HHS Public Access

Author manuscript

Vaccine. Author manuscript; available in PMC 2024 April 11.

Published in final edited form as:

Vaccine. 2018 January 02; 36(1): 36–42. doi:10.1016/j.vaccine.2017.11.046.

Knowledge, attitudes, and practices of private sector immunization service providers in Gujarat, India

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Abstract

Background: India is responsible for 30% of the annual global cohort of unvaccinated children worldwide. Private practitioners provide an estimated 21% of vaccinations in urban centers of India, and are important partners in achieving high vaccination coverage.

Methods: We used an in-person questionnaire and on-site observation to assess knowledge, attitudes, and practices of private immunization service providers regarding delivery of immunization services in the urban settings of Surat and Baroda, in Gujarat, India. We constructed a comprehensive sampling frame of all private physician providers of immunization services in Surat and Baroda cities, by consulting vaccine distributors, local branches of physician associations, and published lists of private medical practitioners. All providers were contacted and asked to participate in the study if they provided immunization services. Data were collected using an in-person structured questionnaire and directly observing practices; one provider in each practice setting was interviewed.

Results: The response rate was 82% (121/147) in Surat, and 91% (137/151) in Baroda. Of 258 participants 195 (76%) were pediatricians, and 63 (24%) were general practitioners. Practices that were potential missed opportunities for vaccination (MOV) included not strictly following vaccination schedules if there were concerns about ability to pay (45% of practitioners), and not administering more than two injections in the same visit (60%). Only 22% of respondents used a vaccination register to record vaccine doses, and 31% reported vaccine doses administered to the government. Of 237 randomly selected vaccine vials, 18% had expired vaccine vial monitors.

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Conflicts of interest statement

The authors declare no conflicts of interest.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.vaccine.2017.11.046.

Conclusions: Quality of immunization services in Gujarat can be strengthened by providing training and support to private immunization service providers to reduce MOVs and improve quality and safety; other more context specific strategies that should be evaluated may involve giving feedback to providers on quality of services delivered and working through professional societies to adopt standards of practice.

Keywords

Health knowledge; Attitudes; Practice; Public-private sector partnerships; Private sector; Vaccination

1. Background

India leads the world in number of childhood deaths [1], is responsible for 30% of the annual global cohort of unvaccinated children [2], and accounts for 47% of global measles mortality [3]. In 2015, through routine immunization programs, only 82% of India's children received three doses of oral polio vaccine (OPV3) [4]; during 2014, estimated state-level percentage of children aged 9–11 months who had been fully vaccinated (i.e., having received bacille Calmette–Guérin [BCG], three doses of diphtheria-pertussis-tetanus vaccine [DPT3], three doses of OPV3, and one dose of measles-containing virus [MCV1]), ranged from 27% to 89% [5]. While strategies for measles elimination and polio eradication have focused on improving vaccination coverage and access to services in the public sector, the private health care sector, comprising a wide range of for-profit and not-for-profit practices, also plays a large and important role in India. In 2013, expenditures in the private sector accounted for 68% of total health expenditures country-wide [6], and an estimated 21% of routine childhood vaccinations in urban areas of India are provided in the private sector [7].

The few studies that have explored the role of the private sector in immunization service delivery in low- and middle-income countries have generally found less knowledge of recommended immunization services and lower quality of service delivery among private sector providers when compared to their public sector counterparts [8]. Globally the pooled prevalence of missed opportunities for vaccination (MOV) for children, in which a person eligible for vaccination, and with no valid contraindication, visits a health service facility and does not receive all of the recommended vaccines, is estimated at 32% among low- and middle-income countries [9]. Little is known, however, about the specific behaviors and practices among private sector providers that could be targeted to decrease this high prevalence. In studies conducted in India, private sector providers had less concern about polio, greater likelihood to depart from recommended vaccine schedules, and lower sense of personal responsibility for providing vaccinations, than did providers in the public sector [10–12]. However, these studies were limited to members of the Indian Academy of Pediatrics (IAP) in Bihar and Uttar Pradesh, and were limited to attitudes rather than actual practices.

Because of limitations of previous studies and the lack of on-site observational assessment of immunization practices, many questions remain about actual immunization practices in the private sector setting in India, and the role that practice changes can play in improving

vaccination coverage. To address this knowledge gap, we conducted a study among private providers who offered child vaccination in two urban settings in Gujarat State, India. Gujarat is a state in Western India, which, like many population centers in India, is urbanizing rapidly (currently 43% urban) and has experienced rapid economic growth that is outpacing growth of social and development metrics. In urban Gujarat state, private immunization providers deliver a large percentage (24%) of immunization services, similar to other urban areas of India [7]. The second and third most populous cities in Gujarat State were selected for this study, Surat (pop. 4,591,246), and Baroda (pop. 1,822,221).

The objectives of our study were to assess: (a) the knowledge, attitudes, and practices of private providers regarding administration of polio, measles and other vaccines, including vaccination schedules, cold chain storage of vaccines, recording vaccine doses administered, and vaccine management; (b) acute flaccid paralysis (AFP) and measles case reporting; and (c) the feasibility of potential public-private partnership strategies to improve access to immunizations in urban populations.

2. Methods

2.1. Survey design

We conducted a systematic assessment of urban private medical providers who offer childhood immunizations in Surat and Baroda municipal corporations in Gujarat State, India. A comprehensive sampling frame of private immunization providers was created by obtaining a list of vaccine purchasers from the major vaccine distributors in these two cities, accounting for approximately 90% of the combined market. This list was supplemented with membership lists of the Surat and Baroda Branches of both the Indian Academy of Pediatrics and the General Practitioner Association, and other published directories of pediatricians (defined as practitioners with an MBBS degree, plus a diploma in pediatrics, or MD in pediatrics) and general practitioners (MBBS degrees without further specialization) from the region. Finally, snowball sampling was used to identify additional providers that were not captured through the previous methods [13].

All identified practitioners were contacted by telephone and a brief interview was conducted to determine whether they provide immunization services to children in a practice located within the city limits. All practitioners were offered the opportunity to participate in the study if they provided immunization services in any non-governmental setting, including both for-profit and not-for-profit practices, such as charity or faith-based organizations. In the case that a given practitioner contacted by telephone was a member of a provider group that share common immunization practices and supplies, he or she was requested to identify a provider who was familiar with the common practices among the group; that provider was contacted to schedule an in-person interview. Practitioners were not required to offer a specific minimum set of vaccines to be eligible to participate; however, practitioners were excluded from the study if they did not provide vaccines to children as part of the routine childhood immunization schedule. Representatives of IAP, Indian Medical Association, and the Gujarat Department of Health and Family Welfare were consulted during study design and pilot testing of the questionnaire, which was performed among pediatricians in

Ahmedabad city to avoid exposing potential study participants in Surat and Baroda to the questionnaire.

2.2. Measures

Each assessment included administration of an in-person structured questionnaire (Web Appendix), which captured information on knowledge, attitudes and practices related to vaccination schedules, potential MOV, record-keeping of vaccine doses administered, injection safety, vaccine management and storage, and reporting of vaccination coverage, adverse events following immunization (AEFI), and notifiable diseases. In addition, for each participant, we directly observed practices for vaccine management and storage, and safety of vaccine administration. Vaccine refrigerators were examined for the presence of thermometers and temperature logs and non-vaccines, including food, and other medications. One vaccine vial was randomly selected from each refrigerator and the vaccine vial monitor (VVMs) was examined.

We also assessed practitioner's willingness to enter into partnerships with the government to deliver subsidized vaccine and improve vaccine dose administration reporting. Practitioners were asked to rate the acceptability of three example partnership models: "Allow the government to use my facility to administer free vaccines to the public", "Receive some free vaccines from the government in exchange for me reporting the number of doses given, and I **could not** charge any fee", and "Receive some free vaccines from the government in exchange for me reporting the number of doses given, and I **could** charge a fee".

2.3. Data collection and analysis

The assessments were conducted by trained interviewers composed of faculty members and residents from the Department of Preventive and Social Medicine at Surat and Baroda Medical colleges. Data were collected on paper case report forms, double entered and managed using REDCap electronic data capture tools [14]. R statistical programming language v.3.2.3 [15] was used for descriptive analyses using chi-square or Fisher's exact tests, as appropriate. P-value cut-offs for statistical significance were determined after adjusting for false discovery rate due to multiple comparisons [16].

2.4. Ethics

This study received ethical approval from the CDC Human Subjects Review Board, and written informed consent was obtained from all participants.

3. Results

In total, the sampling frame included contact information for 3034 practitioners, consisting of 1750 identified as vaccine purchasers by vaccine distribution companies; 227 pediatricians and 1049 general practitioners identified via membership in professional associations; and 8 general practitioners providing immunization services who were identified through snow-ball sampling. Of the total, 298 were eligible to participate, after excluding 94 who practice outside the city limits or were unreachable, 1618 who reported providing only tetanus or rabies vaccines, 809 who denied providing any vaccination

services, 41 who only practiced in the public system, and 174 practitioners from group practices who were not selected for interview. Overall provider response rate was 87% (258/298), 82% (121/147) in Surat, and 91% (137/151) in Baroda. Characteristics of physicians and their practices are described in Table 1. Pediatricians comprised the majority of providers (195, 76%), and the remaining 63 (24%) were general practitioners. A wide range of vaccines were offered by private sector providers (Table 2), including vaccines not available in India's Universal Immunization Program (UIP) schedule. In general, private providers closely followed the IAP-recommended vaccination schedule, rather than the UIP schedule (the IAP schedule includes inactivated polio, pneumococcal conjugate, rotavirus, varicella, hepatitis A, typhoid, human papillomavirus, and measles-mumps-rubella vaccines [17]).

We assessed vaccination practices of practitioners to identify potential MOV (Table 3). Most practitioners (60%) were unwilling to administer three vaccines in the same visit. Of those, 77% reported they did not administer three concurrent injections because of their own judgement of the risks and benefits, rather than parental concerns (21%) or other motivations. For example, a common explanation provided by participants was the belief that simultaneous administration of multiple live vaccines would lead to decreased effectiveness or increased risk of adverse events. In addition, 45% of practitioners stated that they would vary the vaccination schedule "sometimes or often" for financial reasons, e.g., concerns about caregiver's ability to pay for multiple vaccines at the same time.

Recordkeeping and reporting practices were suboptimal (Table 3). Twenty-two percent of practitioners reported using a register to record vaccination doses. In addition, 51% responded they would not vaccinate if the parents did not bring the child's vaccination card. A majority (69%) of practitioners stated they do not report vaccine doses administered to the government. Practitioners commonly responded that they would not report cases that met surveillance definitions for notifiable diseases including measles (88%) and polio (36%). The most common reasons given for not reporting doses or cases of notifiable diseases were not being aware of any reporting requirement, and not knowing where or how to report. However, some respondents reported reluctance to report doses to the government out of concern for tax implications due to increased government attention to service volume.

We directly observed several practices suggesting weakness in vaccine safety and cold-chain quality (Table 3). In almost all practices (92%), vaccines were stored in domestic refrigerators. All practitioners allowed interviewers to directly observe the contents of their refrigerator if one was present on site. Expired (stage 3–4) VVMs were noted in 18% of observed refrigerators. We observed notable outlier practices with respect to stock management; some providers did not maintain refrigerators for vaccine storage, and kept vaccine vials in unrefrigerated thermal boxes (7%), or obtained vaccine vials directly from a nearby pharmacy as needed on a patient-by-patient basis (<1%).

Overall, there was an equal degree of acceptability and unacceptability of the three example public-private partnership models (Fig. 1). However, there was variation in the acceptability of these partnership models between the two cities and between practitioners of different levels of training. The highest level of overall acceptance for any type of model was 44% for

Model 3 (allow government to use the facility), particularly among providers with an MBBS alone (59%).

4. Discussion

This study fills crucial knowledge gaps related to immunization practices in the private sector in India. In comparison to prior studies [10–12], we conducted an on-site assessment of knowledge, attitudes and practices rather than a telephone survey, and the scope of included providers was not limited to pediatrician members of the India Academy of Pediatrics. The response rate for this study (87%) was also higher than in prior studies (range 47–51% among pediatricians) [10–12]. We aimed to maximize the completeness of the sample of providers who vaccinate by obtaining the actual lists of vaccine purchasers from vaccine distributors in the two cities. We were therefore able to capture information from multiple categories of physician immunization providers in Gujarat irrespective of membership in professional organizations.

Our study among private providers in Gujarat found a high prevalence of practices that lead to MOV, such as multiple injection hesitancy. Several studies have demonstrated that concern about multiple injections among providers is associated with vaccination delay and incomplete vaccinations [18–21]. Although providers in our study reported some reluctance from parents towards multiple vaccinations, providers often overestimate this parental concern [22]. In addition, since most providers in our study reported their own reluctance to administer multiple vaccinations at the same visit, multiple injection hesitancy among practitioners might be a key source of MOV that can be addressed in India.

Our findings suggest that MOV in the private sector could be reduced by relatively straightforward changes in practice, such as performing opportunistic screening for vaccination status and appropriate vaccination by providers at all visits. MOV could also be reduced through the improved and increased use of office-based records and child-based vaccination registers, instead of relying solely on home-based vaccination cards; half of the providers responded that they would not vaccinate a child who presented for immunizations without their home-based vaccination card. In addition, other more context-specific strategies to improve provider practices might be needed, including working through professional societies to adopt standards of practice on multiple vaccinations and recordkeeping, for example, and giving feedback to providers through on quality of services delivered. Although only rigorously evaluated in high income countries, provider assessment and feedback interventions are powerful evidence-based strategies to improve vaccination coverage; these strategies both evaluate provider performance in delivering one or more vaccinations to a client population (assessment) and present providers with information about their performance (feedback) [23]. In addition, MOV cannot be fully addressed without a key change in the attitude of practitioners towards immunization; without a specific valid contraindication, every child should be vaccinated with all indicated vaccines to reach and maintain high vaccination coverage [24,25].

We found a wide range of quality in cold chain and injection safety practices. Any blood borne pathogen transmission event that occurs in the private sector due to unsafe

injection practices, or vaccine preventable disease outbreak among vaccinated children due to improper cold-chain storage practices, would be highly visible and threaten to undermine public trust in the UIP; therefore, training on injection safety, and cold-chain maintenance, including the appropriate use and interpretation of VVMs and temperature monitoring practices may be valuable. We did not obtain information on the cold-chain, transportation, and quality assurance systems used by vaccine distributors; future assessments focused on vaccine distributor supply and quality would also be informative.

Finally, we found a great need to clarify and communicate about existing channels for private sector providers to report vaccination doses to reliably estimate vaccination coverage; AEFI to identify and monitor vaccine safety; and notifiable vaccine-preventable diseases, to monitor the impact of vaccination. In particular, with the recent switch to bivalent oral poliovirus vaccine (bOPV) and inactivated poliovirus vaccine (IPV) introduction, ongoing sensitive AFP surveillance is needed to identify potential circulating poliovirus in India.

The gaps in quality and safety that we observed in our study can be addressed through training and refresher orientation, as well as developing mechanisms for government oversight and accreditation of providers. Additionally, increased government engagement with the private sector to improve immunization services has been urged by the World Health Organization [26], through assessing the private sector's contribution to immunization service delivery and determining the optimal model of public-private engagement. Although acceptability of the public-private partnership models that we investigated showed variation by city and level of training of the provider, none of the three models in either city were accepted by more than about half of providers surveyed, and no model had greater than 44% acceptability overall. Exploring the acceptability of the public-private partnership models further will likely require the use of qualitative methods (e.g., focus groups or key informant interviews) at several levels in the health system to understand barriers and identify meaningful public–private partnership models.

This study has some limitations. Our study was designed to provide a description of attitudes and practices related to immunization services among all physicians offering these services in two major cities in Gujarat state. However, these findings might not be representative of all urban settings in India, which range widely in level of economic development and other factors such as religious and cultural norms that influence demand, access, and use of the health care system, as well as norms, attitudes, and practices among health care providers. In addition, although our study aimed to obtain a comprehensive sample of private immunization service providers, no central registration of medical practitioners is available that could be used to generate a complete sampling frame, and physician associations do not exist at a national or state level for general practice physicians or non-physician providers. Although registered non-physicians provide immunization services in some settings in India, we were unsuccessful in obtaining municipal membership lists of non-physician immunization providers affiliated with Ayurvedic Yoga and Naturopathy, Unani, Siddha, and Homeopathy organizations. Additionally, our study was unable to describe the practices of non-registered practitioners providing immunization services in the informal sector. We limited our assessment to private practitioners. A similar study of immunization practices

in India's UIP would be valuable to allow comparison of the two groups. Finally, our findings should be interpreted cautiously, given the potential for social desirability bias in the responses, or the desire of providers not to provide information that might be used to increase regulation or estimate income for the purposes of taxation.

This study provides key information that should influence development of mutually strengthening relationships between the public and private health sector, and policies related to private vaccination provider practices in Gujarat. Immunization services can be strengthened in this State by engaging the private sector to leverage the important position it plays in ensuring high vaccine coverage in the State, while reducing MOV, strengthening cold-chain and injection safety practices, improving recordkeeping and reporting practices, and exploring innovative and mutually-beneficial partnerships.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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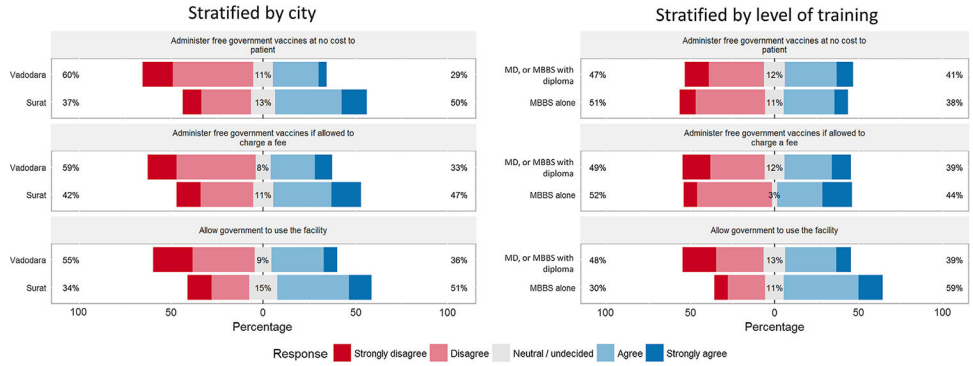

Fig. 1.

Acceptability of example public-private partnership models among vaccination providers, stratified by city (left panel) and by level of training (right panel). Percentages within the figure refer to respondents in overall disagreement (disagree or strongly disagree, left), neutral or undecided (center), and in overall agreement (agree or strongly agree, right).

Table 1

Characteristics of interviewed private immunization providers, Surat and Baroda, Gujarat State, India, 2015.

Characteristic	All providers (N = 258)	Surat (N = 137)	Baroda (N = 121)
	n (%) or median (IQR)		
Number of patients per day	40 (20–55)	40 (29–60)	30 (20–43)
Vaccinations per week	15 (6 –3 0)	15 (5 –3 0)	15 (7 –3 0)
Credentials			
MBBS alone	63 (24%)	38 (28%)	25 (21%)
MBBS with diploma in pediatrics	76 (29%)	44 (32%)	32 (26%)
MD in pediatrics	119 (46%)	55 (40%)	64 (53%)
Graduation year of highest medical degree	1992 (1985–2001)	1992 (1984–2002)	1992 (1987–2000)

Abbreviations: MBBS, Bachelor of Medicine, Bachelor of Surgery degree; MD, Doctor of Medicine degree.

Table 2

Vaccines offered by private immunization providers, Surat and Baroda, Gujarat State, India, 2015.

Vaccine	Offered (%)	Practitioner reports stock-out in preceding 3 months (%)
Vaccines in UIP schedule		
BCG	189 (73%)	0 (0%)
HepB	235 (91%)	0 (0%)
OPV	250 (97%)	1 (0%)
DTP combination without IPV	123 (47%)	1 (1%)
Measles standalone	191 (74%)	1 (1%)
DTP	185 (71%)	4 (2%)
Non-UIP vaccines		
Pneumococcal conjugate	206 (80%)	18 (9%)
Hib	174 (67%)	3 (2%)
HAV	216 (84%)	19 (9%)
HPV	133 (51%)	0 (0%)
Varicella	227 (78%)	38 (17%)
Typhoid	233 (90%)	3 (1%)
Rotavirus	226 (88%)	60 (27%)
IPV	215 (83%)	10 (5%)
MMR	254 (98%)	2 (1%)
DTaP	135 (53%)	42 (31%)
DTP/IPV combination	111 (43%)	24 (22%)

Abbreviations: UIP, Universal Immunization Program; BCG, bacille Calmette- Guerin (tuberculosis vaccine); HepB, hepatitis B vaccine; OPV, oral polio vaccine; DTP, diphtheria, tetanus, and pertussis vaccine; IPV, inactivated poliovirus vaccine; Hib, *Haemophilus influenzae* type b vaccine; HAV, hepatitis A vaccine, HPV, human papillomavirus vaccine; MMR, measles, mumps, and rubella vaccine; DTaP, diphtheria, tetanus, and acellular pertussis vaccine.

Table 3

Immunization practices of private providers overall, and by training and years of experience, Surat and Baroda, Gujarat State, India, 2015.

Practice	Total (N = 258)	Level of training			Years of experience since most recent degree			
		MBBS (N = 63)	MBBS with Diploma or MD (N = 195)	P-value[a]	0–10y (N = 43)	11–20y (N = 70)	>20y (N = 145)	P-value[b]
	n (%)	n (%)			n (%)			
Vaccine administration and office practices								
Vaccinate ≥6 days per week	249 (97%)	57 (90%)	192 (98%)	**.003**	43 (100%)	67 (96%)	139 (96%)	.393
Usually administer 2 vaccines in the same visit	214 (83%)	40 (63%)	174 (89%)	**<.001**	38 (88%)	60 (86%)	116 (80%)	.339
Primary reason for not administering 2 vaccines in same visit								
Practitioner's own judgement	33 (75%)	20 (87%)	13 (62%)	.135	4 (80%)	8 (80%)	21 (72%)	.053
Parental concerns	10 (23%)	3 (13%)			0 (0%)	2 (20%)	8 (28%)	
Other	1 (2%)	0 (0%)	1 (5%)		1 (20%)	0 (0%)	0 (0%)	
Usually administer 3 vaccines in the same visit	103 (40%)	15 (24%)	88 (45%)	**.003**	22 (51%)	25 (36%)	56 (39%)	.236
Primary reason for not administering 3 vaccines in same visit								
Practitioner's own judgement	119 (77%)	41 (85%)	78 (73%)	.157	17 (81%)	36 (80%)	74 (66%)	.642
Parental concerns	32 (21%)	7 (15%)	25 (23%)		3 (14%)	9 (20%)	20 (22%)	
Other	4 (3%)	0 (0%)	4 (4%)		1 (5%)	0 (0%)	3 (3%)	
Routinely vaccinate infants that are mildly ill	81 (31%)	16 (25%)	65 (33%)	.238	18 (42%)	16 (33%)	47 (68%)	.099
Use MMR for MCV1	141 (55%)	11 (17%)	130 (67%)	**<.001**	28 (65%)	43 (61%)	63 (44%)	.009
Vary schedule for financial reasons "Sometimes" or "Often"	115 (45%)	14 (22%)	101 (52%)	**<.001**	19 (44%)	34 (49%)	62 (43%)	.723
Vaccine schedule is visible in waiting room or office	91 (35%)	5 (8%)	86 (44%)	**<.001**	16 (37%)	30 (43%)	45 (31%)	.241
Routinely assess vaccination status of a 10-month old patient presenting for first visit	209 (81%)	39 (62%)	170 (87%)	**<.001**	41 (95%)	53 (76%)	115 (79%)	.026
Would vaccinate at that visit if the infant was not up to date	52 (25%)	5 (8%)	47 (24%)	**.005**	9 (21%)	13 (19%)	30 (21%)	.927
Would vaccinate an infant who did not bring their vaccination card	125 (51%)	27 (46%)	98 (52%)	.394	26 (62%)	30 (43%)	69 (51%)	.170
Recordkeeping and reporting								
Practitioner has an office-based vaccine register	57 (22%)	3 (5%)	54 (28%)	**<.001**	16 (37%)	16 (23%)	25 (17%)	.021

Practice	Total (N = 258)	Level of training			Years of experience since most recent degree			
		MBBS (N = 63)	MBBS with Diploma or MD (N = 195)	P-value[a]	0–10y (N = 43)	11–20y (N = 70)	>20y (N = 145)	P-value[b]
	n (%)	n (%)			n (%)			
Register is used to identify which patients are due for vaccines	29 (51%)	2 (67%)	27 (50%)	.574	11 (69%)	9 (56%)	9 (36%)	.108
Home-based card has a space to indicate due date of next dose	226 (91%)	42 (71%)	184 (97%)	**<.001**	42 (100%)	67 (97%)	117 (85%)	**.002**
Reporting doses to the government								
Practitioner directly submits a report of doses	57 (22%)	1 (2%)	56 (29%)	**<.001**	11 (26%)	19 (27%)	27 (19%)	.059
Government agent regularly collects this information	23 (9%)	0 (0%)			3 (7%)	11 (16%)	9 (6%)	
Doses are not reported to the government	178 (69%)	62 (98%)			29 (67%)	40 (57%)	109 (75%)	
Would report a case of rash with fever and cough	56 (22%)	6 (10%)	50 (26%)	**.007**	13 (30%)	21 (30%)	22 (15%)	.016
Would report a case of acute flaccid paralysis	164 (64%)	14 (22%)	150 (77%)	**<.001**	34 (79%)	51 (73%)	79 (54%)	**.002**
Cold-chain practices								
Vaccine refrigerator has a visible temperature log	56 (22%)	2 (3%)	54 (28%)	**<.001**	15 (35%)	15 (21%)	26 (18%)	.060
Vaccine refrigerator has a thermometer	62 (25%)	5 (9%)	57 (29%)	**.003**	10 (24%)	23 (33%)	29 (21%)	.160
At least one vaccine with expired VVM (stage 3 or 4)	38 (18%)	10 (31%)	28 (16%)	.042	4 (10%)	9 (16%)	25 (23%)	.178
Injection safety practices								
Auto-disable syringes used for immunization	103 (40%)	24 (38%)	79 (41%)	.733	27 (63%)	27 (39%)	49 (34%)	**.003**
Hub cutter used for sharps disposal	250 (97%)	61 (97%)	189 (97%)	.969	43 (100%)	69 (99%)	138 (95%)	.177

Abbreviations: MMR, measles mumps and rubella vaccine; MCV1, first dose of measles-containing vaccine; VVM, vaccine vial monitor.

[a,b]Chi-square or Fisher's exact test, as appropriate. **Bolded** P-values fall below statistical significance cutoffs of P = .033 (a) or P = .007 (b) after adjustment for False Discovery Rate correction.