Pediatricians' perceptions of vaccine effectiveness and safety are significant predictors of vaccine administration in India

Lisa M. Gargano^{a,*}, Naveen Thacker^b, Panna Choudhury^b, Paul S. Weiss^c, Rebecca M. Russ^a, Karen Pazol^a, Manisha Arora^d, Walter A. Orenstein^a, Saad B. Omer^c and James M. Hughes^a

^aEmory University, School of Medicine, 1462 Clifton Road NE, Room 446, Atlanta, GA 30322, USA; ^bIndian Academy of Pediatrics (IAP), Kailash Darshan, Kennedy Bridge, Mumbai 400-007, India; ^cEmory University, Rollins School of Public Health, 1518 Clifton Road, Atlanta, GA 30322, USA; ^dSt. Stephen's Hospital, New Delhi, India

*Corresponding author: Tel: +1 404 712 2225; Fax: +1 404 712 2557; E-mail: lgargan@emory.edu

Received 2 November 2012; revised 2 April 2013; accepted 15 April 2013

Background: New vaccine introduction is important to decrease morbidity and mortality in India. The goal of this study was to identify perceptions that are associated with administration of four selected vaccines for prevention of Japanese encephalitis (JE), typhoid fever, influenza and human papillomavirus (HPV) infection.

Methods: A random sample of 785 pediatricians from a national list of Indian Academy of Pediatrics members was selected for a survey to assess perceptions of vaccine effectiveness and safety, and vaccine administration practices. Logistic regression was used to assess factors associated with selective or routine use.

Results: Pediatricians reported administering typhoid (91.6%), influenza (60.1%), HPV (46.0%) and JE (41.9%) vaccines selectively or routinely. Pediatricians who perceived the vaccine to be safe were significantly more likely to report administration of JE (OR 2.6, 95% CI 1.3 to 5.3), influenza (OR 4.3, 95% CI 2.0 to 9.6) and HPV vaccine (OR 6.2, 95% CI 3.1 to 12.7). Pediatricians who perceived the vaccine to be effective were significantly more likely to report administration of JE (OR 3.3, 95% CI 1.6 to 6.5), influenza (OR 7.7, 95% CI 2.5 to 23.1) and HPV vaccine (OR 3.2, 95% CI 1.6 to 6.4).

Conclusion: Understanding the role perceptions play provides an opportunity to design strategies to build support for vaccine use.

Keywords: India, Japanese encephalitis vaccine, Typhoid vaccine, Influenza vaccine, Human papillomavirus vaccine

Introduction

Japanese encephalitis (JE), typhoid fever, seasonal influenza and human papillomavirus (HPV) represent four important infections that contribute to morbidity and mortality in India. In 2011, 8247 cases of JE in India were reported to WHO.¹ Nevertheless, these figures likely underestimate the true incidence of JE as most infection is commonly asymptomatic or results in a mild illness, and surveillance is often insensitive and fails to account for patients who do not present to the hospital and those patients with milder illness or atypical presentations.² Though surveillance data are limited, the incidence of typhoid fever in India has been cited as ranging from 500–600 cases/100 000 persons per year.³ In India and Bangladesh, the highest incidence is seen among children less than 5 years of age, with a rate of 27.3 per 1000 person-years.⁴ Though influenza surveillance data in India are limited, data from Bangladesh suggests that among children under 5 years of age, the incidence of influenza-associated respiratory

infections is 10 per 100 person-years.⁵ In terms of mortality, over 400 000 children under 5 years die of pneumonia each year in India and an estimated 6.5% of these deaths are related to influenza.⁶ HPV infection is found in 98% of all cervical cancer cases in India.⁷ Currently, there are 366.6 million Indian women aged 15 years and older who are at risk of contracting HPV.⁸ Each year, a reported 72 825 Indian women die of cervical cancer.⁸

Given the absence of a treatment for JE, the threat of antibiotic resistance to treatment of typhoid fever, the high prevalence and disease burden of influenza, and the low rate of cervical cancer screening, immunization is the cornerstone of control of these infectious diseases in India.^{9,10} Currently none of the vaccines available against these diseases are part of the government's Universal Immunization Program (UIP), but they are available for use in the private sector. As a consequence, patients usually learn about these vaccines from their family physician or pediatrician. The overwhelming majority of studies on acceptability of new vaccines among physicians have been carried out in developed

countries. When physicians were asked to rate the most important features of a vaccine, responses included high levels of efficacy and safety.^{11–21}

In light of the multiple barriers to vaccine introduction, Indian healthcare provider confidence in the efficacy and safety of these vaccines is critically important. Pediatricians are influential opinion leaders at the national and state levels and also have an important voice in local communities. The Indian Academy of Pediatrics (IAP; <http://www.iapindia.org/>) is the only national professional organization of pediatricians in India with over 20 000 members from different subspecialties in the field of pediatrics. Pediatricians work mostly in the private sector and provide care mostly to the middle class and affluent segments of the society, primarily in urban areas. The roles of pediatricians are important in childhood immunization as they regularly interact with immunization policy makers. As policy makers try to understand better how to optimize uptake of new vaccines, it will be critical to know whether physicians have confidence in the vaccines. The objectives of this study were to (1) assess the frequency of administration of the four vaccines by pediatricians; (2) measure the perceptions of the pediatricians; (3) assess predictors of and barriers to vaccine administration and (4) describe pediatricians' perceptions of vaccine safety and effectiveness and their relationship to administration of vaccines.

Methods

Study design

This was a cross-sectional survey of pediatricians who are members of IAP. A sample of pediatricians was selected from a national member database maintained by the IAP.

Study sample

Detailed survey methods have been described elsewhere.¹¹ Briefly, a dual-frame simple random sample of 785 participants was selected from a national list of members provided by the IAP, weighted towards Uttar Pradesh and Bihar, two large states with relatively low childhood immunization rates. With a 50% response rate, this sampling scheme allowed us to estimate true population proportions with an error of $\pm 8\%$ in Bihar and Uttar Pradesh and $\pm 10\%$ on a national level.

Data collection

Instrument

Survey items were guided by the Health Belief Model, which holds that a belief in a threat together with belief in the effectiveness of the proposed behavior will predict the likelihood of that behavior.²² The survey instrument was designed to assess attitudes about vaccine safety and effectiveness, barriers to immunization, and immunization practices. Based on focus group discussions and pilot studies, the questions were based on a three-point Likert scale. The instrument was administered in English.

Formative research

Focus group sessions were designed to assess the general intelligibility of questions and usability of data to be obtained from the surveys. Verbal consent was obtained to avoid the need to retain

individual identifiers. The survey instrument developed from the focus groups was pilot-tested prior to implementation.

Measures

Attitudes: the survey assessed the following attitudes toward and beliefs about the vaccines and the protection vaccines provide. The questionnaire addressed 'perceived vaccine effectiveness': how protective do you think each of these vaccines is against disease? (protective, somewhat protective, not very protective) and 'perceived vaccine safety': how safe do you think these vaccines are? (safe, neither safe nor unsafe, unsafe).

Barriers: the question assessing barriers to immunization was 'How important are the following barriers for pediatricians to getting children vaccinated?' (important, neither important nor unimportant, not very important).

Practices: the questions assessing immunization practices included 'How often do you use the following vaccines?' (routinely, selectively, not at all).

Surveys

Participants were surveyed either by telephone or by mail. Persons in both groups received a letter signed by the IAP president thanking them for their participation. Verbal consent was obtained prior to administration of the survey. The study period was June 2009 to June 2010.

Data analysis

Data management and analysis was conducted using SAS version 9.2. Mail and telephone survey responses from pediatricians were combined. Responses to Likert scale questions were dichotomized into two categories: (1) protective or safe versus (2) somewhat protective and not very protective or neither safe nor unsafe and unsafe. Descriptive analyses using sampling weights were performed to evaluate the frequency of vaccine administration and to measure perceptions of the pediatricians. Logistic regression, adjusting for missing values and weights for each variable were used to assess perceptions that predicted vaccine administration. The primary outcome was routine or selective administration. Since many of these vaccines have only been recently introduced in India, the proportion of pediatricians routinely administering most of them is low, reducing the power of the analysis if routine administration alone was the primary outcome. The OR, 95% CI and χ^2 p-values (significant at $\alpha \leq 0.05$) are reported for logistic regression analysis.

Results

Response characteristics

The national survey of pediatricians had a total of 398 (51%) of 785 surveys completed. In Uttar Pradesh, 275 pediatricians were invited and 125 participated (45.5%); in Bihar, 230 were invited and 113 participated (49.1%).

Barriers for pediatricians to getting children vaccinated

When pediatricians were asked about barriers they faced to getting children vaccinated, 76.5% (308/394) reported parents' inability to

pay as an important barrier. However, only 29.9% (133/394) reported that inadequate financial compensation for physicians providing vaccines as a barrier.

Administration of JE, typhoid, influenza and HPV vaccine

Only 3.6% of pediatricians reported routine use of JE vaccine, whereas 51.7% did not administer it at all. However, 51.2% of pediatricians reported routine administration of the Vi polysaccharide typhoid vaccine, with only 6.3% reporting not using it at all. For the influenza vaccine, only 9.7% reported administering it routinely with 33.9% not using it at all. Pediatricians reported the lowest routine use with HPV vaccine at 3.1%, with 46.0% not using HPV vaccine at all (Table 1).

Perceived vaccine safety and effectiveness of JE, typhoid, influenza and HPV vaccine

For vaccine safety, the highest percentage of pediatricians (88.2%) reported that typhoid vaccine was safe compared with 71.7% for influenza and 55.3% for JE vaccine. The lowest percentage of pediatricians (54.8%) felt that HPV vaccine was safe (Table 2). Similar proportions of pediatricians reported that JE (39.6%), typhoid (37.3%) and HPV (34.7%) were effective, while only 22.7% of pediatricians reported that influenza vaccine was effective (Table 2).

Predictors of JE, typhoid, influenza and HPV vaccine administration among pediatricians

Pediatricians who perceived JE vaccine as safe were 2.6 times more likely to report routine or selective administration of JE vaccine (OR 2.6, 95% CI 1.3 to 5.3). Pediatricians who perceived JE vaccine as effective were 3.3 times more likely to administer JE vaccine routinely or selectively (OR 3.3, 95% CI 1.6 to 6.5) (Table 3). For influenza vaccine, pediatricians who perceived the vaccine to be safe were 4.3 times more likely to administer the influenza vaccine selectively or routinely (OR 4.3, 95% CI 2.0 to 9.6) (Table 3). Those pediatricians who perceived influenza vaccine to be effective were 7.7 times more likely to administer influenza vaccine routinely or selectively than those who had lower perceived vaccine efficacy

(OR 7.7, 95% CI 2.5 to 23.1) (Table 3). Pediatricians who perceived HPV vaccine to be safe were 6.2 times more likely to routinely or selectively administer it (OR 6.2, 95% CI 3.1 to 12.7). Those pediatricians who perceived the HPV vaccine to be effective were 3.2 times more likely to routinely or selectively administer HPV vaccine than pediatricians who reported a low perception of HPV vaccine efficacy (OR 3.2, 95% CI 1.6 to 6.4) (Table 3).

Perceptions of vaccine safety and effectiveness and administration of JE, typhoid, influenza and HPV vaccine

The largest proportion of pediatricians who routinely administered any of the four vaccines felt the vaccine was safe and effective (JE 46.2%, typhoid 51.3%, influenza 47.2% and HPV 77.8%). This was followed by those who felt the vaccine was unsafe but effective (JE 30.8%, typhoid 43.4%, influenza 33.3% and HPV 22.2%). Of those who reported not ever administering one of the four vaccines, the largest proportion felt the vaccine was unsafe and ineffective (JE 44.2%, typhoid 31.2%, influenza 44.9% and HPV 52.3%) (Table 4).

Discussion

This is the first study to assess the attitudes of a national sample of pediatricians on vaccines for emerging or re-emerging infections in India. There is increasing evidence of the importance of JE, typhoid, influenza and HPV infections in India; therefore, understanding how healthcare workers view the vaccines that protect against them may have important implications for national immunization policy in India. These vaccines are effective. Andhra-Pradesh, one of the only states to implement a JE control program with routine vaccination, saw significant reductions in both JE incidence and mortality.²³ Some initial studies of vaccination campaigns in high risk areas like Kolkata suggest not only the efficacy but also the cost-effectiveness of routine Vi polysaccharide typhoid vaccination in India.^{24–26}

Even though none of these vaccines is currently included in India’s Universal Immunization Program (UIP), a high proportion of pediatricians reported administering them routinely or selectively. This indicates that many pediatricians think it is important

Table 1. Frequency of administration of Japanese encephalitis (JE), typhoid, influenza and human papillomavirus (HPV) vaccines by pediatricians

	JE vaccine N = 370 % (N)	Typhoid vaccine N = 391 % (N)	Influenza vaccine N = 382 % (N)	HPV vaccine N = 364 % (N)
Routinely	3.6 (13)	51.2 (226)	9.7 (36)	3.1 (9)
Selectively	38.3 (158)	40.4 (149)	50.4 (240)	42.9 (182)
Not at all	51.7 (199)	6.3 (16)	33.9 (106)	46.0 (173)

Weighted percentages.

Table 2. Perceived vaccine safety and effectiveness for Japanese encephalitis (JE), typhoid, influenza and human papillomavirus (HPV) vaccines

	Perceived vaccine to be safe % (N)	Perceived vaccine to be effective % (N)
JE (N = 371)	55.3 (220)	39.6 (161)
Typhoid (N = 393)	88.2 (361)	37.3 (185)
Influenza (N = 383)	71.7 (296)	22.7 (110)
HPV (N = 365)	54.8 (229)	34.7 (147)

Weighted percentages.

Table 3. Correlates of routine and selective administration of Japanese encephalitis (JE), typhoid, influenza and human papillomavirus (HPV) vaccines by pediatricians

	JE vaccine		Typhoid vaccine		Influenza vaccine		HPV vaccine	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Perceived vaccine to be safe	2.6 (1.3 to 5.3)	0.0066	3.5 (0.7 to 17.8)	0.13	4.3 (2.0 to 9.6)	0.0003	6.2 (3.1 to 12.7)	<0.0001
Perceived vaccine to be effective	3.3 (1.6 to 6.5)	0.0008	3.7 (0.7 to 18.6)	0.11	7.7 (2.5 to 23.1)	0.0003	3.2 (1.6 to 6.4)	0.0015

to protect children against these diseases and that they have a high level of acceptance of the importance of administration of these vaccines. JE vaccine is the least likely to be used routinely or selectively by pediatricians. The JE vaccine has been used only sporadically in India to prevent outbreaks of the disease. The absence of a national vaccine campaign against JE may be due to limited surveillance data, lack of epidemiological information, geographical variation in disease risk and/or the expense of the vaccines.²³ Furthermore, questions about vaccine safety, despite the reassurance provided by WHO, may lead to hesitancy in administering the vaccine routinely.²⁷

Typhoid vaccine has the highest percentage of use among pediatricians; this may be due to the fact that typhoid vaccine was once in India's UIP.²⁸ The polysaccharide typhoid vaccine is not used in routine immunization in the UIP because of concerns about safety, efficacy and expense.^{29,30}

Over 60% of pediatricians reported administering influenza vaccine routinely or selectively. The need for annual administration of seasonal influenza vaccine complicates the decision to use the vaccine routinely.

Though screening for HPV is recommended as a preventive procedure, only 2.6% of Indian women between the ages of 18–69 are screened every 3 year;⁸ therefore, understanding correlates of HPV vaccination administration is vital. Similar to findings from another study,¹⁷ we found that pediatricians expressed positive attitudes toward HPV vaccine, with over 50% reporting it to be safe and over one-third reporting it to be effective. Despite this, our study shows that only 46% of pediatricians report using it routinely or selectively. The high cost of the HPV vaccines, the cultural taboo surrounding premarital sex, and public concerns about vaccine safety may further complicate HPV vaccine delivery. The suspension of two HPV vaccination programs initiated in Andhra Pradesh and Gujarat because of media allegations of vaccine-induced deaths has contributed to concerns about safety of the vaccine.¹⁸ In addition, pediatricians do not see patients once cervical cancer has developed and, therefore, do not see the positive impact of vaccination.

Unfortunately, there are several barriers to implementation of routine use of these vaccines. Similar to a previous study we published, which focused on pediatricians in the states of Uttar Pradesh and Bihar, we found that financial constraints of parents were perceived as a more important barrier to vaccination than compensation to the pediatricians.¹⁴

Since families that visit private pediatricians must pay out-of-pocket, this could also affect a pediatrician's recommendation

for a vaccine that is not in India's UIP. The cost of these vaccines varies from Rs350 (US\$6.50) for typhoid vaccine to Rs5800/dose (US\$107/dose) for the HPV vaccine. A potential area for further research is whether having the vaccine in stock and the cost of doing so influences pediatricians' usage.

Overall, more pediatricians consistently reported that they felt these vaccines were safe than effective. A higher percentage of pediatricians reported that typhoid vaccine was safe compared to JE, influenza and HPV vaccines. The lowest percentage of pediatricians reported finding influenza vaccine effective. This is an important point of potential intervention because higher perceived vaccine efficacy was associated with routine use of other vaccines not in India's routine immunization schedule.¹⁴

Both perceived vaccine safety and effectiveness were significant predictors of JE, influenza and HPV vaccine usage. Other questions that this study raises are why some pediatricians who think these vaccines are safe and effective do not use them at all and why those who reported thinking these vaccines were unsafe and ineffective still use them; these results suggest that there are other factors playing a role in some of the decision making in the latter group. Potential explanations are that their perceptions of disease severity or their level of knowledge regarding the burden of these diseases in India may play an important role. Future studies will need to elucidate whether pediatricians' experiences with the vaccines shaped their perceptions of safety and, therefore, their administration practices. Also, our data show that perceptions of vaccine effectiveness may play a more important role in administration of the vaccine than perceptions of vaccine safety. Of those pediatricians who reported routinely or selectively administering any of these vaccines, a higher proportion reported that these vaccines were unsafe but effective than those who reported thinking the vaccines were safe but ineffective. These data point to a need for education among pediatricians on burden of disease, disease severity, vaccine safety and, especially, vaccine effectiveness.

Professional medical societies such as the IAP can play a major role in increasing administration of new vaccines and encouraging the government to incorporate these vaccines into the UIP by drafting recommendations and guidelines for consideration by the government when developing policies for introduction of new vaccines.

Limitations

This study has the potential for non-response bias; pediatricians who are less supportive of vaccines may have been less likely to

Table 4. Perceptions of vaccine safety and effectiveness and administration of Japanese encephalitis (JE), typhoid, influenza and human papillomavirus (HPV) vaccines among pediatricians

	JE vaccine N = 371 % (N)			Typhoid vaccine N = 393 % (N)			Influenza vaccine N = 383 % (N)			HPV vaccine N = 365 % (N)		
	Routinely	Selectively	Not at all	Routinely	Selectively	Not at all	Routinely	Selectively	Not at all	Routinely	Selectively	Not at all
Safe and effective	46.2 (6)	42.8 (68)	23.1 (46)	51.3 (117)	38.3 (57)	18.8 (3)	47.2 (17)	29.6 (71)	10.3 (11)	77.8 (7)	39.6 (72)	25.3 (44)
Safe but ineffective	7.7 (1)	12.0 (19)	8.0 (16)	1.3 (3)	2.0 (3)	0 (0)	8.3 (3)	0.4 (1)	1.9 (2)	0 (0)	6.6 (12)	5.2 (9)
Unsafe but effective	30.8 (4)	27.0 (43)	24.6 (49)	43.4 (99)	49.0 (73)	50.0 (8)	33.3 (12)	55.4 (133)	43.0 (46)	22.2 (2)	35.7 (65)	17.2 (30)
Unsafe and ineffective	15.4 (2)	18.2 (29)	44.2 (88)	4.0 (9)	10.7 (16)	31.2 (5)	11.1 (4)	14.6 (35)	44.9 (48)	0 (0)	18.1 (33)	52.3 (91)

Weighted percentages.

complete the survey than pediatricians who are more supportive of vaccines. We were unable to compare characteristics of pediatricians who completed surveys with those who did not since no information was collected for non-responders. Although confidentiality and anonymity of the respondents were maintained, there is a possibility that respondents may have overestimated their administration of these vaccines. The survey did not define what proportion of administration 'selective administration' was. The distinction between routine and selective may have been confusing to some participants. This study only assessed perceived safety and effectiveness of the vaccines; other constructs may provide further understanding of predictors of administration. The findings may not be generalizable to other provider categories such as primary health center physicians.

Conclusions

Understanding predictors of administration of vaccines for epidemic and endemic diseases could help focus interventions to improve their use. Recognition of the importance of perceptions of efficacy and safety of JE, typhoid, influenza and HPV vaccines by pediatricians presents an opportunity to design strategies to build support for introduction of these vaccines.

Authors' contribution: NT, PC, KP, WO and SB conceived the study; LG, NT, PC, PW, KP, MA, WO, SO and JH designed the study protocol; LG, PW and SO analyzed the data; LG, NT, PC, PW, RR, WO, SO and JH interpreted the data; LG and RR drafted the manuscript. All authors critically reviewed and revised the manuscript and read and approved the final version. LG is the guarantor of the paper.

Acknowledgements: We would like to thank our survey participants, Dianne Miller and Ashley Freeman at Emory University for their administrative support, and members of the IAP Executive Board and the St. Stephen's Hospital survey team, including Vipin Gupta. We also thank the Government of India and the National Polio Surveillance Project.

Funding: This work was supported by grant #50230 from the Bill and Melinda Gates Foundation.

Competing interests: None declared.

Ethical approval: Emory University's Institutional Review Board and Maulana Azad Medical College, New Delhi, Institutional Ethics Committee both determined that this study did not meet the definition of 'Human Subjects Research' and was classified as 'Quality Improvement' not requiring review.

References

- 1 WHO. Japanese encephalitis reported cases. WHO World Health Organization: Immunization, Vaccines And Biologicals. Vaccine Preventable Diseases Vaccines Monitoring System 2012 Global Summary 2012. Geneva: World Health Organization; 2012.
- 2 Tsai TF. New initiatives for the control of Japanese encephalitis by vaccination: minutes of a WHO/CVI meeting, Bangkok, Thailand, 13-15 October 1998. Vaccine 2000;18:1-25.

- 3 Ochiai RL, Acosta CJ, Danovaro-Holliday MC et al. A study of typhoid fever in five Asian countries: disease burden and implications for controls. *Bull World Health Organ* 2008;86:260–8.
- 4 Sinha A, Sazawal S, Kumar R et al. Typhoid fever in children aged less than 5 years. *Lancet* 1999;354:734–7.
- 5 Azziz-Baumgartner E, Alamgir AS, Rahman M et al. Incidence of influenza-like illness and severe acute respiratory infection during three influenza seasons in Bangladesh, 2008–2010. *Bull World Health Organ* 2012;90:12–9.
- 6 Nair H, Brooks WA, Katz M et al. Global burden of respiratory infections due to seasonal influenza in young children: a systematic review and meta-analysis. *Lancet* 2011;378:1917–30.
- 7 Das BC, Hussain S, Nasare V, Bharadwaj M. Prospects and prejudices of human papillomavirus vaccines in India. *Vaccine* 2008;26:2669–79.
- 8 WHO and ICO. Human Papillomavirus and Related Cancers, 2010. Geneva: World Health Organization; 2010.
- 9 Gaïnd R, Paglietti B, Murgia M et al. Molecular characterization of ciprofloxacin-resistant *Salmonella enterica* serovar Typhi and Paratyphi A causing enteric fever in India. *J Antimicrob Chemother* 2006;58:1139–44.
- 10 Saxena V, Dhole TN. Preventive strategies for frequent outbreaks of Japanese encephalitis in Northern India. *J Biosci* 2008;33:505–14.
- 11 Choudhury P, Thacker N, Gargano LM et al. Attitudes and perceptions of private pediatricians regarding polio immunization in India. *Vaccine* 2011;29:8317–22.
- 12 Clark SJ, Cowan AE, Stokley et al. Physician perspectives to inform a new recommendation for meningococcal conjugate vaccine (MCV4). *J Adolesc Health* 2006;39:850–5.
- 13 de Carvalho NS, Teixeira LM, Pradel EM et al.. Vaccinating against HPV: physicians' and medical students' point of view. *Vaccine* 2009;27:2637–40.
- 14 Gargano LM, Thacker N, Choudhury P et al. Predictors of administration and attitudes about pneumococcal, *Haemophilus influenzae* type b and rotavirus vaccines among pediatricians in India: a national survey. *Vaccine* 2012;30:3541–5.
- 15 Kahn JA, Rosenthal SL, Tissot AM et al. Factors influencing pediatricians' intention to recommend human papillomavirus vaccines. *Ambul Pediatr* 2007;7:367–73.
- 16 Kahn JA, Zimet GD, Bernstein DI et al. Pediatricians' intention to administer human papillomavirus vaccine: the role of practice characteristics, knowledge, and attitudes. *J Adolesc Health* 2005;37:502–10.
- 17 Krupp K, Marlow LA, Kielmann K et al. Factors associated with intention-to-recommend human papillomavirus vaccination among physicians in Mysore, India. *J Adolesc Health* 2010;46:379–84.
- 18 Pandhi D, Sonthalia S. Human papilloma virus vaccines: Current scenario. *Indian J Sex Transm Dis* 2011;32:75–85.
- 19 Patel MM, Janssen AP, Tardif RR et al. A qualitative assessment of factors influencing acceptance of a new rotavirus vaccine among health care providers and consumers. *BMC Pediatr* 2007;7:32.
- 20 Riedesel JM, Rosenthal SL, Zimet GD et al. Attitudes about human papillomavirus vaccine among family physicians. *J Pediatr Adolesc Gynecol* 2005;18:391–8.
- 21 Romani MH, Musharrafieh UM, Lakkis NA, Hamadeh GN. Family physicians beliefs and attitudes regarding adult pneumococcal and influenza immunization in Lebanon. *Fam Pract* 2011;28:632–7.
- 22 Rosenstock I. Historical Origins of the Health Belief Model. *Health Educ Monogr* 1974;3:28–35.
- 23 WHO. World Health Organization: Regional Office for South-East Asia. Bi-Regional Meeting on Japanese Encephalitis, 2005. Geneva: World Health Organization; 2005.
- 24 Ali M, Sur D, Kim DR et al. Impact of Vi vaccination on spatial patterns of typhoid fever in the slums of Kolkata, India. *Vaccine* 2011;29:9051–6.
- 25 Sur D, Ochiai RL, Bhattacharya SK et al. A cluster-randomized effectiveness trial of Vi typhoid vaccine in India. *N Engl J Med* 2009;361:335–44.
- 26 WHO. Report of the Meeting on Typhoid Fever, a Neglected Disease: Towards a Vaccine Introduction Policy, 2007. Geneva: World Health Organization.
- 27 WHO. Safety of Japanese Encephalitis Vaccination in India. *Wkly Epidemiol Rec* 2007;82:17–24.
- 28 Laxminarayan R, Ganguly NK. India's vaccine deficit: why more than half of Indian children are not fully immunized, and what can—and should—be done. *Health Aff (Millwood)* 2011;30:1096–103.
- 29 Sur D, Manna B, Chakrabarty N et al. Vaccine desirability during an effectiveness trial of the typhoid fever polysaccharide Vi vaccine in Kolkata India. *Hum Vaccin* 2009;5:614–20.
- 30 WHO. Typhoid Vaccines: WHO Position Paper. *Wkly Epidemiol Rec* 2008;83:49–60.