The Taiwan National Health Insurance Program and Full Infant Immunization Coverage

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Objectives. We compared hospital-born infants and well-baby care use associated with complete immunizations in Taiwan before and after institution of National Health Insurance (NHI).

Methods. We used logistic regression to analyze data from 1989 and 1996 National Maternal and Infant Health Surveys of 1398 and 3185 1-year-old infants, respectively.

Results. Infants born in hospitals were found to receive fewer immunizations than those born elsewhere before NHI but significantly more after NHI. Use of well-baby care correlates strongly and positively with the probability that a child will receive a full course of immunization after NHI.

Conclusions. The NHI policy of including hospitals as immunization providers facilitates access to immunization services for children born in those facilities. Through NHI provision of free well-baby care, health planners have stimulated the demand for immunization. (*Am J Public Health.* 2005;95:305–311. doi: 10.2105/AJPH.2002.012567)

Increased immunization coverage is responsible for Taiwan's success in dramatically reducing infant morbidity and mortality resulting from infectious diseases such as poliomyelitis, neonatal tetanus, diphtheria, pertussis, tuberculosis, and hepatitis B. In the year 2000, Taiwan reported 0 cases of poliomyelitis, congenital rubella syndrome, or neonatal tetanus, and only 24 reported cases of measles (4 of which were confirmed).[1]

For the effective control of vaccine-preventable childhood diseases, all children born in Taiwan are required to receive 16 doses of vaccines free of charge by 18 months of age, including 1 dose of bacille Calmette–Guérin (BCG) vaccine, 3 doses of hepatitis B vaccine, 4 doses of diphtheria-tetanus-pertussis, 4 doses of oral poliomyelitis vaccine, 1 dose of measles vaccine, 1 dose of measles-mumps-rubella vaccine, and 2 doses of Japanese encephalitis vaccine. In 1999, the average coverage rate for all free vaccines, except for measles, was reported to be over 90%.[1] This figure is comparable with the 73.2% US coverage rate for 4:3:1:3:3 vaccine series among children aged 19 to 36 months, where only measles-mumps-rubella (91.5%) and *Haemophilus influenzae* type b (93.5%) vaccines are beyond 90%, whereas the remainder of diphtheria-tetanus-pertussis (83.3%), polio (89.5%), and hepatitis B (88.2%) are still below 90%. These statistics approximate the US Department of Health and Human Services' goal of 90% coverage levels for all vaccinations given to children by the year 2010.[2,3]

Taiwan's government started providing free vaccinations for children approximately 20 years ago. Most vaccinations are delivered at public health stations, which are the primary public health care providers of basic medical and health services, with locations in every township.[1] Since 1988, the Department of Health has encouraged medical institutions, including pubic and private hospitals and pediatric and maternal clinics, to offer immunization services to expand general immunization availability and promote better child health care. However, before the implementation of National Health Insurance (NHI), many institutions declined to offer child immunizations because of the minimal fees received for providing such a service and because the majority of children (approximately 85%) received immunizations at public health stations.[4,5] After the launch of NHI in 1995, more than 90% of medical care institutions joined the Bureau of National Health Insurance system under contract.[6] Under the new NHI, many institutions that desired to attract new patients implemented immunization programs. The new participation in immunization programs by these medical care institutions reduced the number of children receiving immunizations at public health stations to 70%.[7]

The push by the Bureau of National Health Insurance to move the immunization program from the public sector to the private sector was done without negatively impacting vaccine coverage. Many developing countries, such as those in Latin America, are similar to pre-NHI Taiwan, with almost all immunizations made available by the public sector for free or at minimal cost, with the hope of achieving vaccine coverage in a high proportion of the population.[8] The successful experience Taiwan has had with health care reform and the implementation of NHI may provide a valuable lesson to many developing countries that aspire to create some type of NHI and to make health care a natural right for their citizens.

As many outbreaks of infectious diseases in the Western world have been blamed on incomplete immunization coverage, we can assume that childhood immunization programs help protect against infectious diseases.[9] Research evaluating the relative importance of factors that cause incomplete immunization coverage, including socioeconomic factors, parental awareness, health care provider practices, and inadequate health education and communication,[10–14] has important policy implications.

Santoli et al.[13] found an association between child health care service use and immunization. Because children require a total of 5 to 7 visits to a clinic during their preschool years to complete the recommended series of immunizations, children with higher health care use rates are more likely to receive the full course of immunizations. Gore

et al.[9] found mothers' perceptions regarding the support received at immunization clinics to be a key determinant of whether or not children completed the full program of immunizations. The higher the mother perceived the level of immunization clinic support to be, the higher the level of immunization that was completed. Also, the impact of health insurance on the use of health care programs by children has long been recognized and documented. In the United States, there is a significant body of evidence showing that children covered by health insurance plans tend to make greater use of preventive and other health care services.[15–23]

Whereas studies conducted in various countries around the world underscore the importance of immunization services, with particular attention being paid in recent years to the relationship between sociodemographic differences in immunization use, few studies to date have examined the relative importance of factors determining immunization use in Taiwan. In particular, no study has ever been conducted comparing immunization use before and after the introduction of NHI in 1995. Notable exceptions to this subject include a study conducted by Chen et al. analyzing antenatal care use before and after NHI implementation[24] as well as 2 recent articles researching neonatal-related issues.[25,26]

Therefore, the objectives of our study were, first, to identify the principal factors affecting the use of immunization services among 1-year-old children in Taiwan and, second, to find out whether Taiwan's NHI has improved general preventive care of infants by comparing characteristics of hospital-born infants and well-baby care services usage associated with complete immunizations in Taiwan before and after NHI.

METHODS

Data

Data for this study were drawn from 2 Department of Health–sponsored National Maternal and Infant Health Surveys conducted in 1989 and 1996 by the same research team. To ensure the national representativeness of data, all women who had gestational outcomes occurring at 20 weeks' gestation or later and who gave birth between May 15 and 17, 1989, and between February 12 and 16, 1996, were recruited for the 2 surveys. A 2-stage sampling procedure was used to collect valid data. First, for the collection of all gestational outcomes occurring at 20 weeks' gestation or later during the sampling dates, each county and city health bureau helped to issue a birth event recording form to all medical institutions in the corresponding administrative area. Public health nurses from each health station then carried out home visit interviews with people who had completed the form 1 year after the birth of their children. A total of 1926 and 3998 birth events were reported in 1989 and 1996, respectively. Of the reported events in these 2 cohorts, 86.3% and 90.7% of the target population completed the interviews. After excluding the missing data, the sample sizes of these 2 cohorts were 1398 and 3185, respectively.

The National Maternal and Infant Health Survey provides information on prenatal care use as well as the immunization history of infants aged 1 year. Immunization status is ascertained from either medical records or vaccination cards. In Taiwan, information on immunization kept on parent-held immunization records before NHI (although the mother retains an immunization card) has since become part of a child's medical record. Approximately 89.4% and 99.9% of mothers in the 1989 and 1996 samples, respectively, presented the immunization cards and medical records to the interviewer before the survey. Definitions of the variables used in this study are presented in Table 1.

Hypotheses

On the basis of the information provided above, we hypothesize a model to demonstrate a difference in vaccination facility preference between pre- and post-NHI periods and to indicate a correlation between increasing the use of well-baby care and the completion of the full course of child vaccinations.

Before implementation of NHI, many hospitals did not provide vaccines to children. Those that did provide vaccines charged patients both registration and visitation fees. Therefore, most children received vaccinations from public health stations. After NHI, with free vaccinations and free well-baby care at contracted medical care facilities, parents would presumably be more willing to take their newborns back to a hospital for vaccinations. Our study examines the hypothesis that the coefficient corresponding to hospital is negative before NHI implementation and positive after NHI implementation.

To improve the general quality of health in Taiwan, the government offered free health care services for children even before the implementation of NHI. Today, NHI authorizes 6 free doctor visits for children aged younger than 4 years.[6] This well-baby care program might provide health care providers the opportunity to promote routine immunization to parents. Therefore, we hypothesized that by participating in the well-baby care program, children would be more likely to be immunized.

Methodology of Calculation

We applied a descriptive analysis in our presentation of the characteristics of our 2 sample groups to address differences in coverage that may result from changes in society, educational campaigns, historical trends, and other factors. We then used logistic regression to analyze the effects of sociodemographic characteristics on childhood immunization completion.

RESULTS

Characteristics of the 2 Groups

A comparison of suggested vaccination completion ratios in the pre- and post-NHI periods is shown in Table 2. The estimated percentage of children receiving complete immunization was below 90%, constituting 65.5% and 87.7% in the 2 surveys, respectively. The low coverage rate of measles vaccinations seems to be the major factor resulting in the low percentage of complete childhood immunization. The explanation for such a low coverage rate of measles vaccination might be the special acculturation and lack of education/knowledge found in Taiwan's society.

Taiwan's Department of Health recommends that the first dose of measles vaccination be received at 9 months of age. However, some parents prefer that their children become infected rather than being vaccinated

TABLE 1—Dependent and Independent Variable Specifications of the National Maternal and Infant Health Survey Sample

Variables	Specification
Dependent variable	
Vaccination	Dummy: the infant received all suggested vaccinations during the past 12 mo = 1
Independent variables	
Infant characteristics	
Gender	Dummy: male = 1
Gestation period	Dummy: gestational age is ≥ 36 wk (average wk) = 1
Birth order	Dummy: firstborn = 1
Hospital birth	Dummy: born in a hospital = 1
Well-baby care	Dummy: infant received well-baby care during the past 12 mo = 1
Primary caregiver	
Grandparent	Dummy: grandparents take care of infant = 1
Babysitter	Dummy: babysitter takes care of infant = 1 (reference group: parents)
Maternal characteristics	
Age, y	
25–34	Dummy: 25–34 y = 1
≥ 35	Dummy: 35 y and above = 1 (reference group: 24 y and below)
Education	
Junior high	Dummy: junior high school degree = 1
Senior high	Dummy: senior (or vocational) high school degree = 1
Junior college	Dummy: junior college degree = 1
College and above	Dummy: college degree and above = 1 (reference group: primary school and below)
Occupation	
Government	Dummy: government employee, teacher and soldier = 1
Laborer	Dummy: laborer = 1
Farmer	Dummy: farmer = 1
Businesswoman	Dummy: businesswoman = 1
Other	Dummy: other (reference group: housewife = 1)
Geographic characteristics	
Central	Dummy: household located in Taichung Hsien, Changhwa Hsien, Nantou Hsien, Yunlin Hsien, Taichung City = 1
South	Dummy: household is located in Chiayi Hsien, Tainan Hsien, Kaohsiung Hsien, Pingtung Hsien, Kaohsiung Municipality, Chiayi City, Tainan City = 1
East	Dummy: household is located in Taitung Hsien, Hwalien Hsien, Penghu Hsien = 1 (reference group: North including Taipei Hsien, Keelung Hsien, Ilan Hsien, Taoyuan Hsien, Hsinchu Hsien, Miaoli Hsien, Taipei Municipality)

because of the deep belief that obtaining the antibody by means of infection is more natural and healthier.[27,28] It is not unusual for such cultural beliefs to contribute to inadequate immunization among some developing countries.[27,28] Through health education campaigns, Taiwan's government has attempted to change certain culture-specific beliefs, which may have led in part to the increase in measles vaccination coverage. In addition, such an increase in measles vaccination coverage may also be attributable in large part to a national plan, inaugurated in 1991, calling for the elimination of poliomyelitis, congenital rubella syndrome, neonatal tetanus, and measles.

Table 3 provides mean values and standard deviations for each variable and the percentage of the sample receiving complete immunizations. Sociodemographic characteristics are divided into 3 groups: infant characteristics, maternal characteristics, and geographic characteristics. A significant change in birth order and hospital choice was observed in infants between the pre- and post-NHI survey results. The birth order variable mean increased by 7.2% over the pre-NHI survey, indicating that more women proportionally had their first pregnancy after 1995 under the NHI program. Many women in Taiwan now tend to delay marriage and have fewer babies, and to have them later in life.[24] These changes may also have brought about the dramatic increase in the birth order variable from 0.372 to 0.444 (where 1 indicates the first child), with very high standard deviations. Furthermore, firstborn infants are more likely to be fully vaccinated than their counterparts regardless of NHI implementation (68.7% vs 63.3% before NHI; 91.0% vs 84.5% after NHI).

Approximately 48.7% of women in the first (pre-NHI) survey reported giving birth in a hospital compared with 54% after NHI (a 5.3% increase). Hospital-born infants were less likely to receive complete immunization than those born elsewhere before NHI (63.0% vs 67.8%) but were more likely to receive it after NHI (89.0% vs 86.1%). Regardless of whether NHI was implemented, most of the infants receiving complete immunization were taken care of by grandparents—the next most common caretakers were parents and babysitters. There were no significant differences in the other variables such as gender and gestation period observed between the 2 surveys. We did find that infants who received well-baby care were less likely to be fully vaccinated in the pre-NHI period (63.7% vs 67.6%) than those in the post-NHI period (90.1% vs 85.0%).

Data reviewed for the mothers included age, level of education, and occupation. The likelihood of infants receiving complete immunization seemed to decrease with increasing maternal age. There was no apparent relationship between maternal education level

TABLE 2—Estimated Coverage for Selected Vaccinations and Vaccination Series Among Infants Aged 1 Year in Taiwan Before and After Implementation of National Health Insurance (NHI)

	Pre-NHI			Post-NHI		
Vaccination	No.	Mean	SD	No.	Mean	SD
BCG	1349	0.965	0.184	3173	0.997	0.059
Hep B						
Hep B_1	1369	0.979	0.143	3178	0.998	0.043
Hep B_2	1360	0.973	0.163	3175	0.997	0.053
Hep B_3	1353	0.968	0.177	3134	0.984	0.124
OPV						
OPV_1	...	...	...	3164	0.994	0.079
OPV_2	...	...	...	3131	0.983	0.128
OPV_3	...	...	...	3036	0.954	0.211
DTP [a]						
DTP_1	1343	0.967	0.194	3057	0.960	0.196
DTP_2	1376	0.984	0.124	3164	0.994	0.079
DTP_3	1300	0.930	0.255	3039	0.954	0.209
MV	970	0.694	0.461	2829	0.889	0.315
Complete vaccination series	1398	0.655	0.486	3185	0.877	0.330

Note. BCG = bacille Calmette–Guérin vaccine; Hep B = hepatitis B vaccine; OPV = oral polio vaccine; DTP = diphtheria-tetanus-pertussis; MV = measles vaccine.
[a]DTP included OPV before NHI.

and complete immunization of the child before NHI. However, after NHI, highly educated mothers were more inclined to take their infants to receive complete immunization than were their counterparts. A mother's occupational status was not associated with any significant difference in childhood immunization use either before NHI or after NHI.

In terms of geographic distribution, most respondents (41%–45%) live in Taiwan's northern region, the most developed and populated area on the island. Approximately 7% live in Taiwan's sparsely populated, mountainous eastern region, with the remainder situated in the central/western and southern parts of the island. There were also no obvious variations in childhood immunization among different areas in either survey.

Logistic Regression Analyses

Table 4 shows the factors associated with immunization service used by 1-year-old infants in Taiwan and compares the estimated effects of sociodemographic characteristics on the probability of receiving the complete immunization series before and after NHI implementation. In addition to parameter estimates and *P* values for each variable in the analysis, a probability ratio for each independent variable is provided in columns 3 and 6.

Less than one fourth of independent variables were found to be significantly related to the probability of receiving a complete series of immunizations during either survey period. Only 2 variables, first-order birth and hospital delivery, show significant differences between the pre- and post-NHI surveys. Consistent with findings in other published reports, birth order (status as a firstborn child) positively influenced the completion of the vaccination series in both surveys. That firstborn children receive more vaccinations than their siblings is consistent with expectations, as a first-time mother is more likely to be nervous about the health of her child and to devote more time to child care activities.[26] The probability ratio for both periods (1.2978 and 1.6489) implies that, regardless of the NHI program, firstborn children were 1.5 times more likely to receive a complete series of vaccinations than their siblings.

The use of hospitals for the delivery coefficient in the 2 surveys is, as expected, significantly different, with the negative value in the first survey turning positive in the second. It is somewhat surprising that in the pre-NHI period, hospital delivery does not appear to be strongly significant at the $P=.01$ level but is very close to statistical significance at the $P=.05$ level. This suggests that infants born in hospitals before the implementation of NHI tended to receive fewer vaccinations than those not born in hospitals, whereas those born in hospitals after the implementation of NHI were more likely to be fully vaccinated than their non–hospital-born counterparts. This outcome reinforces our hypothesis that, because of NHI-induced policy changes, NHI has encouraged mothers of children born in hospitals to have their children receive the full series of recommended vaccinations.

Two other variables, babysitter as primary caregiver and government occupation of the mother, were significantly associated with the probability of receiving the suggested vaccinations before implementation of NHI, although these associations were not found after implementation of NHI. The negative value assigned to the babysitter coefficient indicates that infants who were cared for by babysitters were less likely to receive vaccinations than those taken care of by their parents. Moreover, children of government-employed mothers were more likely to be immunized than children of housewives. The explanation for why government employees were more likely to receive the complete series of vaccinations may be that mothers in public service positions have greater access to financial resources and information on immunization benefits.

Three variables—gestation period, use of well-baby care, and a parent's achievement of a college degree or better—were shown to significantly influence the probability of infants receiving immunizations during the post–NHI implementation period. Well-baby care had a particularly significant ($P=.001$) and positive effect, reinforcing the hypothesis that infants taken for well-baby care check-ups were more likely to receive the complete vaccination series.

In contrast to findings in previous studies of maternal and infant health care use,[24,26]

TABLE 3—Characteristics of the National Maternal and Infant Health Survey Sample Before and After Implementation of National Health Insurance (NHI): Taiwan, 1989 and 1996

	Pre-NHI (n = 1398)		Post-NHI (n = 3184)	
	Mean (SD)	%[a]	Mean (SD)	%[a]
Variables				
Infant's characteristics				
Gender	0.534 (0.50)		0.527 (0.50)	
Male		65.9		87.0
Female		65.0		88.5
Gestation period	0.971 (0.17)		0.936 (0.25)	
≥36 wk		65.4		88.0
<36 wk		65.9		82.4
Birth order	0.372 (0.48)		0.444 (0.50)	
First birth		68.7		91.0
Not first birth		63.6		84.5
Hospital birth	0.487 (0.50)		0.540 (0.50)	
Yes		63.0		89.0
No		67.8		86.1
Well-baby care use	0.539 (0.50)		0.550 (0.50)	
Yes		63.7		90.1
No		67.6		85.0
Primary caregiver				
Grandparents	0.225 (0.42)	68.3	0.285 (0.45)	89.3
Babysitter	0.114 (0.32)	59.4	0.142 (0.35)	86.3
Parents	0.661 (0.47)	65.6	0.573 (0.49)	87.2
Maternal characteristics				
Age, y				
<25	0.302 (0.46)	65.6	0.228 (0.42)	88.3
25–34	0.657 (0.47)	66.0	0.699 (0.46)	87.9
≥35	0.041 (0.20)	55.2	0.073 (0.26)	83.3
Education				
Primary school and below	0.157 (0.36)	61.8	0.046 (0.21)	81.4
Junior high	0.280 (0.45)	66.8	0.180 (0.38)	85.6
Senior high	0.423 (0.49)	68.0	0.528 (0.50)	88.2
Junior college	0.083 (0.28)	59.5	0.150 (0.36)	88.3
College and above	0.057 (0.23)	58.2	0.096 (0.30)	90.9
Occupation				
Housewife	0.617 (0.49)	63.9	0.396 (0.49)	86.3
Government	0.070 (0.26)	67.4	0.125 (0.33)	89.2
Laborer	0.137 (0.34)	70.0	0.208 (0.41)	88.1
Farmer	0.007 (0.08)	70.0	0.004 (0.06)	
100.0				
Businesswoman	0.112 (0.32)	67.5	0.203 (0.40)	88.5
Other	0.057 (0.23)	66.0	0.064 (0.25)	88.3
Geographic characteristics				
Central	0.275 (0.45)	68.3	0.250 (0.43)	88.1
South	0.250 (0.43)	62.6	0.226 (0.42)	86.7
East	0.064 (0.25)	72.2	0.077 (0.27)	86.0
North	0.410 (0.49)	64.2	0.448 (0.50)	88.2

[a] The percentage of the sample who have complete immunizations.

our study found no regional differences in the achievement of complete infant immunization either before or after NHI implementation.

DISCUSSION

Although a large difference in the rate of immunization coverage for children is recorded between the pre- and post-NHI periods, the factors we identified as significantly affecting the probability of receiving a complete series of immunizations in general did not change significantly between the 2 periods. Furthermore, most of the demographic characteristics used to describe infants and their mothers are found to have insignificant bearing on whether or not a child was fully vaccinated in either period. We identify birth order as the only variable having a consistent and strong impact on the probability of being fully vaccinated. In other words, first-time mothers are more likely to have their children receive the complete series of immunizations than mothers who have given birth previously. Our findings for Taiwan concur with findings from other countries.[10,11]

A hospital birth is 1 variable found to influence vaccine completion, although the effect was different in each of the 2 periods analyzed. The negative value of the coefficient during the pre-NHI period and the positive value after the implementation of NHI indicate a reduced probability of vaccination before implementation and a greater probability afterward. This finding supports a hypothesis that differences in practices across health facilities affect the probability that children will receive vaccinations. The NHI policy of including hospitals as immunization providers tends to facilitate access to immunization services for children born in those facilities, which appears to explain the coefficient value reversal described above.

Well-baby care use shows a strong positive correlation with the probability of being fully immunized in the post-NHI period but an insignificant correlation before the implementation of NHI. This indicates that, by providing free well-baby care through NHI, health planners have successfully stimulated the demand for immunization. Although all physicians were permitted to provide well-baby care before the implementation of NHI, they typi-

TABLE 4—Logistic Regression Analysis for Completion of Immunization in Infants Aged 1 Year in the National Maternal and Infant Health Survey Sample Before and After Implementation of National Health Insurance (NHI): Taiwan, 1989 and 1996

Variable	Pre-NHI[a]			Post-NHI[b]		
	Coefficient	*P* Value	Odds Ratio	Coefficient	*P* Value	Odds Ratio
Constant	0.4270	0.273	...	0.7512	0.024**	...
Infant's characteristics						
Gender	0.0340	0.768	1.0346	–0.1545	0.160	0.8568
Gestation period	–0.0747	0.827	0.9281	0.4814	0.015**	1.6183
Birth order	0.2607	0.044**	1.2978	0.5001	0.001***	1.6489
Hospital birth	–0.2405	0.054*	0.7863	0.2352	0.039**	1.2652
Well-baby care	–0.1367	0.257	0.8722	0.4169	0.001***	1.5172
Principal caregiver						
Grandparents	–0.0136	0.930	0.9865	0.2890	0.839	1.0293
Babysitter	–0.3831	0.048**	0.6817	–0.2677	0.122	0.7651
Maternal characteristics						
Age, y						
25–34	0.1687	0.217	1.1837	0.0356	0.803	1.0363
≥35	–0.1284	0.673	0.8795	–0.1867	0.408	0.8297
Education						
Junior high	0.2365	0.192	1.2669	0.2448	0.325	1.2774
Senior high	0.2800	0.105	1.3232	0.3760	0.110	1.4564
Junior college	–0.2284	0.381	0.7958	0.3368	0.224	1.4005
College and above	–0.2882	0.358	0.7496	0.6395	0.047**	1.8955
Occupation						
Government	0.6462	0.023**	1.9083	0.0454	0.824	1.0464
Laborer	0.2904	0.120	1.3369	0.1302	0.392	1.1390
Farmer[c]	0.3495	0.622	1.4184	...	...	...
Businesswoman	0.3339	0.101	1.3964	0.0144	0.932	1.0145
Other	0.2524	0.334	1.2871	–0.0026	0.992	0.9974
Geographic characteristics						
Central	0.1603	0.277	1.1739	–0.0144	0.918	0.9857
South	–0.1412	0.345	0.8683	–0.1033	0.465	0.9019
East	0.3129	0.228	1.3674	–0.1780	0.388	0.8369

[a]Log likelihood = –884.1923; LR $\chi^2(21) = 33.9$; Prob > $\chi^2 = .036$; pseudo $R^2 = .018$; n = 1398.
[b]Log likelihood = –1154.7057; LR $\chi^2(20) = 67.1$; Prob > $\chi^2 = .0001$; pseudo $R^2 = .028$; n = 3171.
[c]In the post-NHI period farmer ≠ 0 predicts success perfectly. The dummy variable-farmer was dropped and 13 observations were not used.
*$P < .1$; **$P < .05$; ***$P < .01$.

cally did not possess enough information about the recommended immunization schedule to encourage parent compliance. However, NHI's restriction of well-baby care to contracted family doctors and pediatricians has allowed the Bureau of National Health Insurance to target effectively information and recommendations with regard to vaccinations.

There are some potential limitations to this study. Because the coverage level for most vaccines (other than the measles vaccine) is very high (>93%) for both pre-NHI and post-NHI periods, whether or not an infant has received the measles vaccine is probably the strongest determinant of whether or not an infant has received the complete immunization series. The result may be that our findings of the logistic regression analysis are limited to those examined infants who received a measles vaccine. Another limitation stems from the 6-year time gap. Some changes regarding trends or factors independent of NHI may not have been captured and thus may have weakened the power to detect statistically significant differences in coverage between the pre-NHI and post-NHI periods.

In spite of these limitations, we reveal in this article that the policy of including hospitals in the immunization program and the free well-baby care program has had a major impact on immunization coverage. This should be reassuring news for the health authorities in Taiwan, because their efforts to promote immunization coverage are producing results. Taiwan's NHI well-baby care program has increased access to immunization programs for the nation's children by changing from regulating which facilities could administer immunizations to regulating which doctors could administer the immunizations. Before, a small percentage of the nation's 1-year-olds received largely incomplete immunizations at a few public facilities. Now, a significantly larger percentage of the nation's 1-year-olds are receiving a full course of immunizations at a much wider range of public and private health care facilities. This improvement was achieved by allowing better access to immunization programs and encouraging contracted family doctors and pediatricians to help the health authorities provide immunization to those children in need of it, by encouraging them to disseminate information and make recommendations with regard to available vaccination programs.

Taiwan's almost complete changeover in its provision of immunization services from the public to the private sector is somewhat unusual among developing countries. Its accomplishment can provide reassurance to other countries that, if they have growth in economic development similar to that of Taiwan (e.g., Latin America, other Asian-Pacific Economic Cooperation members), they may aspire to implement national health insurance someday. Moreover, they need not be overly concerned about the potential negative impact of NHI on otherwise well-run public health services–provided immunization services (e.g., via Expanded Program on Immunizations). ■

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Human Participant Protection

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