74.7%).

The coverage rate for the 4:3:1:3:3:1 series at 24 months of age was 59.4% (95%CI 55.8-63.1). Coverage for 4:3:1:3:3:1 was significantly higher in 2011 than in 2008 (47.9% 95%CI 44.5-51.4). The proportion of children UTD for this series increased at the 15 and 18 month benchmarks, similar to the 4:3:1 series.

By 48 months of age, the proportion UTD for the 4:3:1:3:3:1 series was 68.7% (95%CI 64.9-72.7), which is significantly higher than that observed in the 2008 EKRS (54.5%; 95%CI 50.9-58.3). The 2011 proportion is similar to that observed in the 2005 EKRS (65.3%; 95%CI 61.2-69.6%).

For comparison with the California Department of Public Health KRS data, coverage rate for the series omitting Hib, 4:3:1:-:3 or 4:3:1:-:3:1, were also calculated.

The coverage rate for the 4:3:1:-:3 series at 24 months was 76.3% (95%CI 72.2-80.4). Coverage was similar to the 2008 percentage, 75.3% (95%CI 71.1-79.7) . Multivariate logistic regression analysis revealed the odds of foreign born children (OR=0.28, 95%CI 0.20-0.40) being UTD at 24 months was 72% less likely than San Francisco born children when controlling for other factors.

For the 4:3:1:-:3:1 series, the percent of children UTD at 24 months was 71.3% (95%CI 67.4-75.4), which was similar to the 2008 percentage, 68.6% (95%CI 64.6-72.8). Multivariate logistic regression revealed the odds of Chinese children (OR=2.23, 95%CI 1.56-3.20) being UTD at 24 months were 123% more likely than White children being UTD at 24 months when controlling for other factors.

INTERPRETATION & DISCUSSION

4:3:1 Series UTD at 24 Months of Age

The proportion of children UTD for the 4:3:1 series at 24 months of age between 2008 and 2011 was the same as in 2011 (79.3%, 95%CI 75.2-83.5) as in 2008 (79.3%, 95%CI 75.0-83.9). It is also not significantly different from the UTD proportion measured in the 2002 EKRS, which estimated 81.5% (95%CI 79.6-83.4) coverage, nor different from the 2005 EKRS: 77.4% (95%CI 72.9-82.0) .

Multivariate Logistic Analyses

Even though the sampled proportions among population groups (i.e., by race/ethnicity, sex, place of birth, school type) differed in some respects, the relative likelihood (i.e., odds ratio) of being fully immunized for the 4:3:1 series at 24 months of age among population groups remained similar between the 2011, 2008, and 2005 EKRS. In both the 2008 and 2005 surveys, the adjusted logistics models indicated that Blacks, foreign-born and public school kindergarten-aged children were significantly less likely to have been fully immunized than their referent counterparts; the 2011 adjusted logistic module indicated that Blacks and foreign born



were significantly less likely to have been fully immunized than their referent counterparts. In the 2011 and 2008 EKRS, Hispanic children were no longer at increased risk for 4:3:1 undervaccination at 24 months compared to White children, and Chinese children were more likely to be UTD than compared with White children.

Comparison of San Francisco Vaccination Coverage to the California 2011 KRS Results

The San Francisco percentage of children UTD at 24 months for the 4:3:1 series (79.3%, 95%CI 75.2-83.5) was not significantly different from the overall California percentage (77.4% ± 1.9%) nor from the percentage among Bay Area* students (82.4% ± 4.0%). Like San Francisco, the California study found the data “suggest a persistent disparity in immunization coverage among Black children.”

*Bay Area includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties

Immunization Coverage among Kindergarten Students at 24 months of age, San Francisco, California, United States

Vaccination	San Francisco, % (95%CI)	California*, % ± margin of error	United States**, % ± margin of error
DTP	84.4% (95%CI 80.1-88.8)	79.9% ± 1.7%	82.8% ± 4.2%
Polio	92.3% (95%CI 87.9-96.9)	92.3% ± 1.2%	90.7% ± 3.6%
MMR	89.6% (95%CI 85.3-94.2)	92.7% ± 1.1%	93.9% ± 2.4%
HepB	90.3% (95%CI 85.9-94.8)	91.3% ± 1.2%	90.6% ± 3.3%
Varicella	84.8% (95%CI 80.5-89.2)	88.1% ± 1.7%	91.8% ± 3.8%
4:3:1	79.3% (95%CI 75.2-83.5)	77.4% ± 1.9%	80.0% ± 4.6%
4:3:1:-:3	76.3% (95%CI 72.2-80.4)	75.0% ± 1.8%	Not available
4:3:1:-:3:1	71.3% (95%CI 67.4-75.4)	71.0% ± 2.1%	Not available

*California percentages from the 2011 KRS report: 2011 Kindergarten Retrospective Survey Results California Department of Public Health, Immunization Branch

**Data from the 2007 National Immunization Survey (NIS) are used for comparison, because data from the KRS are retrospective; children in all three surveys were born between 2004 and 2006

Comparison of San Francisco Vaccination Coverage to Healthy People 2020 Targets

The National Center for Health Statistics has designated Healthy People 2020 targets for childhood vaccination levels. Relevant goals are listed in the table below.

See <http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=23> for more information.

Healthy People 2020 Goal	San Francisco – 36 months
80% of children aged 19 to 35 months receive the recommended doses of DTaP (diphtheria, tetanus, and acellular pertussis antigens), polio, MMR (measles, mumps, rubella), Hib (<i>Haemophilus influenzae</i>), hepatitis B, varicella and PCV (pneumococcal conjugate vaccine) vaccines.	PCV data not gathered in EKRS; 66.2 (95%CI 62.4-70.1) UTD for 4:3:1:3:3:1 series at 36 months
90 percent of children aged 19 to 35 months received 4 or more doses of the combination of diphtheria, tetanus, and acellular pertussis antigens (DTaP)	89.6% (95% CI 85.3-94.2) at 36 months
90 percent of children aged 19 to 35 months received 3 or more doses of Hib vaccine	77.9% (95%CI 73.8-



	82.1) at 36 months
90 percent of children aged 19 to 35 months received at least 3 doses of the hepatitis B vaccine	92.1% (95% CI 87.7-96.7) at 36 months
90 percent of children aged 19 to 35 months received 1 dose of measles-mumps-rubella (MMR) vaccine	93.1% (95% CI 88.7-97.8) by 36 months
90 percent of children aged 19 to 35 months received at least 3 doses of polio vaccine	94.8% (95% CI 90.4-99.5) by 36 months
90 percent of children aged 19 to 35 months received at least 1 dose of the varicella vaccine	90.5% (95% CI 86.2-95.1) by 36 months
90 percent of children aged 19 to 35 months received at least 4 doses of the pneumococcal conjugate vaccine	Not assessed
60 percent of children aged 19 to 35 months received 2 or more doses of hepatitis A vaccine	Not assessed
85 percent of the birth cohort received the first dose of hepatitis B vaccine within 3 days of birth	29.8%
80 percent of children aged 19 to 35 months received 2 or more doses of rotavirus vaccine	Not assessed
80 percent of children aged 19 to 35 months received the recommended doses of DTaP, polio, MMR, Hib, hepatitis B, varicella, and PCV vaccines.	No SF series included PCV. For the 4:3:1:3:3:1 series*, 66.2% (95%CI 62.4-70.1) at 36 months
95 percent of children enrolled in kindergarten received 4 doses of DTaP vaccine	92.0% (95% CI 87.6-96.6) at 48 months
95 percent of children enrolled in kindergarten received 2 doses of MMR vaccine	94.6% (95% CI 90.1-99.2) at 48 months
95 percent of children enrolled in kindergarten received 3 or more doses of polio vaccine	96.0% (95% CI 91.5-100.0) at 48 months
95 percent of children enrolled in kindergarten received 3 or more doses of hepatitis B vaccine	93.7 % (95% CI 89.2-98.3) at 48 months
95 percent of children enrollees in kindergarten received 2 or more doses of varicella vaccine	Assessed only 1 varicella; 92.1% (95% CI 87.7-96.7) had received 1 varicella dose at 48 months

*4:3:1:3:3:1= 4 DTP, 3 polio, 1 MMR, 3 Hib, 3 Hep B, 1 varicella

Individual vaccinations

The HP 2020 goal for individual vaccinations for children age 19-35 months is 90 percent of children receiving 4 or more doses of the combination of diphtheria, tetanus, and acellular pertussis antigens (DTaP), 3 or more doses of Hib vaccine, at least 3 doses of the hepatitis B vaccine, 1 dose of measles-mumps-rubella (MMR) vaccine, at least 3 doses of polio vaccine, and at least 1 dose of the varicella vaccine. San Francisco met the 90% goal for the individual Hep B, MMR, polio, and varicella. San Francisco almost met the HP 2020 goal for DTaP (at 36 months 89.6%, 95%CI 85.3-94.2). San Francisco did not meet the HP 2020 goal for Hib; the proportion of all San Francisco children UTD at 36 months for Hib was 77.9 (95%CI 73.8-82.1), much lower than the HP 2020 target of 90%.

The HP 2020 goal for individual vaccinations for children enrolled in kindergarten is 95 percent of children received 4 doses of DTaP vaccine, 2 doses of MMR vaccine, 3 or more



doses of polio vaccine, 3 or more doses of hepatitis B vaccine, or 2 or more doses of varicella vaccine. In San Francisco, the 2011 EKRS estimated proportion of children aged 48 months UTD for individual vaccinations for polio met the Healthy People 2020 targets of 95% for children enrolled in kindergarten being UTD. San Francisco almost met the DTaP, MMR, and Hep B HP 2020 goals. In San Francisco, at 48 months of age, 96.0% (95%CI 91.5-100.0) had received 3 or more doses of polio vaccine, 94.6% (90.1-99.2) of kindergarteners had received two doses of MMR, 93.7% (95%CI 89.2-98.3) had received 3 or more doses of hepatitis vaccine, and 92.0% (95%CI 87.6-96.6) had received 4 doses of DTaP.

The HP 2020 goals also include 85% of the birth cohort receiving the first dose of hepatitis B vaccine within 3 days of birth. In San Francisco, only 29.8% of current kindergarteners received their first hepatitis B vaccine within 3 days of birth, much lower than the 85% HP 2020 Goal. The recommendation for a universal hepatitis B birth dose came into effect in San Francisco in 2005.

Caveats to the Data

Results from the 2011 EKRS should be interpreted with the following caveats.

Potential Sampling Bias

While a random sample of schools was obtained, this is not a random sample of students.

Place of birth data was unknown or missing for 376 (21.3%) of the sampled population. It is difficult to infer whether this large amount of missing information on the UTD comparison would lead to differential or non-differential classification because of the inability to adjust for sampling bias by birthplace; population-based data for birthplace is not available from the U.S. census.

Ethnicity group was unknown or missing for 365 (20.7%). Because there is significant variability in vaccination rates between ethnicity groups, basing conclusions on a sample not entirely representative of the ethnicity distributions of San Francisco kindergarteners could result in a biased estimate of vaccination coverage for the overall population. The 2002, 2005, 2008, and 2011 EKRS proportions of children UTD for the 4:3:1 series at 24 months of age were adjusted to address the differential race/ethnicity-specific sampling fractions between the 2002 and 2005 EKRS. Adjustment altered the 2011 EKRS rate slightly (adjusted = 78.4%, unadjusted = 79.3%). Adjustment did not alter the 2008 (adjusted = 79.6%, unadjusted = 79.3%) or 2005 EKRS rate (adjusted = 77.4%, unadjusted=77.4%) and only unsubstantially modified the 2002 EKRS rate (adjusted rate = 82.0%, unadjusted =81.5%). While the adjusted coverage rate for the 2011 EKRS is lower than that obtained from the 2008 survey, it is not significantly different. The difference in the proportion UTD for the 4:3:1 series among the 2002, 2005, 2008, and 2011 EKRS was not the result of bias in sampling by race/ethnicity.

Hib Vaccination

It may not be possible to accurately assess Hib vaccination, because elementary schools are not required to fill out Hib information on the blue card. It may be possible that the Hib vaccination



rates were affected by the Hib vaccine shortage in California from December 2007- March 2010; the Hib vaccination requirement, meaning one dose of Hib on or after the 1st birthday, was temporarily lifted, unless the child had certain risk factors, to attend childcare or preschool. The requirement was suspended in Fall 2008 and not reinstated until September 2011. Children in this sample had their first birthdays in 2005-2007.

Exemptions

The proportion of sampled children with exemptions to vaccination due to medical contraindications or parental personal beliefs increased to 3.3% from 1.6% in 2005 and 1.2% in 2008. Exempted children are counted in the denominator when the proportion UTD for any vaccination or series is calculated. Consequently, an increase in the frequency of exemptions from vaccination influences the proportion UTD downward.

Efforts to monitor the frequency of exemptions for personal beliefs should be continued. Efforts should be continued and/or strengthened to provide parents and pediatricians with the most complete and accurate information regarding vaccine safety and the personal and public health benefits of an adequately immunized child.

CONCLUSIONS

Overall

In 2011, the percentage of San Francisco kindergarten children immunized for the 4:3:1 series at 24 months of age, 79.3% (95%CI 75.2-83.5) was similar to past years, 79.3% (95%CI 75.0-83.9) in 2008 and 77.4% (95%CI 72.9-82.0) in 2005. Generally, immunization rates have not changed considerably since the 2008 KRS. Black children continue to be less likely than White children to be UTD at 24 months for the 4:3:1 series, while Chinese children continue to be more likely than White children to be UTD at 24 months for the 4:3:1 series. To improve the immunization assessment, data quality for place of birth and ethnicity needs to be addressed in future KRS studies.

HP2020 Goals

Overall, San Francisco met most of the HP 2020 goals. At 36 months, San Francisco children (either by estimate or the upper limit of the 95% Exact confidence interval) met most of the Healthy People 2020 vaccination coverage targets for individual vaccinations, including 90% of children aged 19-35 months receiving

- at least 3 doses of hepatitis B vaccine,
- 1 dose of MMR vaccine,
- 3 doses of polio vaccine, and
- 1 dose of varicella vaccine.

San Francisco did not meet the HP 2020 goal of 90% of children aged 19-35 months receiving 3 or more doses of Hib vaccine. Because schools are not required to fill out information for Hib vaccine on the blue card and because of the Hib vaccination shortage, the next EKRS will probably not see an improvement towards reaching this HP 2020 goal.



By 48 months, San Francisco kindergarteners had almost met or met the Healthy People 2020 individual vaccination goal of 95% of children enrolled in kindergarten.

In San Francisco, only 29.8% of current kindergarteners received their first hepatitis B vaccine within 3 days of birth, much lower than the 85% HP 2020 goal. The recommendation for a universal hepatitis B birth dose came into effect in 2005. The 2014 EKRS should be a better reflection of how San Francisco is meeting this HP 2020 goal.



Table 1. Univariate associations between children UTD on Series 4:3:1* and available demographics at 24 months of age, San Francisco, EKRS 2011

Demographic	Complete 4:3:1 Series*	Incomplete series or not UTD	OR (95% CI)	P**
	N (% , 95%CI)	N (%)		
<i>Sex</i>				
Male	656 (78.8, 72.9-85.1)	176 (21.2)	1.00	
Female	741 (79.8, 74.1-85.7)	188 (20.2)	1.072 (0.84, 1.37)	0.57
<i>Birthplace</i>				
San Francisco	724 (82.5, 76.6-88.7)	154 (17.5)	1.00	
California	110 (79.7, 65.5-96.1)	28 (20.3)	0.82 (0.51, 1.33)	0.43
United States	225(81.5, 71.2-92.9)	51 (18.5)	1.01 (0.70, 1.45)	0.95
Foreign-born	62 (63.3, 48.5-81.1)	36 (36.7)	0.33 (0.25, 0.43)	<0.001
Unknown	275 (74.1, 65.6-83.4)	96 (25.9)	0.54 (0.40, 0.73)	<0.001
<i>Ethnicity</i>				
Black/African Am	82 (67.8, 53.9-84.1)	39 (32.2)	0.54 (0.38, 0.77)	<0.001
Other Asian/PI	126 (83.4, 69.5-99.4)	25 (16.6)	1.29 (0.77, 2.17)	0.34
Chinese	355 (88.1, 79.2-97.7)	48 (11.9)	1.84 (1.32, 2.58)	<0.001
Hispanic/Latino	256 (80.5, 70.9-91.0)	62 (19.5)	1.07 (0.73, 1.55)	0.73
White	213 (72.4, 63.0-82.9)	81 (27.6)	1.00	
Other	92 (80.7, 65.1-99.0)	22 (19.3)	1.44 (0.83, 2.50)	0.20
Unknown	270 (75.8, 67.1-85.4)	86 (24.2)	0.85 (0.55, 1.32)	0.47
<i>School Type</i>				
Private	362 (74.5, 67.0-82.6)	124 (25.5)	1.00	
Public	1038 (81.1, 76.2-86.2)	242 (18.9)	1.06 (0.76, 1.47)	0.74

Note: Children with exemptions were excluded from this analysis.

* Completed the 4:3:1 vaccination series (4 DTP, 3 Polio, 1 MMR).

** The probability that this result or one more extreme occurring by chance.



Table 2. Multivariate logistic regression analysis of children UTD on Series 4:3:1* by available demographics at 24 months of age, San Francisco, KRS 2011

Demographic	Odds Ratio	95% CI	p**
<i>Birthplace</i>			
San Francisco	1.00		1.00
California	0.87	0.51-1.44	0.58
United States	0.97	0.69-1.37	0.86
Foreign-born	0.26	0.19-0.36	<0.001
Unknown	0.65	0.48-0.90	0.009
<i>Race/ethnicity</i>			
Black/African Am	0.56	0.39-0.80	0.002
Other Asian/PI	1.48	0.90-2.44	0.127
Chinese	2.10	1.49-2.97	<0.001
Hispanic/Latino	1.11	0.78-1.58	0.578
White	1.00		
Other	1.64	0.95-2.82	0.076
Unknown	1.04	0.66-1.65	0.856

Note: Children with exemptions were excluded from this analysis.

* Completed the 4:3:1 vaccination series (4 DTP, 3 Polio, 1 MMR).

** The probability that this result or one more extreme occurring by chance.

