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Monitoring Paediatric Immunization Outcomes: An Observational Study among Frontline Vaccinators

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Abstract **Original Research Article**

The study titled "Assessment of Attitude and Current Practices among Healthcare Professionals on Vaccine safety in Pediatric Healthcare settings" conducted to research the attitudes and cutting-edge practices of healthcare specialists regarding vaccine safety within pediatric healthcare settings. With the growing significance of immunization in Vaccine Preventable Diseases (VPDs) in children, the perceptions and attitudes of healthcare professionals are important. Healthcare professionals (HCPs) adhere to strict safety protocols as per National Standards when conducting immunization programs in pediatric practices. This involves assessing true contraindications and precautions before administering vaccines. Yet obstacles like misinformation and safety remain a deterrent for those who wish to cycle. Background A deeper understanding of the reasons behind under-immunization in pediatric population is essential for targeting strategies to maximize vaccine coverage for all recommended vaccines. ***Objective:*** The goal of the study was to assess the attitude and current practices of healthcare professionals towards side effects monitoring and vaccine safety communication in pediatric healthcare settings and to develop and targeted involvements and strategies aimed at enhancing vaccine acceptance, improving side effects monitoring protocols and addressing barriers to immunization among pediatric populations. ***Methodology:*** This is a prospective observational study. Healthcare Professionals involved in pediatric immunization programme were included in the study. After obtaining written informed consent, subjects were included in the study based on inclusion criteria, and data was gathered using a data collection form containing questioneries. All recorded data were entered using MS Excel software to analyse using ANOVA, Chi-square, T- test. ***Result:*** Findings from 20 HCPs revealed that knowledge accounts for 83% of the variability in practice, with a strong positive correlation (r = 0.81), while attitude explains 67% of the variability, with a moderate positive correlation (r = 0.31). ***Conclusion:*** Significant gaps were identified between attitude, knowledge, and current practices, with many professionals lacking specific training in vaccine safety, leading to insufficient confidence in managing post-vaccination side effects. The study found that a common reason for delayed pediatric vaccinations was parental lack of knowledge about vaccines. Addressing false contraindications and improving communication with parents are necessary to enhance HCP involvement in vaccination strategies.

Keywords: Vaccine Preventable Diseases, Healthcare professionals.

INTRODUCTION

Immunization is widely acknowledged as one of the most cost-effective and impactful health interventions, significantly reducing morbidity, mortality, and long-term disabilities associated with vaccine-preventable diseases (VPDs) across pediatric populations globally [1,2]. Frontline Vaccinators such as Healthcare professionals including pediatricians, nurses are central to ensuring safe vaccine delivery, adherence to schedules, and management of adverse events. Their responsibilities include screening for contraindications, educating caregivers, and monitoring children during and after immunization. Documentation of vaccine lot number, site, and time of administration is vital for post-vaccination surveillance [3]. Although vaccines are largely safe, rare but serious adverse events such as anaphylaxis require immediate recognition and emergency intervention. The World Health Organization (WHO) has implemented multifaceted strategies to

enhance post-vaccination monitoring through strengthened vaccine safety surveillance systems globally. A cornerstone of these efforts is the Global Vaccine Safety Blueprint 2.0, which emphasizes country-level pharmacovigilance capacity-building, integration of adverse events following immunization (AEFI) reporting systems, and fostering collaboration with regulatory bodies [4,5]. Active surveillance through digital platforms, such as VigiFlow and VigiBase, allows real-time reporting and signal detection. WHO also promotes the use of participant-centered mobile-based surveillance models, including SMS follow-ups and digital case-reporting tools [6]. Among VPDs, Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, disproportionately affects children, with India accounting for approximately 31% of the global pediatric TB burden. However, underdiagnosis and a 56% detection gap hinder effective treatment, with only 6–7% of cases receiving care under the National Tuberculosis Elimination Programme (NTEP). Poliomyelitis, caused by poliovirus, historically resulted in widespread paralysis among children until the introduction of Oral Polio Vaccine (OPV) and Inactivated Polio Vaccine (IPV), which significantly reduced global incidence [7]. Rotavirus, a leading cause of severe childhood diarrhea, is inadequately controlled by sanitation alone, necessitating vaccines such as Rotarix and RotaTeq [8]. Pneumococcal infections, caused by *Streptococcus pneumoniae*, remain the foremost infectious cause of death in children under five. The pneumococcal conjugate vaccine (PCV13) has been effective in curbing invasive pneumococcal disease and reducing nasopharyngeal carriage [9,10]. Other critical VPDs include diphtheria, tetanus, pertussis, measles, mumps, and rubella all targeted by toxoid or live-attenuated vaccines. While these vaccines have dramatically reduced disease incidence, resurgence has occurred in areas with declining immunization rates [11,12]. The immunological basis and safety of inactivated, recombinant, and conjugated vaccines underscore their value in vulnerable populations. India's Universal Immunization Programme (UIP) incorporates BCG, OPV, IPV, MR, Hepatitis B, ROTA, PCV, and Pentavalent vaccines, offering comprehensive protection. Nevertheless, persistent challenges including waning immunity, delivery gaps, and adverse event surveillance demand strengthened vaccine strategies and innovations in pediatric immunization delivery systems [13].

METHOD

This prospective observational study was conducted over six months at the Pediatric Outpatient Department of ESI-PGIMSR, Rajajinagar, Bengaluru. The study included one month for planning, three months for data collection, and two months for analysis and report preparation. A total of 20 healthcare professionals from the pediatric department, directly involved in immunization delivery, were enrolled based on the inclusion criterion of departmental affiliation. Ethical clearance was obtained from the Institutional Ethics Committee, and informed consent was secured from all participants. A structured questionnaire, developed in accordance with CDSCO guidelines, was used to assess participants' knowledge, attitudes, and practices regarding vaccine safety. The questionnaire captured demographic details, knowledge on vaccine administration, and methods for managing post-vaccination adverse events. Over the data collection phase, 400 pediatric vaccination cases were observed. Information on administration technique, side effects, and management strategies was documented and entered into Microsoft Excel.

Questionaries:

We developed the questionnaire after reviewing the CDSCO guideline on Pediatric Immunization. The questionnaire consisted of Six sections, where section 1,2,3,4,6 contained 10 questions and section 5 contained 5 open ended questions (i) Section 1- mostly closed-ended questions, to collect information about Healthcare professionals knowledge regarding vaccine administration (questions 1–5), perceptions regarding vaccine safety (questions 6–10), (ii) Section 2- about the Healthcare Professional's attitude toward vaccine safety (questions 11-20) (iii) Section 3- on current practices in Vaccine administration (question 21-30), (iv) Section 4 – about the parents knowledge on vaccines and its side effects (question 31-40), (v) Section 5 – contains open ended question for professionals about their thought on current scenerio regarding vaccines (question 41-45), (vi) Section – 6, describes the demographic information of the child and parents feedback regarding the vaccination (question 46-55). To assess professional's beliefs and attitudes towards vaccinations, they were asked to rate their level of agreement with Section 2,3,4 each questioneries to a five-point Likert scale (completely disagree, partially disagree, no opinion, partially agree, completely agree). To evaluate their knowledge regarding vaccine contraindications, they were asked to classify 4 clinical conditions or situations as temporary contraindications or permanent contraindications to administering any live vaccines like ROTA (Rotavirus) vaccine.

Statistical Analysis:

Statistical analysis was conducted using Analysis of Variance (ANOVA), independent T-test, and Chi-square test to assess associations and trends in vaccine safety practices among pediatric healthcare professionals. These tests were employed to compare knowledge levels, administration practices, and adverse event management strategies across participants. The primary objective was to evaluate existing practices and identify gaps in the delivery of pediatric immunization services. Findings from the analysis aimed to inform targeted interventions, optimize clinical protocols, and strengthen adherence to national vaccination safety standards, thereby enhancing overall pediatric patient

outcomes and promoting evidence-based vaccine administration within the healthcare setting.

RESULT

Demographic details of Healthcare Professionals:

The study population consisted of 20 healthcare professionals actively involved in pediatric immunization activities. The gender distribution showed a predominance of male participants (75%), with females comprising 25% (Table 1). In terms of professional experience, 65% of the participants had less than five years of experience, 15% had between five and ten years, and 20% had more than ten years. Professionally, pediatricians represented the majority (75%), followed by nurses (15%) and general practitioners (10%). Knowledge levels regarding immunization practices were high, with 85% demonstrating accurate understanding of pediatric immunization schedules and vaccine contraindications. However, 15% of the respondents lacked sufficient awareness in both areas. Information sources varied: 45% relied on articles or journals, 20% on continuous medical education, 15% on textbooks, and 10% each on seminars and official medical guidelines. Regarding practical competencies, 80% reported knowing how to manage common post-vaccination side effects most being pediatricians while 20%, predominantly nurses and general practitioners, indicated inadequate familiarity. A similar proportion (80%) actively communicated side effect information to parents. However, only 60% consistently documented vaccine administration and adverse effects, and the same proportion considered their ADR reporting practices to be accurate. Confidence in vaccine administration was high (90%), and 70% engaged in parental education on vaccine safety. Notably, 60% had received specific training on vaccine safety, while 70% expressed dissatisfaction with current training programs and recommended enhancements to content and delivery.

Table 1: Demographic details of participating healthcare professionals and survey of vaccine safety

Characteristics		No. of Professionals (n)	Percentile (%)
Age in Years	<35	4	20
	35-44	7	35
	45-54	4	20
	54-64	5	25
	>64	0	0
Gender	Male	15	75
	Female	5	25
Professionals	Pediatricians	15	75
	General Practitioner	2	10
	Nurses	3	15
Years of Experience	<5	13	65
	5-10	3	15
	>10	4	20
Degree of Knowledge on Immunization schedule	High	17	85
	Low	3	15
Degree of awareness on contraindication of vaccines	High	17	85
	Low	3	15
Source of information regarding vaccines	Books	3	15
	Journals	9	45
	CME (continuous medical education)	4	20
	Conference	2	10
	Medical Guidelines	2	10
Degree of knowledge on management of post vaccination SE	High	16	80
	Low	4	20
Degree of proper documentation on vaccine administration and ADR reporting for Vaccines	High	12	60
	Low	8	40
Activity towards educating parents on vaccine safety	Proactive	14	70
	Not active	6	30
Vaccinology Training	Yes	12	60
	No	8	40
Satisfication with available training resources	Fully Satisfied	6	30
	Seek Improvement	14	70

Knowledge on Vaccine Safety:

A comparative analysis of knowledge regarding vaccine contraindications among pediatricians (n=15), general practitioners (n=2), and nurses (n=3) revealed key differences in awareness across clinical conditions (Table 2). All pediatricians (100%) correctly identified that mild illness without fever and local reactions to a previous dose are not contraindications to vaccination (Figure 1). This awareness was similarly observed among all nurses (100%), while general practitioners failed to recognize mild illness as a non-contraindication (0%). In the case of severe immunosuppression, only 20% of pediatricians recognized it as a valid contraindication, with the remaining 80% potentially underestimating its clinical significance. In contrast, both general practitioners (100%) and two-thirds of nurses (66.7%) correctly identified it as a contraindication, indicating comparatively better awareness among these groups for this specific condition. Regarding history of allergies, 93.3% of pediatricians accurately identified it as a relevant clinical consideration, while the remaining 6.7% did not. Awareness was notably lower among general practitioners (50%) and nurses (66.7%), suggesting variability in interpretation of allergy history in immunization decision-making.

Table 2: Professionals response to the question "For administering live vaccines which of the following conditions you consider to be a contraindication?"

Condition	Pediatrician (n=15)				General Practitioner (n=2)				Nurse (n=3)			
	Temporary Contrindication		Permanent contraindication		Temporary Contrindication		Permanent contraindication		Temporary Contrindication		Permanent contraindication	
	n	%	n	%	n	%	n	%	n	%	n	%
Mild illness without fever	15	100	0	0	2	100	0	0	3	100	0	0
Severe immunosuppression	3	20	12	80	0	0	2	100	1	33.3	2	66.7
Local reaction to a previous dose	15	100	0	0	2	100	0	0	3	100	0	0
History of allergies	14	93.3	1	6.7	1	50	1	50	1	33.3	2	66.7

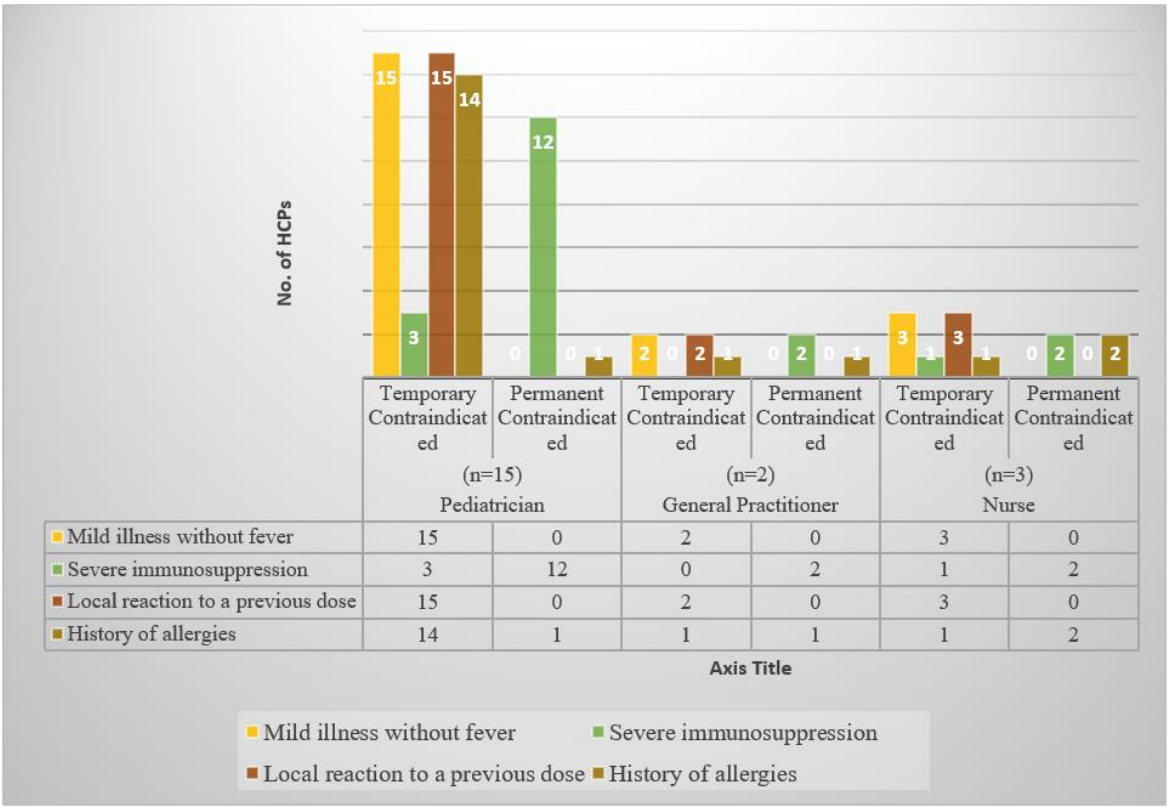


Figure 1: Professionals response to the question "For administering live vaccines which of the following conditions you consider to be a contraindication?"

Attitude towards Vaccination:

The attitudinal responses of healthcare professionals toward various aspects of pediatric vaccination were assessed using a structured questionnaire consisting of ten statements (Table 3). Regarding vaccine safety (I), 90% of participants agreed

either completely (60%) or partially (30%) that they are confident in the safety of vaccines, with only 10% expressing partial disagreement. In statement II, assessing the frequency of discussions about potential vaccine side effects with parents, 70% completely agreed and 5% partially agreed, though 25% remained unsure, highlighting a communication gap. A significant majority (80%) completely agreed that the benefits of vaccines outweigh the risks (III), while 5% strongly disagreed and 10% partially disagreed. In terms of concern about side effects (IV), 70% completely agreed, 5% partially agreed, and 25% were either unsure or partially concerned. Almost all participants (90%) completely agreed with the importance of staying updated on vaccine safety protocols (V), underscoring a shared commitment to current best practices. Responses to statement VI, regarding recommending vaccines with rare but serious side effects, were more varied, with only 35% completely agreeing, 20% partially agreeing, and 40% either disagreeing or unsure, reflecting a cautious approach. When asked about the necessity for adequate training on vaccine safety (VII), half of the respondents completely agreed, while the remaining 50% were distributed across disagreement and uncertainty, suggesting unmet training needs. Statement VIII revealed that 60% were fully proactive in reporting adverse vaccine reactions, though 15% disagreed to some extent. Encouragingly, 95% of participants expressed complete support for national vaccination programs (IX), with the remaining 5% partially agreeing. Finally, in statement X, 90% of respondents completely agreed that addressing vaccine hesitancy is critical in clinical practice, reflecting a strong awareness of its relevance.

Table 3: Healthcare professionals' attitude towards Vaccination

Questioneries Statement	Strongly disagree		Partially disagree		Unsure		Partially agree		Completely agree		Total
	n	%	n	%	n	%	n	%	n	%	N
Confident in the safety of vaccines	0	0	2	10	0	0	6	30	12	60	20
Frequently discussions on potential vaccine side effects with parents	0	0	0	0	5	25	1	5	14	70	20
The benefits of vaccines outweigh the risks	1	5	2	10	0	0	1	5	16	80	20
Concerned about potential vaccine side effects	0	0	1	5	4	20	1	5	14	70	20
Importance of staying updated about the latest vaccine safety protocols	0	0	0	0	1	5	1	5	18	90	20
Recommend a vaccine with rare but serious side effects	5	25	3	15	1	5	4	20	7	35	20
Requirement of adequate training on vaccine safety	3	15	2	10	3	15	2	10	10	50	20
Proactive in reporting adverse vaccine reactions	0	0	2	10	1	5	5	25	12	60	20
Supportive towards national vaccination programms	0	0	0	0	0	0	1	5	19	95	20
Vaccine hesitancy is critically important in clinical practice	0	0	0	0	0	0	2	10	18	90	20

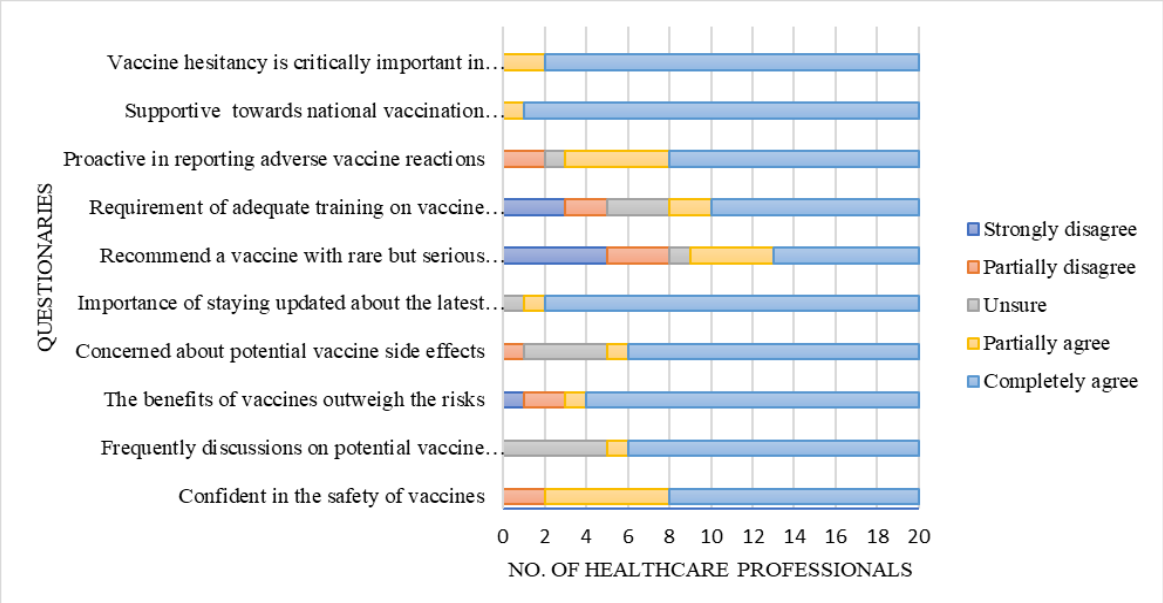
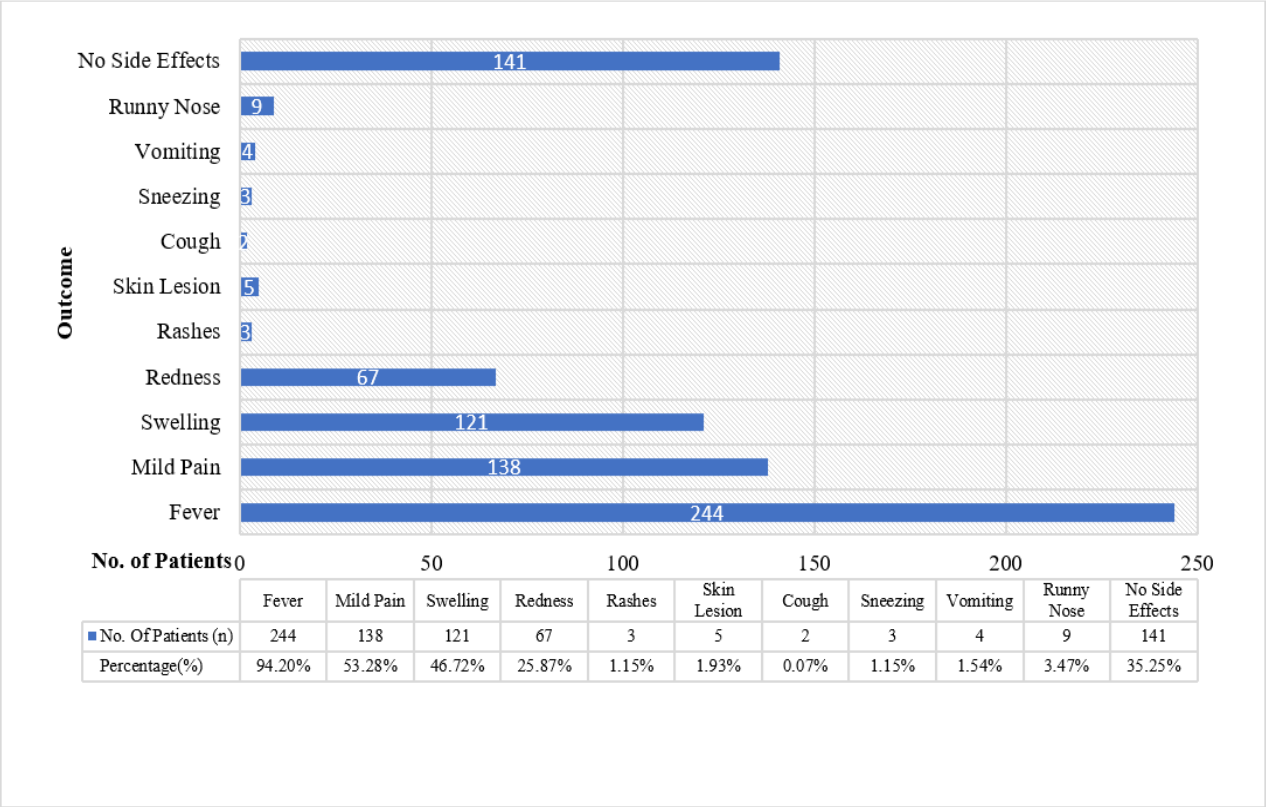


Figure 2: Professionals attitude toward vaccination

Post Vaccination Surveillance Outcome:

Out of 400 pediatric patients assessed post-vaccination, 259 children (64.75%) reported experiencing at least one side effect, while 141 children (35.25%) remained asymptomatic, indicating that a majority encountered some form of post-immunization reaction. Among those reporting adverse events, the most prevalent symptom was fever, observed in 244 patients (94.2%), followed by mild pain at the injection site in 138 patients (53.28%), swelling in 121 patients (46.72%), and redness in 67 patients (25.87%). Less frequent but notable symptoms included runny nose (9 patients, 3.47%), skin lesions (5 patients, 1.93%), rashes (3 patients, 1.15%), sneezing (3 patients, 1.15%), vomiting (4 patients, 1.54%), and cough (2 patients, 0.77%). These findings highlight that while most adverse events were mild and self-limiting, continuous monitoring remains essential to ensure vaccine safety and guide appropriate post-vaccination care.



	Fever	Mild Pain	Swelling	Redness	Rashes	Skin Lesion	Cough	Sneezing	Vomiting	Runny Nose	No Side Effects
No. Of Patients (n)	244	138	121	67	3	5	2	3	4	9	141
Percentage(%)	94.20%	53.28%	46.72%	25.87%	1.15%	1.93%	0.07%	1.15%	1.54%	3.47%	35.25%

Figure 3: Distribution of Post Vaccination Surveillance outcome

Statistical Analysis:

ANOVA test was performed to analyze the significant relationship between Knowledge, Attitude, Practice in HCP was found to statistically significant at p <.05 (p=.00078) (Table 4). T test was performed to analyze the significant relationship between Attitude and Knowledge in HCP was found to statistically significant at p<.05(p=.02746) and to analyze the significant relationship between Attitude and Practice in HCP was found to statistically significant at p<.05(p=.02978) and the relationship between Knowledge and Practice was found to statistically significant at p<.05(p=.00747). ANOVA test was performed to analyze the significant relationship between Year Of Experience and Knowledge among HCP was found to statistically in-significant at p<.05(p=.81127) and the relationship between Year Of Experience and Practice among HCP was found to statistically in-significant at p<.05(p=.57538) and the relationship between Year Of Experience and Attitude among HCP was found to statistically in-significant at p<.05(p=.47841). ANOVA test was performed to analyze the significant relationship between Level of Education and Knowledge among HCPs was found to statistically in-significant at p<.05(p=1) and the relationship between Level of Education and Practice among HCPs was found to statistically in-significant at p<.05(p=.10937) and the relationship between Level of Education and Attitude among HCPs was found to statistically significant at p<.05(p=.00508). CHI SQUARE test was performed to analyze the significant relationship between Trained HCPs, Not Trained HCPs and Knowledge Attitude Practice of HCPs was found to statistically significant at p<.05(p=.1534)

Table 4: Statistical Analysis using ANOVA, T-test, and Chi-square test to assess associations and trends in vaccine safety practices among pediatric healthcare professionals

Sl. No.	Test	Parameters	p-value
1	ANOVA	Knowledge, Attitude, Practice	.00078
2	T Test	Attitude, Knowledge	.02746
		Attitude, Practice	.02978
		Knowledge, Practice	.00747
3	ANOVA	Year of Experience, Knowledge	.81127
		Year of Experience, Practice	.57538
		Year of Experience, Attitude	.47841
		Level of Education, Knowledge	1
		Level of Education, Practice	.10937
		Level of Education, Attitude	.00508
4	CHI SQUARE	Trained, Not Trained, Knowledge Attitude, Practice	.01534

CORRELATION:

Among the Pediatricians the correlation between the Attitude and Practice suggests a strong positive relationship and the correlation between the Attitude and Knowledge suggest a positive relationship and the correlation between the Knowledge and Practice suggest a positive relationship (Table 5). Among the Nurses the correlation between the Attitude and Practice suggests a strong positive relationship and the correlation between the Attitude and Knowledge suggest a strong positive relationship and the correlation between the Knowledge and Practice suggest a positive relationship. Those HCPs having year of experience less than 5 years correlates a strong positive relationship between Attitude and Practice, a moderate positive relationship between Knowledge and Attitude and a positive relationship between Knowledge and Practice. The HCPs with experience of 5-10 years, the correlation between Attitude and Practice suggests a strong positive relationship, the correlation between Attitude and Knowledge, Practice and Knowledge both suggest moderate positive relationship. With more than 10 years of experience the HCPs the correlation between Attitude and Practices suggests strong relationship.

Table 5: Correlation between Attitude, Practice and Knowledge

Level of Experience		Attitude	Practice	Knowledge
Pediatrician	Attitude	1		
	Practice	0.741225	1	
	Knowledge	0.530974	0.232416	1
General Practitioner	Attitude	1		
	Practice	1	1	
	Knowledge	-1	-1	1
Nurse	Attitude	1		
	Practice	0.821	1	
	Knowledge	0.677	0.333	1
Year of Experience		**Attitude**	**Practice**	**Knowledge**
< 5 years	Attitude	1		
	Practice	0.818	1	
	Knowledge	0.286	0.0813	1
5-10 years	Attitude	1		
	Practice	0.9155	1	
	Knowledge	0.1133	0.1375	1
>10 years	Attitude	1		
	Practice	0.994	1	
	Knowledge	0.755	0.818	1

Regression Analysis:

The regression analysis assessed the effect of Knowledge and Attitude on Practice. Both predictors were statistically significant. Knowledge showed a strong influence with a p-value of 0.00293 and an R^2 of 0.83 (Table 6), indicating that it accounts for 83% of the variance in Practice. This reflects a very strong and reliable positive relationship. Attitude also demonstrated a significant effect with a p-value of 0.03593 and an R^2 of 0.67, explaining 67% of the variance. Although substantial, its impact is comparatively weaker than Knowledge.

Table 6: Influence of Knowledge and Attitude on Practice

Intercept	X Variable	P Value	R Square
Practice	Knowledge	.00293	0.83
Practice	Attitude	.03593	0.67

The scatter plot between Knowledge and Practice displays a strong linear upward trend, with data points closely clustered around the regression line, indicating low residual error (Fig 4). This visual alignment reflects the high R^2 value of 0.83, confirming that Knowledge explains the majority of the variation in Practice. The tight fit of the line reinforces the strength and consistency of the relationship, illustrating that as Knowledge increases, Practice reliably improves. The regression plot between Attitude and Practice shows a positive trend, but with noticeably more variability around the regression line (Fig 5). This is visually consistent with the lower R^2 value of 0.67, indicating that Attitude explains less of the variance in Practice compared to Knowledge. The wider spread of data points suggests greater prediction error and a less stable relationship. While the association remains statistically significant, the plot demonstrates that Attitude is a weaker and less consistent predictor of Practice.

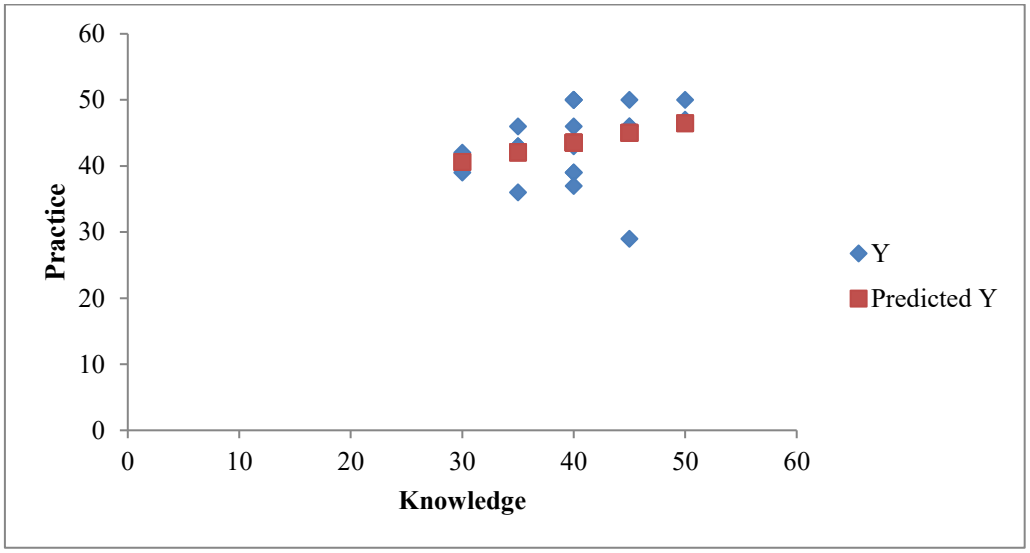


Figure 4: Knowledge - Practice Line Fit Plot

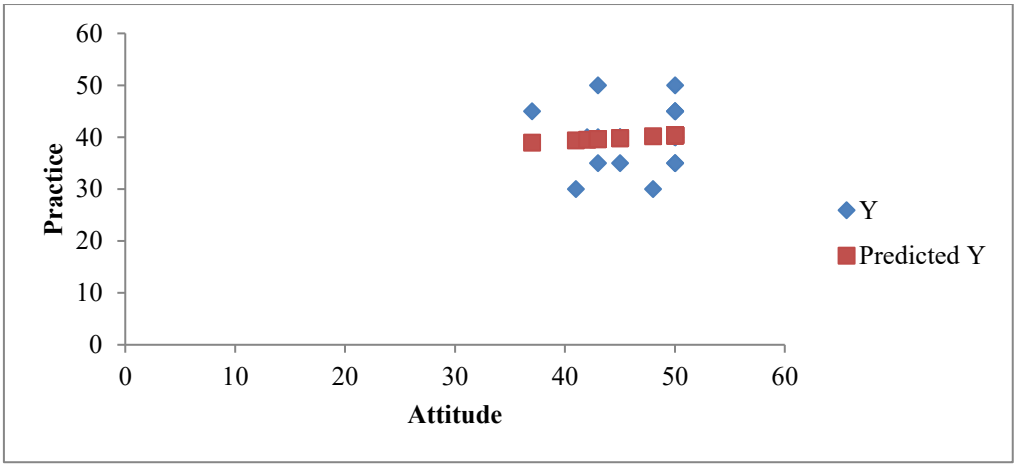


Figure 5: Attitude - Practice Line Fit Plot

Outcome of the Study:

Figure 6: Case 1

Figure 7: Case 2

Figure 8: Case 3

During the study period, among a cohort of over 400 pediatric patients who received routine immunizations, three cases were identified exhibiting mild-to-moderate AEFI, characterized primarily by cutaneous and systemic manifestations. A 2.5-month-old female developed fever, mild pain, and generalized rash on the same day of receiving OPV^2, $ROTA^2$, and $PENTA^2$ vaccines, and was managed conservatively with Paracetamol drops (Case 1) (Figure 4). An 8-month-old male infant, presented a sudden-onset of cutaneous rash within 24 hours of OPV^3, $ROTA^3$, $PENTA^3$, IPV^2, and PCV^2 administration. The child had no prior history of similar skin reactions, recent infections, or medication intake. Cutaneous examination revealed multiple erythematous macules, papules, vesicles, and targetoid lesions distributed over the neck region. There was no mucosal or systemic involvement. Dermoscopic evaluation showed a targetoid pattern with central brown peppering and peripheral pink-white areas, while histopathology revealed features consistent with an erythema multiforme like reaction. The Naranjo adverse drug reaction probability score was 4, suggesting a possible vaccine-related cause. He was treated with Vitamin D3 drops, topical mupirocin ointment, and Dermadew Aloe cream (Case 2) (Figure 5). The third case involved an 18-month-old male who developed fever and a diffuse cutaneous rash on legs one day after receiving OPV booster, MR booster, DPT booster, and the second dose of Vitamin A. He was managed with Paracetamol drops and Albendazole syrup (Case 3) (Figure 6). All three children recovered completely with supportive care, and no serious complications were observed.

DISCUSSION

This observational study included 20 healthcare professionals who met the inclusion criteria. Of these, 75% were male and 25% female. Pediatricians comprised the majority (75%), followed by nurses (15%) and general practitioners (10%), in line with demographic distributions reported by Hodel *et al.,* (2024) [14] A total of 85% of participants demonstrated accurate knowledge of the recommended immunization schedule, and 85% were aware of contraindications for specific vaccines 93.33% of whom were pediatricians. These findings are consistent with Coyer *et al.,* (2023) [15], who reported 91.5% awareness among pediatricians. Sources of immunization knowledge varied: 45% relied on academic articles or journals, 20% on continuous medical education, 15% on books, and 10% each on seminars and medical guidelines. Knowledge of managing post-vaccination side effects was high, with 80% demonstrating familiarity 93.75% being pediatricians. Conversely, 20%, mostly nurses and general practitioners, showed limited understanding, echoing gaps identified by Swarnkar *et al.,* (2016) [16]. Moreover, 80% of participants regularly informed parents about common side effects, emphasizing the role of communication in vaccine acceptance. Documentation practices were inconsistent: while 60% reported regular documentation (80% among pediatricians), 40% primarily non-pediatricians failed to do so, highlighting a need for standardized protocols. Regarding adverse drug reaction (ADR) reporting, 60% rated their practices as "perfect," with 80% of these being pediatricians. However, 40% nurses and general practitioners rated their reporting as "poor," aligning with prior findings on inadequate ADR documentation Kaufman et al., (2021) [17]. Confidence in vaccine administration was high (90%), with 100% of pediatricians expressing full confidence; general practitioners accounted for those reporting hesitancy, consistent with Ali *et al.,*(2023) [18]. Seventy percent of professionals, particularly pediatricians (93.33%), regularly educated parents about vaccine safety, while the remaining 30% nurses and general practitioners did not. Only 60% received vaccine-specific training in the past year, with no nurses undergoing such training. While 30% of respondents were satisfied with current training programs, 70% advocated improvements, echoing concerns raised by Kumar *et al.,*(2021) [19]. During the study period 400 pediatric patients observed, 66.25% were infants aged 1–12 months, and 20.5% were newborns. Common vaccine combinations administered included OPV1, ROTA1, PENTA1, IPV1, and PCV1 (21.5%) and OPV0, BCG, and Hepatitis B (20.5%). Vaccine compliance was high (98%), with only 2% experiencing delays, primarily due to lack of knowledge (50%) and logistical barriers (37.5%) as per Johnson *et al.,*(2024) [20]. Among vaccinated children, 64.75% experienced side effects: fever (94.2%) was most

common, followed by pain (53.28%), swelling (46.72%), and redness (25.87%). Less frequent symptoms included rashes (1.15%) and vomiting (1.54%). Most side effects had immediate onset (68.73%). Management included paracetamol (238 cases), vitamin D3, cetirizine, albendazole, and supportive treatments. These findings mirror patterns described by Mittal *et al.,* (2024) [21].

CONCLUSION:

This study's primary objective was to assess the attitude and current practices of healthcare professionals towards side effects monitoring and vaccine safety communication in pediatric healthcare settings. The findings among those 20 healthcare professionals indicates Knowledge attributes to 83% of variability in Practice with strong positive correlation (0.81) and Attitude contributes to 67% variability in Practice with moderate positive correlation (0.31). Thus, Significant gaps were identified between Attitude, Knowledge and Current Practices among HCPs. A large number of professionals doesn't undergo the specific training regarding vaccine safety, that indicates insufficient confidence on managing post-vaccination side effects. Although most professionals demonstrated sound knowledge of immunization schedules and side effect management, inconsistencies in documentation, training, and ADR reporting were evident particularly among non-pediatric staff. The study reinforces the need for continuous professional development tailored to all cadres of healthcare workers to ensure uniform understanding and application of immunization protocols. Moreover, while a high proportion of pediatric patients received vaccines on schedule and side effects were largely mild and managed effectively, the variability in knowledge sources and training satisfaction levels suggests room for improvement in educational outreach and systematized guidance. Addressing these disparities is crucial for strengthening vaccine confidence, enhancing ADR surveillance, and fostering more consistent parent education. Ultimately, the study underscores the importance of equipping all healthcare professionals not just pediatricians with the necessary tools, training, and protocols to uphold optimal pediatric vaccination outcomes, reduce delays, and safeguard child health through evidence-based immunization practices.

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Author Contribution

KB and P contributed to the Conceptualization, Data collection and draft making. AK and BR contributed total draft checking. KB and LS made the manuscript drafting and revision. The authors declare that no paper mill was used, and that all data were generated in-house.

Data availability

All source data for this work (or generated in this study) are available upon reasonable request.

Declarations

Ethical Approval: This study was approved by the Institutional Ethics Committee (IEC) of Employees' State Insurance Corporation (ESIC) Medical College, PGIMSR and Model Hospital. The study adhered to the guidelines of the Indian Council of Medical Research (ICMR), Government of India.

Approval No:
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REFERENCES

1. World Health Organization. Immunization coverage. Geneva: WHO; 2023.
2. Andre FE, Booy R, Bock HL, Clemens J, Datta SK, John TJ, *et al.,* Vaccination greatly reduces disease, disability, death and inequity worldwide. Bull World Health Organ. 2008;86(2):140–6. http://dx.doi.org/10.2471/blt.07.040089
3. Kroger AT, Atkinson WL, Marcuse EK, Pickering LK; Advisory Committee on Immunization Practices (ACIP) Centers for Disease Control and Prevention (CDC). General recommendations on immunization: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep. 2006 Dec 1;55(RR-15):1-48. Erratum in: MMWR Morb Mortal Wkly Rep. 2006 Dec 8;55(48):1303. Erratum in: MMWR Morb Mortal Wkly Rep. 2007 Mar 23;56(11):256. Erratum in: Pediatrics. 2007 May;119(5):1008. PMID: 17136024.
4. World Health Organization. Manual for the surveillance of adverse events following immunization. Geneva: WHO; 2019.
5. Bonhoeffer J, Kohl K, Chen R, Duclos P, Heijbel H, Heininger U, *et al.,*The Brighton Collaboration: addressing the need for standardized case definitions of adverse events following immunization (AEFI). Vaccine 2002;21(3–4):298–302. Available from: http://dx.doi.org/10.1016/s0264-410x(02)00449-8
6. Gonella, L. A., Moretti, F., Capuano, A., De Sarro, C., Ferrara, L., Geninatti, E., Guarnieri, G., Hysolakoj, X., Lalli, M., Leoni, O., Mangano, A. M. P., Marani Toro, P., Mecchia, V., Merlano, M. C., Palleria, C., Potenza, A. M., Rossi, P., Rossi, M., Sanità, F., VigiVax Working Group. (2024). SMS-based active surveillance of adverse events following immunization in children: The VigiVax

study. *Vaccines*, *12*(9), 1076. https://doi.org/10.3390/vaccines12091076
7. Ministry of Health and Family Welfare. India TB Report 2023: National Tuberculosis Elimination Programme. New Delhi: MoHFW; 2023.
8. Parashar UD, Hummelman EG, Bresee JS, Miller MA, Glass RI. Global illness and deaths caused by rotavirus disease in children. Emerg Infect Dis. 2003;9(5):565–72. http://dx.doi.org/10.3201/eid0905.020562
9. Klugman, K. P., Madhi, S. A., Huebner, R. E., Kohberger, R., Mbelle, N., Pierce, N., & Vaccine Trialists Group. (2003). A trial of a 9-valent pneumococcal conjugate vaccine in children with and those without HIV infection. *The New England Journal of Medicine*, *349*(14), 1341–1348. https://doi.org/10.1056/NEJMoa035060
10. Cherry JD. Historical review of pertussis and the classical vaccine. J Infect Dis. 1996 Nov;174 Suppl 3:S259-63. doi: 10.1093/infdis/174.supplement_3.s259. PMID: 8896526.
11. Garon JR, Cochi SL, Orenstein WA. The Challenge of Global Poliomyelitis Eradication. Infect Dis Clin North Am. 2015 Dec;29(4):651-65. doi: 10.1016/j.idc.2015.07.003.
12. Whitney, C. G., Farley, M. M., Hadler, J., Harrison, L. H., Bennett, N. M., Lynfield, R., Reingold, A., Cieslak, P. R., Pilishvili, T., Jackson, D., Facklam, R. R., Jorgensen, J. H., Schuchat, A., & Active Bacterial Core Surveillance of the Emerging Infections Program Network. (2003). Decline in invasive pneumococcal disease after the introduction of protein-polysaccharide conjugate vaccine. *The New England Journal of Medicine*, *348*(18), 1737–1746. https://doi.org/10.1056/NEJMoa022823
13. Ministry of Health and Family Welfare, Government of India. UIP Operational Guidelines 2022
14. Hodel, K. V. S., Fiuza, B. S. D., Conceição, R. S., Aleluia, A. C. M., Pitanga, T. N., Fonseca, L. M. D. S., Valente, C. O., Minafra-Rezende, C. S., & Machado, B. A. S. (2024). Pharmacovigilance in vaccines: Importance, main aspects, perspectives, and challenges-A narrative review. *Pharmaceuticals (Basel, Switzerland)*, *17*(6), 807. https://doi.org/10.3390/ph17060807
15. Coyer, L., Sogan-Ekinci, A., Greutélaers, B., Kuhn, J., Saller, F. S., Hailer, J., Böhm, S., Brosch, R., Wagner-Wiening, C., & Böhmer, M. M. (2023). Knowledge, attitudes and behaviors regarding tick-borne encephalitis vaccination and prevention of tick-borne diseases among primary care physicians in Bavaria and Baden-Wuerttemberg, Germany, May-September 2022. *Microorganisms*, *11*(4), 961. https://doi.org/10.3390/microorganisms11040961
16. Swarnkar M, Baig VN, Soni SC, Shukla US, Ali J. Assessment Of Knowledge and Practice About Immunization Among Health Care Providers. Natl J Community Med. 2016 Apr. 30;7(04):281-5. https://njcmindia.com/index.php/file/article/view/914
17. Kaufman, J., Tuckerman, J., Bonner, C., Durrheim, D. N., Costa, D., Trevena, L., Thomas, S., & Danchin, M. (2021). Parent-level barriers to uptake of childhood vaccination: a global overview of systematic reviews. *BMJ Global Health*, *6*(9), e006860. https://doi.org/10.1136/bmjgh-2021-006860
18. Ali Y, Piche-Renaud PP, Karimi-Shahrbabak E, Farrar DS, Fadaleh SA, Burey S, Morris SK. Pediatricians' perceptions, practices, and barriers regarding COVID-19 vaccine for children: A cross-sectional survey in Ontario, Canada. Vaccine. 2023 May 5;41(19):3058-3065. doi: 10.1016/j.vaccine.2023.03.041.
19. Srivastava, S., Kumar, P., Chauhan, S., & Banerjee, A. (2021). Household expenditure for immunization among children in India: a two-part model approach. *BMC Health Services Research*, *21*(1), 1001. https://doi.org/10.1186/s12913-021-07011-0
20. Shattock, A. J., Johnson, H. C., Sim, S. Y., Carter, A., Lambach, P., Hutubessy, R. C. W., Thompson, K. M., Badizadegan, K., Lambert, B., Ferrari, M. J., Jit, M., Fu, H., Silal, S. P., Hounsell, R. A., White, R. G., Mosser, J. F., Gaythorpe, K. A. M., Trotter, C. L., Lindstrand, A., … Bar-Zeev, N. (2024). Contribution of vaccination to improved survival and health: modelling 50 years of the Expanded Programme on Immunization. *Lancet*, *403*(10441), 2307–2316. https://doi.org/10.1016/S0140-6736(24)00850-X
21. Mittal S, Rawat C, Gupta A, Solanki HK, Singh RK. Adverse Events Following Immunization Among Children Under Two Years of Age: A Prospective Observational Study From North India. Cureus. 2023 Apr 30;15(4):e38356. doi: 10.7759/cureus.38356