

How Do Physicians Immunize Their Own Children? Differences Among Pediatricians and Nonpediatricians

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ABSTRACT. *Context.* Immunization has an essential impact on public health worldwide. Numerous studies have shown the efficacy of different vaccines to protect individuals from various diseases. However, some parents choose not to vaccinate their children for reasons such as, among others, doubts regarding their usefulness, concerns over safety or efficacy, etc. Physicians are known to exert a direct influence on immunization rates by answering questions and clarifying misconceptions. Yet, it is unknown how they immunize their own children.

Objective. We sought to assess how physicians interested in vaccination issues immunized, or would immunize, their own children.

Design, Setting, and Participants. An 11-question, Web-based survey with a total of 102 discrete answers was sent to 2070 Swiss physicians in October 2004. All physicians were subscribers to a nonprofit, Web-based expert network (InfoVac, www.infovac.ch) that distributes monthly newsletters and answers question within 2 days on immunization issues. The InfoVac network reaches >95% of pediatricians in Switzerland but <20% of general practitioners. All responses were anonymous, and no identifier could be used to trace the participants of the survey. Questions were divided into 2 parts: (1) physicians who were parents were asked which vaccines they

gave to their own children and at what age, and (2) all physicians were asked which vaccines they would give to their own child and at what age if they had a newborn child in 2004. Vaccines available in Switzerland at the time of the survey were offered as possible replies, and recommended vaccines were considered as those noted in the Swiss federal immunization schedule issued yearly. One question compared their immunization practice between their own children and their patients. Sociodemographics, qualifying year, membership in different professional groups, and their type of practice were also requested.

Statistics. Standard descriptive statistics were used for sociodemographic characteristics. Univariate statistical analyses were performed for each variable to determine its relationship to the dependent variable, being a pediatrician or nonpediatrician. Logistic-regression analysis was used to calculate the adjusted odds ratios (ORs) and 95% confidence intervals (CIs), controlling for any statistically significant demographic variables that might function as confounders (gender, parenthood, workplace, year of diploma, and type of practice). For all statistical tests, differences were considered significant at $P < .05$.

Main Outcome Measure. We performed a comparison of past and projected immunization rates in the children of pediatricians and nonpediatricians.

Results. One thousand seventeen valid questionnaires were received (response rate: 49.1%; pediatricians: 53.3%). Nine hundred fifteen physicians (90%) had ≥ 1 child. All physicians reported immunizing children in their practice. Pediatricians were more likely to be women and to work in private practice than nonpediatricians but less likely to belong to a self-reported alternative medicine association. Among the nonpediatricians, 317 were general practitioners, 144 were internists, and 95 were other specialists. Ninety-two percent of pediatricians followed the official immunization recommendations for their own children. In contrast, after controlling for gender, workplace, type of practice, and year of diploma, nonpediatricians were more likely not to have immunized their children against measles, mumps, hepatitis B, or *Haemophilus influenzae* type b. They more frequently postponed diphtheria-tetanus-pertussis (DTP) (OR: 4.5; 95% CI: 2.0–10.19) and measles-mumps-rubella (MMR) vaccination. Although projected immunization rates were higher than effective rates, 10% of nonpediatricians would still not follow the official immunization recommendations in 2004. They would more frequently refrain from using combination vaccines and postpone DTP and MMR immunization to later in life. Several comparisons confirmed the weaker use of the more recently licensed vaccines by nonpediatricians. In addition to vaccines currently recommended in Switzerland, both groups of physicians added hepatitis A, influenza, and varicella vaccines to the vaccination

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schedule of their own children. Pediatricians were more likely to give pneumococcal (OR: 2.26; 95% CI: 1.004–4.68) and meningococcal C (OR: 2.26; 95% CI: 1.62–3.17) vaccines to their own children. In contrast, they were less likely to give tick-borne encephalitis virus vaccine (OR: 0.65; 95% CI: 0.44–0.95).

Conclusions. Ninety-three percent of the surveyed physicians agree with the current official vaccination recommendations and would apply them to their own children. However, the observation that 5% of nonpediatricians would not use *Haemophilus influenzae* type b vaccine if they had a child born in 2004 is unexpected and concerning. In contrast, both groups gave additional vaccines than those recommended to their own children. Among physicians in Switzerland interested in immunization, a significant proportion of nonpediatricians decline or delay the immunization of their own children with the recommended MMR- or DTP-based combination vaccines, which indicates that clarification of misconceptions such as fear of “immune overload” has not yet reached important targets among health care providers who thus are unlikely to answer parental concerns adequately. *Pediatrics* 2005;116:e623–e633. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2005-0885; immunization, immunization schedule, health survey, children, recommendations, physician's role, Switzerland, measles-mumps-rubella vaccine, questionnaire, hepatitis B vaccine, diphtheria-tetanus-pertussis vaccine, safety, administration, vaccination, vaccines, guideline adherence, multivariate analysis.

ABBREVIATIONS. OR, odds ratio; CI, confidence interval; Hib, *Haemophilus influenzae* type b; TBE, tick-borne encephalitis virus; DTP, diphtheria-tetanus-pertussis; DTaP, diphtheria-tetanus-acellular pertussis; MMR, measles-mumps-rubella; IPV, inactivated polio virus vaccine; BCG, bacillus Calmette-Guerin.

Immunization has an essential impact on public health worldwide.¹ Numerous studies have shown the efficacy of different vaccines to protect children and adults from various bacterial and viral infections, and several diseases have been either eradicated or significantly reduced in many countries thanks to universal immunization.² Nevertheless, a number of individuals (including parents deciding for their children) do not take advantage of this preventive measure for different reasons such as doubts regarding their usefulness, concerns over safety or efficacy, philosophical or religious opinions, or vaccine cost.^{3–7} It is well known that health care providers can influence the rates of immunization by answering parents' questions and addressing misconceptions.^{8,9} It is also recognized that physicians can act as role models.¹⁰ Personal experience with the disease and the vaccine can have a powerful impact on how convincing the physician seems to the parents.^{11,12} However, even health care providers can sometimes have misleading beliefs about immunization and send an unclear message to parents.^{4,13} This becomes a crucial issue in countries in which parental demands and concerns have increased to a level that compromises the success of immunization programs. This problem is illustrated best by the persistent insufficient vaccine coverage against measles leading to continual large outbreaks in several

Western European countries including Switzerland.^{14–18}

Our study therefore aimed at interviewing physicians to evaluate how they have immunized, or would immunize, their own children and what kind of role models they provide to parents regarding immunization.

DESIGN, SETTING, AND PARTICIPANTS

A Web-based questionnaire (Fig 1) was sent to 2070 Swiss physicians in October 2004. The list of participants' e-mail addresses was generated from the list of subscribers to InfoVac¹⁹ (www.infovac.ch), a nonprofit Web-based expert network that distributes monthly newsletters to physicians in Switzerland and answers physicians' questions on immunization issues within 24 to 48 hours. This newsletter reaches >95% of pediatricians in Switzerland, who are automatically registered at no cost, but only a minority (<20%) of general practitioners and interested physicians subscribe (for a yearly fee of \$20 US). All responses were anonymous, and no identifier could be used to trace the participants of the survey. Therefore, 1 e-mail reminder was sent 3 weeks later to encourage participation. The 11-question survey instrument, with a total of 102 discrete answers, was presented on 1 single screen to keep transmission time short and possible loss of information resulting from connection problems to a minimum. Questions were divided into 2 parts: in the first part, parent physicians were asked which vaccines (individual and combination vaccines) they gave to their children and at what age or which vaccines they chose not to administer; in the second part, they were asked which vaccines they would or would not give and at what age if they had a newborn child in 2004. One question compared their immunization practice between their own children and their patients (Fig 1, question 6). Vaccines available in Switzerland at the time of the survey were offered as possible replies, and recommended vaccines were considered as those noted in the in the Swiss federal immunization schedule²⁰ issued yearly. Open fields were included to allow free expression of the motivations behind the use or nonuse of each of the vaccines. Sociodemographics, qualifying year, membership in different professional groups, and type of practice were also asked for separately. All screens were designed to be easily read on a single screen, and check boxes provided answers for closed-ended questions. Text fields were available for answers to open-ended questions. All data were automatically transferred in a centralized database and did not have to be reentered. Published recommendations for designing Web-based surveys were followed.²¹

MAIN OUTCOME MEASURES

Sociodemographic characteristics of the participants are described by using standard descriptive statistics (frequencies and means and SDs). Comparisons of baseline demographic and immunization measures were performed by using χ^2 tests for categorical data or Fisher's exact test where appropriate. Univariate statistical analyses were performed for each variable to determine its relationship to the dependent variable, being a pediatrician or nonpediatrician. Logistic-regression analysis was used to calculate adjusted odds ratios (ORs) and 95% confidence interval (CIs), controlling for any statistically significant demographic variables that might function as confounders (gender, parenthood, workplace, year of diploma, or type of practice).

For all statistical tests, differences were considered significant at $P < .05$ or when the 95% CI did not include 1.0. SPSS 12.0.1 (SPSS Inc, Chicago, IL) statistical software was used for analyses.

RESULTS

Questionnaires were sent by e-mail to 2070 Swiss physicians (including 860 pediatricians) registered with InfoVac. After a single e-mail reminder, 1017 valid questionnaires were received (response rate: 49.1%; pediatricians: 53.3%). Sixteen questionnaires were invalid and withdrawn: 1 was filled in by a nonphysician, 2 were duplicates, and 13 were empty surveys. Table 1 summarizes the participants' char-

How do physicians immunize their own children?

1. Do you have children ?

- No Please go directly to question 7!
- Yes
 - < 5 years old
 - 5-15 years old (several answers possible)
 - > 15 years old

2. Which vaccine(s) would you give to your **own** children? (several answers possible)

- B.C.G.
- Diphtheria
- Tetanos
- Pertussis
- Polio
- Hib
- Measles
- Rubella
- Mumps
- Hepatitis B
- Hepatitis A
- Pneumococcal
- Meningococcal C
- Varicella
- Tick-born encephalitis
- Flu
- Other vaccine(s)
 - 1.
 - 2.

3. Are there 2004 recommended vaccines that you **didn't want** give to your **own** children ? (several answers possible)

- I gave all vaccines that were available at that time
- I didn't give any recommended vaccines
- I didn't give tetanos because:
- I didn't give diphtheria because:
- I didn't give pertussis because:
- I didn't give combined DTP/DTaP because:
- I didn't give Hib because:
- I didn't give polio because:
- I didn't give measles because:
- I didn't give rubella because:
- I didn't give mumps because:
- I didn't give MMR because:
- I didn't give hepatitis B because:

4. Did you decide to postpone the first dose of **DTP/DTaP** of your **own** children? (several answers possible if different for each child)

- no, immunization between approximately 2 and 6 months
- yes, immunization between approximately 6 and 12 months
- yes, immunization between approximately 12 and 14 months
- yes, immunization > 24 months
- not immunized

Fig 1. InfoVac Web-based questionnaire.

acteristics. In general, the time since qualification or region of practice had no statistically significant effect on vaccine use. Nine hundred fifteen (90%) physicians had ≥ 1 children (24% younger than 5 years of age, 50% between 5 and 15 years, and 52% older than

15 years of age). Women were more likely to be pediatricians, and pediatricians worked more often in private practice than nonpediatricians. Pediatricians were also less likely to belong to a self-reported alternative medicine association (3.1% vs 7%; $P =$

5. Did you decide to postpone the first dose of **measles/MMR** of **your own children?** (several answers possible if different for each child)

- no, immunization between 12 and 24 months
- yes, immunization between 2 and 5 years
- yes, immunization between 5 and 10 years
- yes, immunization between 10 and 15 years
- yes, immunization > 15 years
- not immunized

6. Do you think that your **own children** have been immunized **differently** than children/patients in your own practice? (several answers possible)

- yes, my children received more vaccines
- yes, my children received less vaccines
- yes, my children have been immunized earlier
- yes, my children have been immunized later
- no, no difference

7. If you were a "new parent" in 2004, **which vaccines** would you give to **your own children?** (several answers possible)

- B.C.G.
- Diphtheria
- Tetanos
- Pertussis
- Polio
- Hib
- Measles
- Rubella
- Mumps
- Hepatitis B
- Hepatitis A
- Pneumococcal
- Meningococcal C
- Varicella
- Tick-born encephalitis
- Flu
- Other vaccine(s) 1.2.

8. If you were a "new parent" in 2004, **which combination vaccine** would you give to **your own children?** (several answers possible)

- DTaP
- DTaP-IPV
- DTaP-Hib
- DTaP-IPV/Hib
- Hexavalent
- MMR
- Hepatitis A/B
- no combination vaccine

9. If you were a "new parent" in 2004, **at what age** would you give **the first dose** of **DTaP** to **your own children?**

- 2-4 months
- 5-6 months
- 7-12 months
- > 12 months
- > 24 months
- not vaccinated

Fig 1. Continued.

10. If you were a "new parent" in 2004, **at what age** would you give the first **measles or MMR vaccine to your own children** ?

- < 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- > 15 years
- not vaccinated

11. If you were a "new parent" in 2004, are there any combination vaccines **recommended** by the Swiss vaccine schedule that you wouldn't give to your **own children** ? (*several answers possible*)

- I would give all recommended vaccines
- I wouldn't give any recommended vaccines
- no diphtheria vaccine because:
- no tetanus vaccine because:
- no pertussis vaccine because:
- no DTPa vaccine because:
- no polio vaccine because:
- no Hib vaccine because:
- no DTPa-IPV/Hib vaccine because:
- no hexavalent vaccine because:
- no measles vaccine because:
- no rubella vaccine because:
- no mumps vaccine because:
- no MMR vaccine because:
- no hepatitis B vaccine because:

To help us identify some factors that might influence the way physicians immunize their own children, please answer to the following questions :

You are : (*several answers possible*)

- a man
- a woman
- a pediatrician
- a general practitioner
- an internist
- another specialist

You finished your medical school :

- ≥ 2000
- between 1990-1999
- between 1980-1989
- between 1970-1979
- between 1960-1969
- < 1960

You live in _____ (list of cantons)
 You work in _____ (list of cantons)

You work : (*several answers possible*)

- in private practice
- at a hospital
- in public administration
- in school medicine
- in the pharmaceutical industry
- other professional area :

Fig 1. Continued.

Of which medical association are you a member : (several answers possible)

- SSP/SGP (Pediatric)
- Forum für Praxispädiatrie (Pediatric)
- SSMG/SGAM (general medicine)
- CMPR/KHM (primary care medicine)
- SSMI/SGIM (internal medicine)
- SSI/SGInf (infectiology)
- Alternative medicine association

Where do you find information concerning immunization in your daily practice (1 to 5, 1 being the most useful) :

- documents of the Swiss Federal Office of Public Health
 - documents of Forum für Praxispädiatrie
 - documents prepared by the pharmaceutical industry
 - documents distributed by Infovac
 - other documents
- (such as :)

We thank you for your participation and look forward to sharing the results with you.

Your InfoVac experts

Fig 1. Continued.

.027; OR: 0.473; 95% CI: 0.24–0.92). Nonpediatricians were more likely to have graduated a longer time ago, to have children, and to be from the German-speaking part of Switzerland. Among the nonpediatricians, there were 317 general practitioners, 144 internists, and 95 other specialists. All physicians reported immunizing children in their practice.

Overall, immunization rates reported by physicians for their own children were very high. This was true for all vaccines but was especially striking in

immunization rates for measles (95.7%), rubella (95.1%), and mumps (93.8%). When asking pediatrician parents ($n = 392$) which individual recommended vaccines they gave to their own children (Table 2), they were more likely to have given *Haemophilus influenzae* type b (Hib) (OR: 1.5; 95% CI: 1.001–2.14), measles (OR: 3.1; 95% CI: 1.3–7.2), mumps (OR: 1.97; 95% CI: 1.05–3.7), and hepatitis B (OR: 1.48; 95% CI: 1.07–2.05) vaccines than nonpediatrician physician parents ($n = 523$). They were also

TABLE 1. Characteristics of Participating Physicians ($n = 1017$)

Characteristic	Pediatricians ($n = 458$), %	Nonpediatricians ($n = 559$), %	Statistics		
			χ^2	<i>df</i>	<i>P</i>
Gender					
Female	42.6	26.1	27.43	1	<.001
Have children	85.6	93.6	17.72	1	<.001
<5 y old	22.7	21.1	NS		
5–15 y old	42.4	46.3	NS		
>15 y old	41.7	50.8	8.38	1	.004
Type of activity*					
Private practice	56	48.9	37.85	5	<.001
Hospital	19.7	11.4			
Administration	1.1	3.6			
School health service	21.9	31			
Industry	0.7	2.5			
Other	0.7	2.5			
Year of medical diploma†					
>2000	1.4	0.3	29.59	5	<.001
1990–1999	13.2	12.1			
1980–1989	14.4	22.6			
1970–1979	12.5	17.3			
1960–1969	3.6	2.2			
<1960	0.4	0.2			
Region of practice‡					
French-speaking part	34.6	28	9.30	2	.01
German-speaking part	59.1	68.1			
Italian-speaking part	6.3	3.9			

NS indicates not significant.

* Thirteen were not available.

† Seven were not available.

‡ Thirty-three were not available.

more likely to have given all recommended vaccines to their own child (OR: 2.19; 95% CI: 1.368–3.5). The comparatively lower use of Hib vaccine essentially reflected its more recent availability, because it was given to 97.3% of children <5 years old. Similarly, hepatitis B is currently recommended at 11 to 15 years of age in Switzerland, which is reflected in a significantly higher (84.8%) vaccine use by physician parents of children >15 years old.

In addition to the vaccines currently recommended in Switzerland, both groups of physicians frequently added hepatitis A, influenza, and varicella vaccines to the vaccination schedule of their own children (Table 2). Pediatrician parents were more likely to have given pneumococcal (OR: 2.17; 95% CI: 1.004–4.68) and meningococcal C (OR: 2.26; 95% CI: 1.62–3.17) vaccines to their own children. In contrast, they were less likely to have given tick-borne encephalitis virus (TBE) vaccine than nonpediatrician parents (OR: 0.65; 95% CI: 0.44–0.95).

When asked about timing of immunization, nonpediatrician parents were 4.5 times more likely to not

have administered the first dose of diphtheria-tetanus-pertussis (DTP) or diphtheria-tetanus-acellular pertussis (DTaP) combination vaccine at the recommended age of 2 to 6 months (OR: 4.5; 95% CI: 2.0–10.19). In fact, they were more likely to have given the first dose of this vaccine between 6 and 12 months of age. This remained true when looking only at parents of children younger than 5 years of age (OR: 13.27; 95% CI: 1.59–110.8). More pediatrician parents gave the measles-mumps-rubella (MMR) vaccine at the recommended schedule than nonpediatrician parents (OR: 2.78; 95% CI: 1.64–4.69). A statistically significant number of nonpediatricians (4.8%) didn't give the MMR vaccine at all to their own children. In general, pediatricians were more likely to immunize their own children than their patients (OR: 1.55; 95% CI: 1.11–2.15) and tended to immunize at an earlier age compared with nonpediatrician parents ($P = .051$; OR: 2.766; 95% CI: 0.994–7.697), whereas nonpediatrician parents were more likely to give exactly the same vaccines and in

TABLE 2. Own Children's Vaccination in Pediatricians Versus Nonpediatricians, Controlling for Demographics ($n = 915$)

	Pediatricians ($n = 392$), %	Nonpediatricians ($n = 523$), %	<i>P</i>	Adjusted OR*	95% CI
Individual vaccines					
Recommended vaccines in Switzerland					
Diphtheria	100	99.4	NS		
Tetanus	100	99.6	NS		
Pertussis	98.7	96.9	NS		
Polio	99.2	99.4	NS		
Hib	71.4	68.8	.05	1.46	1.001–2.14
Measles	97.4	94.5	.009	3.09	1.33–7.17
Mumps	95.2	92.7	.035	1.97	1.05–3.69
Rubella	95.7	94.6	NS		
Hepatitis B	68.1	64.6	.019	1.48	1.07–2.05
Additional vaccines					
Hepatitis A	48.5	46.5	NS		
Meningococcus C	31.9	18.4	<.001	2.26	1.62–3.17
TBE	14.8	24.5	.025	0.65	0.44–0.95
Influenza	12.8	14.3	NS		
Pneumococcus	5.1	2.9	.049	2.17	1.004–4.68
Varicella	3.1	3.6	NS		
Combination vaccines					
DTP between 2 and 6 mo†	97.4	91.4	<.001	4.51	2.0–10.19
DTP between 6 and 12 mo†	1.5	4.8	.022	0.31	0.11–0.84
MMR between 12 and 24 mo†	93.6	85.7	<.001	2.77	1.64–4.69
MMR not given	0.8	4.8	.002	0.14	0.04–0.51
In general					
All recommended vaccines	91.6	85.1	.001	2.19	1.37–3.49
More vaccines than recommended	28.8	21	.009	1.55	1.11–2.15
Earlier vaccination than recommended	3.1	1.3	.051‡	2.77	0.99–7.69
No difference in timing of vaccination	65.8	72.1	.041	0.73	0.53–0.99

NS indicates not significant

* Controlling for gender, workplace, year of diploma, and type of practice.

† First dose.

‡ Not statistically significant.

the same time frame to their own children as to their patients.

When asked which recommended vaccines they would give if they had a young child in 2004, 93.2% of the physicians agreed that they would follow the current Swiss vaccination recommendations (Table 3). Projected immunization rates were generally higher than effective rates (Table 2). This was especially noticeable in vaccines against Hib (97.8%), hepatitis B (94.8%), measles (98.5%), rubella (97.9%), and mumps (97%). There were marked differences between pediatricians and nonpediatricians: pediatricians were more likely to give Hib and hepatitis B vaccines than nonpediatricians (OR: 3.78 and 1.92, respectively, after controlling for demographics). More than 94% of all respondents agreed with using combination vaccines such as DTaP-inactivated polio vaccine (IPV)-Hib and MMR, for their child in 2004. Pediatricians were more likely to give pentavalent (DTaP-IPV-Hib), hexavalent (DTaP-IPV-Hib-Hepatitis B), and MMR combination vaccines than nonpediatricians (OR: 3.86, 1.96, and 2.81, respectively). They would also give the first doses of DTaP and MMR vaccines at a younger age ($P = .001$ and $P < .001$, respectively) than nonpediatricians. Although 93.2% of all physicians agreed with following the recommendations for vaccinating their own child, nonpediatricians were twice as likely as pediatricians to deviate, for their own child, from the recommended schedule (OR: 2.02; 95% CI: 1.16–3.53). Ad-

ditional vaccines were also selected frequently by physicians in 2004 (Table 3). Pediatricians would be more likely to protect their children with pneumococcal and meningococcal C (OR: 3.04 and 2.16, respectively) vaccines. However, they would be less likely to give the bacillus Calmette-Guerin (BCG) and TBE vaccines than nonpediatricians (OR: 0.39 and 0.53, respectively).

CONCLUSIONS

Little is known about the immunization practices of physicians regarding their own children.²² The results of this study suggest that although 93% of the surveyed physicians agree with current official vaccination recommendations and would apply them to their own children, this opinion is not shared by a significant proportion of nonpediatricians who were twice as likely not to have followed (and, hypothetically, not to follow in 2004) the official recommendations for their own children.

DTP-polio-immunization rates were remarkably high in children of both groups of physicians. In contrast, Hib coverage was significantly lower. This reflected in part its more recent availability (1990), because 97.3% of the physicians with children <5 years old had protected their children against Hib. However, the observation that 5% of nonpediatricians would not use the Hib vaccine if they had a child born in 2004 is unexpected, given the severity of the disease, the high efficacy and safety of Hib

TABLE 3. Projected Vaccination of Own Children in 2004: Pediatricians Versus Nonpediatricians, Controlling for Demographics ($n = 1017$)

	Pediatricians ($n = 458$), %	Nonpediatricians ($n = 559$), %	<i>P</i>	OR	95% CI
Individual vaccines					
Recommended vaccines in Switzerland					
Diphtheria	99.6	97.7	NS		
Tetanus	99.6	98	NS		
Pertussis	99.1	96.6	NS		
Polio	98.9	97.9	NS		
Hib	98.7	95.2	.013	3.78	1.33–10.76
Measles	98.7	96.4	NS		
Mumps	96.5	95.5	NS		
Rubella	98	95.9	NS		
Hepatitis B	95.9	92.1	.040	1.92	1.03–3.59
Additional vaccines					
Hepatitis A	48	47	NS		
Meningococcus C	40.8	25.2	<.001	2.16	1.61–2.89
TBE	11.4	20.8	.001	0.52	0.36–0.78
Pneumococcus	18.3	7.2	<.001	3.04	1.93–4.79
Varicella	9.2	12.5	NS		
Influenza	8.7	10.4	NS		
BCG	3.7	5.9	.009	0.39	0.19–0.79
Combination vaccines					
DTaP-IPV-Hib	98.3	94.1	.003	3.86	1.59–9.4
Hexavalent	44.8	30.4	<.001	1.96	1.48–2.59
MMR	97.6	94.1	.014	2.81	1.24–6.41
DTP between 2 and 4 mo*	98.2	91.4	<.001	2.11	1.55–2.87
MMR before 2 y*	95.6	84.6	<.001	2.27	1.66–3.12
In general					
All 2004 recommended vaccines	94.8	90.2	.013	2.02	1.16–3.53

Gender, parenthood, workplace, year of diploma, and type of practice were controlled for. NS indicates not significant; hexavalent, DTaP-polio-Hib-hepatitis B combination vaccine.

* First doses.

vaccines, and the availability of DTaP-IPV/Hib pentavalent combination vaccines, which prevents an additional shot. This observation is supported by the fact that only 94.1% of nonpediatricians (compared with 98.3% of pediatricians) would use a pentavalent vaccine for their own children in 2004. Reasons evoked by physicians declining the use of Hib vaccines for their own children included lack of awareness ("no invasive Hib disease seen in 25 years of private practice") but also reflected a subjective relative-risk analysis led by the desire to reduce vaccines to a minimum ("risk currently minimal in my area") (Table 4). It is fortunate that a 4-dose Hib-immunization schedule induces efficient herd immunity in Switzerland and elsewhere.²³

Hepatitis B immunization was introduced into the Swiss immunization schedule in 1998 and is currently officially recommended at 11 to 15 years of age, and hepatitis B immunization containing hexavalent infant vaccines was introduced as an alternative in 2001. Only a minority (30.4%) of nonpediatricians would use such a hexavalent combination vaccine for their children in 2004. However, 94.8% of physicians would immunize their own children against hepatitis B in 2004, which is significantly higher than the median national immunization rate (52%) recorded in 2003.²⁴

In contrast, observed and projected rates of MMR immunization by nonpediatricians are of concern. Although acceptance rates are much higher than in the general population (84%),^{25,26} almost 5% of physicians in this survey did not use the MMR vaccine and would not give it to their own children in 2004. The main reasons evoked by this minority of physicians include the wish to avoid trivalent combined vaccines because of safety concerns, the preference for infection-driven rather than vaccine-induced immunity, and the conviction that homeopathic treatment allows a benign outcome of measles, mumps, and rubella. These are frequent beliefs in the general population and that they are supported by physicians who adhere to alternative medicine concepts is not unexpected.^{27,28} The impact of misconceptions regarding MMR vaccines can be appreciated by the

recent autism–MMR-vaccine controversy, which led to a decrease in MMR-immunization levels in the United Kingdom.^{18,29–31} It therefore represents a significant threat to the World Health Organization's program to eliminate measles from the European region and may predict the persistent circulation of the measles virus and consecutive outbreaks.^{15–17,32} Indeed, herd immunity is thought to succeed in the control of measles only when immunization levels are >93% to 95%.³³

The belief that immunization may be initiated "too early" is also a frequent parental concern fueled by theoretical issues such as immune overload.^{3,34,35} Again, almost 10% of nonpediatricians indicated that they would initiate DTaP immunization beyond the age of 4 to 6 months and 15% would not give the first dose of measles or MMR vaccine before 2 years of age, thus contributing to the maintenance of a reservoir of susceptible nonimmune young children.

A contrasting observation of this survey was the relatively frequent use of additional vaccines that physicians chose for their own children despite the lack of reimbursement. The use of hepatitis A vaccine was similar in both groups of parent physicians, probably reflecting similar travel attitudes. Pediatricians were much more likely to offer additional vaccines to their children than nonpediatricians. This was most marked for the pneumococcal conjugate vaccine, currently only recommended for high-risk groups in Switzerland, and the group C meningococcal conjugate vaccine, which possibly reflects the greater experience of pediatricians with serious outcomes of the diseases caused by these organisms and/or their greater access to information and training opportunities on these recently available vaccines.^{36–38} The observation that nonpediatricians were 3 times more likely to select the BCG vaccine for a newborn child in 2004 despite its withdrawal from the Swiss routine-immunization schedule in 1987 indirectly suggests the importance of continuous education in vaccine-related issues. In contrast, immunization against TBE was selected twice as often by nonpediatricians, which might reflect the fact that immunization against TBE is recommended in

TABLE 4. Main Physicians' Reasons for Withholding Immunization in this Survey

Vaccine	Reasons for Withholding
Overall	"immune system not ready"; "immune overload"
Diphtheria	"not necessary, risk currently minimal in Switzerland"
Pertussis	"not useful, illness usually not severe"
	"vaccine linked with side effects"
Polio	"only useful when travelling: no travel, no vaccine"
Hib	"no invasive Hib disease seen in 25 years of private practice"
Hexavalent combination	"not clear if linked with severe side effects"
	"I am afraid of side effects"
	"no experience with it"
MMR	"vaccine more harmful than disease"
	"vaccine useless at young age: should be given later"
	"luxury vaccine: diseases mild"
	"only necessary in girls/women"
	"homeopathic treatment prevents disease"
Hepatitis B	"only to teenagers"
	"not sure the vaccine works"
	"only to 'at-risk' groups"
	"risk of side effects such as multiple sclerosis"

Switzerland for adults and children >6 years of age living in endemic areas, and general practitioners or internists are more used to its administration than pediatricians.

Our results must be interpreted in the context of several methodologic limitations. The Web-based survey was pilot tested for usability but not validated for reliability or external validity. The first part of this survey might have been influenced by a recollection bias, because physicians were asked to remember which vaccines were given to their own children, sometimes several decades before. However, the second part explored how physicians, hypothetically, would immunize their children if born in 2004 (ie, at the time of the survey). Here, a response-effect bias is possible but unlikely because there are no "right" answers. Self-reported evaluations by physicians have already been used successfully in other areas.³⁹ Recruiting subscribers to InfoVac, a nonprofit Web-based expert group on immunization issues, and the 50% response rate introduces several obvious biases. Although the survey reached >95% of the pediatricians, the proportion of nonpediatricians was much more limited. It is most likely that subscribers to the InfoVac services, and among them survey participants, are more directly interested in immunization issues, such that our results cannot be generalized to all physicians. This is especially true for nonpediatricians who have to actively register with InfoVac. Thus, the differences observed between pediatricians and nonpediatricians answering this survey are of primary importance, because both groups are particularly interested in vaccination issues. The observation that significantly lower immunization rates were indicated by nonpediatrician parents is of concern: vaccine use could be even lower for nonpediatrician physicians who were not reached by this survey, increasing the difference between pediatricians and nonpediatricians even further.

In conclusion, 95% of pediatricians practicing in Switzerland immunize, or would immunize, their children according to recommended schedules and vaccines. They give at least as many vaccines to their own child as to their patients (and frequently many more), immunize as early as recommended, and also make a comprehensive use of the most recent combination vaccines. In contrast, a relatively large proportion of nonpediatricians do not follow, nor plan to follow, current immunization recommendations for their own children. Despite their scientific training and education, they express the same concerns as those that prevail in the public. Although this survey cannot establish the effectiveness of Swiss physicians as role models for immunization, it is known that convinced physicians are more apt to provide their patients with vaccines that they believe to be beneficial.^{40–43} Thus, unless additional vaccine education and information efforts targeted toward these physicians eventually prove successful, the control of communicable diseases such as measles may prove impossible in Switzerland and other countries.

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