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Predictors of Adverse Events Following Immunization Reporting amongst Healthcare Workers in Jigawa State, Northern Nigeria, 2022

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Abstract

An adverse event following immunization (AEFI) is any untoward medical occurrence that follows immunization and does not necessarily have a causal relationship with the usage of the vaccine. Reporting of AEFI is suboptimal amongst healthcare workers (HWs). This study aimed to determine predictors of HW's reporting of AEFI. A descriptive cross-sectional study was conducted among HWs in selected health facilities (HFs) in Jigawa State using an open data kit self-administered questionnaire to collect data on socio-demographic characteristics, training, knowledge, and their practices on AEFI reporting. Analysis was conducted using Statistical Package for Social Sciences (SPSS) for frequencies, proportions, and associations using bivariate analysis and multivariate analysis using logistic regression to determine predictors of AEFI reporting with statistical significance set at p<0.05 and 95% confidence interval. Of the 400 respondents, 280 (70%) respondents had good knowledge of AEFI, 328(82%) sends routine AEFI reports and of 212 (53%) who recently encountered an AEFI, 174 (82.1%) exhibited some good reporting practices. Female gender (AOR 0.46, p=0.035), full-time employees (AOR 0.227, p=0.019), a recent encounter with an AEFI (AOR 3.087, p=0.007) and being trained on AEFI (AOR 5.54, p=0.011), reporting to elicit training (AOR 2.70, p=0.031) were predictors of routine reporting from health facility and reporting an encountered AEFI respectively. Overall, gender, employment status, being trained, and recent AEFI encounter to elicit training were predictors of AEFI reporting. To improve reporting of AEFI, there is a need to engage and train health workers on AEFI surveillance.

Keywords: *Adverse events following immunization, Knowledge, Practice, Predictors, Reporting.*

Introduction

Vaccination has been adjudged one of the most successful public health interventions globally, which has achieved a significant reduction in morbidity and mortality associated with vaccine-preventable diseases [1]. Childhood immunization is one interventions that has promoted the health, well-being, and survival of children [2]. Vaccines have been documented to be the safest method of protecting children from life-threatening vaccine preventable diseases [3, 4]. About 45% of the world's children under five in 2020 were vaccinated with life-saving vaccines, and every minute, more than five children are saved, preventing 3.5-5 million deaths a year [3, 4].

Adverse Event Following Immunization (AEFI) refers to any unfavourable event occurring following vaccination related to the vaccine administration and or its handling [5-9]. AEFI can be categorized as vaccine

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reactions, program errors, coincidental events, injection reactions, and unknown events [5, 6, 10]. AEFI can lead to death or a life-threatening condition requiring hospitalization with or without permanent sequel [5]. The occurrence of AEFI is on a global scale, with 1.14 cases of AEFIs and 1.4% deaths reported in the United States of America for every 10,000 cases of vaccinations [11]. While other studies conducted in Spain and USA showed that AEFI rate varies between 11.9–19% per 1000 doses ("Retrospective Qualitative and Quantitative Analysis of Adverse Events Following Vaccination – Journal of Young Pharmacists," n.d.). Furthermore, 14.1 and 129.5 cases of AEFI per 100,000 vaccine doses had been reported in Australia and Sri Fanka respectively [11]. While in Nigeria, reported rates of AEFI varied from 19.3% to 57%, indicative of the fact that the occurrence of AEFI in the Nigerian context needs to be studied [11].

Reporting AEFIs is important in recognizing the occurrence of rare events for new vaccines which may not be known during clinical trials or to monitor the rates of such events for well-established vaccines. Health care workers at primary health centers(PHCs) are the key persons involved in routine immunization activities and represent the first level of contact with children and their caregivers [12]. They form a very significant group among the stakeholders of vaccine safety [13]. In the event of an AEFI, they are expected to make the correct diagnosis, provide firsthand information and prompt counseling to the parents of affected children, and be able to institute [12] appropriate management [14].

Poor knowledge of AEFI among healthcare workers will result in many cases of AEFI going unreported and unaddressed, which may undermine confidence in national immunization programmes, as well as reduce immunization uptake and have a negative public health impact. A study examining Canadian family physicians awareness of vaccine-associated adverse events showed that less than half of the study respondents were aware of a monitoring system for AEFI, one-third knew of the reporting criteria, and only one in four had received vaccine adverse events education during medical training [12]. A study in the United States of America among physicians, pharmacists, and nurses that examined reporting systems, the frequency of reporting of vaccine adverse events, beliefs, and awareness of AEFI found that 71% had never reported AEFI, and 17% indicated they were not aware of how to report [14]. A study from the United Kingdom on AEFI reporting of meningococcal serogroup C conjugate vaccine found that nurses reported AEFIs more frequently than general practitioners and hospital doctors [15].

Available literature showed that healthcare workers in many developing countries have poor attitudes and inadequate knowledge of AEFI and AEFI reporting systems [14-16]. In a similar study in Kenya [15], only 29.2% of health workers studied had good knowledge on AEFI surveillance. In Nigeria, only a few studies were conducted on AEFI [11, 17, 18]. A study in Lagos southwestern Nigeria [18] reported that 80% of the health workers studied have good knowledge on AEFI handling and reporting while a similar study in Zaria, Northwestern Nigeria [11] reported a relatively lower proportion(58.9%) of respondents having good knowledge on AEFI. Though the Lagos study evaluated the healthcare workers' knowledge and reporting practices on AEFI, it did not assess their attitude concerning AEFI management and reporting.

AEFI reporting in Nigeria relies strictly on passive surveillance, which consists of routine monthly reporting by health care providers to the local government authorities (Districts) using AEFI reporting forms and active during campaigns [19]. The passive nature of AEFI surveillance has limitations like underreporting, lack of completeness of reports, non-reporting, and potential reporting bias, which ultimately could lead to delays in detecting, investigating, and giving information to the community on the

adverse events as well as to the relevant action by health authorities [20]. Reported AEFIs must be carefully documented and managed properly to increase the confidence of the public in accepting vaccinations for all eligible children [21]. It is therefore important that all events are reported, carefully investigated, and reviewed for their potential causality, particularly whether the event is linked to a biologically plausible mechanism of action [22].

There is a paucity of information on the predictors of AEFI reporting in the country and the reporting of AEFI is still a major challenge amongst health workers in Nigeria and as shown in studies that have documented the knowledge, perception, attitudes, and practices of health care workers toward AEFI reporting [11, 18]. Understanding the factors affecting AEFI reporting amongst HCWs will provide the opportunity to strengthen the surveillance system. With the introduction of new vaccines in the system, it is pertinent that the predictors of AEFI reporting amongst primary care health providers who mostly are the first to come in contact with caregivers, is known and they should be adequately equipped with the required knowledge and skills to effectively deliver key messages on immunization including the benefits and risks of vaccines, and appropriately explain AEFI to caregivers and alleviate the concerns and myths about vaccines [23].

The study was conducted to determine predictors of AEFI reporting amongst health workers in selected health facilities in Jigawa State, Northern Nigeria, and specifically to determine the knowledge, practices, and predictors of AEFI reporting among healthcare workers.

Materials and Methods

Study Area

The study was conducted in selected health facilities providing routine immunization (RI) in Jigawa state, Northern Nigeria. Respondents were healthcare workers providing RI and other health-related services who might likely come across AEFI cases during their daily work in the selected. The state has a projected 2021 population of 5,828,200 based on the 2016 national population census with an under 1year target population of 233,128. There are 27 LGAs in the state with 288 administrative wards and a total of 712 health facilities providing RI services.

Study Design

A descriptive cross-sectional quantitative study was conducted amongst randomly selected health workers spread across health facilities in Jigawa state, Northern Nigeria, A self-administered structured questionnaire with multiple choice open and closed-ended questions was developed with references from similar studies conducted and input from professionals in the immunization landscape to capture information on socio-demographic information and AEFI training history, knowledge of health workers on adverse events, and healthcare workers' practice of reporting an AEFI. Questionnaire was deployed electronically on an open data kit (ODK) shared via a link to be accessed by all healthcare workers.

Sampling

The sample size of 404 was calculated using the Lens formula $n=z^2pq/d^2$[24] with a correcting for 10% nonresponse rate. A probability sampling methodology was adopted in a two-stage sampling technique. All LGAs were enrolled for this study, with all secondary Health facilities (one per LGA) automatically selected. Public health facilities (PHCs) offering RI were randomly selected across the LGAs. Respondents were then selected from identified health facilities, and the questionnaire link was deployed to such facilities.

Data Analysis

Data were collected from September to October 2021. The cleaned data was

downloaded into the Microsoft office Excel 2010 database. Coding and analysis were done using Statistical Package for Social Sciences, IBM® SPSS version 21 (SPSS Inc., USA). Statistical significance was set at p-value ≤ 0.05 at 95% confidence interval. Knowledge was assessed with 14 questions and an obtainable maximum score of 18 points. Two of the knowledge questions had 3 expected responses and all were allotted a score for each correct response.

Each correct response for knowledge, and practice was scored "1 point" while an incorrect response was scored "0 point". Yes or no responses also scored "1 and 0 points", respectively. Respondents with a score of 13-18 (over 70%) were graded as good knowledge, a score of 9 – 12 (50% - 70%) as fair and a score of 0 – 8 (<50) as poor knowledge. For practice, an overall assessment of health workers' practices towards AEFI reporting was reviewed across 15 questions; however only 5 questions were graded with a maximum obtainable score of "5 points", and a minimum of "0 points" for health workers who had encountered an AEFI in the last 3 months. The overall practice was graded on a scale of 0-2 for poor practice and 3-5 for good practice.

Univariate analysis was conducted for frequencies, proportions for categorical variables and mean ± standard deviation and median for numerical variables. All were summarized using frequency, tables, and charts. Bivariate analysis was conducted using the Chi-Square test and Fisher's exact test where indicated, to compare the outcomes of interest (predictors of AEFI reporting) with independent variables at the statistical level of significance (α) set at p<0.05. The independent variables were age, gender, designation, employment status, years of experience as a health worker and on immunization, training received on immunization and specifically on AEFI, and training need. The outcome (dependent) variables were healthcare workers knowledge of AEFI and practices on AEFI reporting. Variables found to be significant in the Chi-square test (p-value <0.05) were subjected to a binomial logistic model to determine their relationship with the outcome (dependent) variables of interest. A 2-tailed test of the hypothesis was conducted with a statistical level of significance (α) set at p<0.05 to obtain an adjusted odds ratio (AOR) at 95% confidence interval.

Ethical Considerations

To conduct this assessment, permission was sought from the Jigawa state primary health care board for onward transmission to the selected LGA to the Heads of departments of Health.

The participation of the health workers providing RI and other services was made voluntary and only consented HCWs were administered the questionnaire. Information about the participants was kept confidential, and their names were not indicated to ensure the anonymity of participants. There was no potential risk attached to the study or participating in the study, and findings will be used by authorities to develop plans to improve the immunization system.

Limitations

The research was not without limitations. Though the respondents were kept anonymous, respondents had challenges around divulging sensitive information, and this led to some questions not being appropriately responded to. Health workers in private health facilities were excluded from this research, and hence findings might not be representative of the entire state. The questionnaire was self-administered, and as such, some of the responses could have been biased.

To address limitations associated with the research work such as fear of divulging sensitive information and incomplete entry, an electronic questionnaire administration was used to ensure the privacy and confidentiality of respondents.

Results

Socio-demographic Characteristics and AEFI Training History

Overall, a total of 400 questionnaires were administered to health workers spread across all LGAs in the state. Most respondents were males 352 (88%), had over six years of experience as health workers 286 (71.5%), and over 6 years of experience in immunization 271 (67.8%). Community health extension workers (CHEW) contributed the highest proportion of respondents 263 (65.8%), 328 (82%) were full-time personnel, 394(98%) had received training on RI, 382(95.5%) trained on AEFI; however, 345 (86.2%) reportedly required additional training. The mean age of the respondents was 37.4 (±8.4SD) years old (Table 1).

Table 1. Socio-demographic Characteristics of Respondents in Jigawa State, 2022

Characteristic		**Frequency (N)**	**Percentage (%)**
Age Group (in years)	20-29	77	19.3
	30-39	159	39.8
	40-49	129	32.3
	≥50	35	8.8
Sex	Male	352	88
	Female	48	12
Designation	CHEW	263	65.8
	Environmental Health	39	9.8
	CHO	35	8.8
	JCHEW	22	5.5
	Nurse	4	1.0
	Midwife	3	0.8
	Doctor	2	0.5
	Other*	32	8.0
Years of experience as a health worker	<1yr	9	2.2
	1-6yrs	105	26.2
	>6yrs	286	71.5
Years of experience on immunization	<1yr	16	4
	1-6yrs	113	28.2
	>6yrs	271	67.8
Role in immunization	Vaccinator	188	47
	Recorder	57	14.2
	Health Educator	61	15.2
	Community Mobilizer	41	10.2
	OIC	141	35.2
	Other**	104	
Employment status	Full	328	82.0
	Casual	42	10.5
	Volunteer	30	7.5
Capacity Building	Trained on AEFI	382	95.5
Duration of last training on AEFI	Last 6 months	247	61.8
	Last one year	73	18.2
	>1 year	62	15.5

*Other: Health technicians and health assistants, **Other: Doubles as ward focal person, routine immunization officer, ANC nurse and Surveillance focal point

Knowledge of AEFI Reporting

Most respondents, 389 (97.2%) could define an AEFI, could mention at least one cause-specific type of AEFI 323 (80.8%) and listed a minimum of 3 types of reportable AEFIs 360 (90%). On reporting AEFIs, only 225 (55.5%) mentioned that all healthcare workers should report, and 367 (91.8) indicated immediate reporting. Though over 90% listed hydrocortisone and adrenaline as contents of an AEFI kit, referral to them was the first line of management in 298 (74.5%) respondents. Overall, 280 (70%) respondents had good knowledge of AEFI, 110 (27.5%) had fair knowledge, and 10 (2.5%) had poor knowledge, with mean knowledge score of 13.43 (+ 2.27). Respondents age (p=0.005), employment status (p=0.002), training on AEFI module (p=0.001), years of experience as a health worker (p=0.033), and years of experience on immunization (p=0.05) were significantly associated with HWs' knowledge of AEFI (Table 2).

Table 2. Association between Knowledge of AEFI and Health Workers' Characteristics in Jigawa State

Variables	**Level of Knowledge**		**Fisher Exact^{+} or X^2 (p-value)**
	Poor N (%*)	**Good N (%*)**	
	120 (30.0)	**280 (70.0)**	**400**
Age (years)			
20 – 29	36 (46.8)	41 (53.2)	**12.76 (0.005)**
30 – 39	41 (25.8)	118 (74.2)	
40 – 49	34 (26.4)	95 (73.6)	
≥ 50	9 (25.7)	26 (74.3)	
Gender			
Male	101 (28.7)	251 (71.3)	2.39 (0.122)
Female	19 (39.6)	29 (60.4)	
Designation			
CHW	90 (28.1)	230 (71.9)	5.44^{+} (0.112)
Nurse/Midwife	1 (14.3)	6 (85.7)	
Doctor	0 (0.0)	2 (100.0)	
Others	29 (40.8)	42 (59.2)	
Employment status			
Full time	86 (26.2)	242 (73.8)	**12.59 (0.002)**
Volunteer	15 (50.0)	15 (50.0)	
Casual (part-time)	19 (45.2)	23 (54.8)	
Received RI training			
Yes	117 (29.7)	277 (70.3)	1.06^{+} (0.370)
No	3 (50.0)	3 (50.0)	
Received AEFI training			
Yes	108 (28.3)	274 (71.7)	**12.07 (0.001)**
No	12 (66.7)	6 (33.3)	
Years of experience			
≤ 6 years	43 (37.7)	71 (62.3)	**4.52 (0.033**)
> 6 years	77 (26.9)	209 (73.1)	
Years of Immunization experience			

≤ 6 years	47 (36.4)	82 (63.6)	3.75 (0.053)
> 6 years	73 (26.9)	198 (73.1)	
Need AEFI training			
Yes	108 (31.3)	237 (68.7)	2.03 (0.154)
No	12 (21.8)	43 (78.2)	
Routinely send AEFI report			
Yes	93 (28.4)	235 (71.6)	2.35 (0.125)
No	27 (37.5)	45 (42.5)	

Factors Affecting Healthcare Workers Knowledge of AEFI

A logistic regression analysis was performed to determine the effects of age, being trained on AEFI, employment status, and years of experience on the respondents' level of AEFI knowledge. The model showed statistical significance, $\chi^2(7) = 13.93$ (p = 052). The model explained 9.1% (Nagelkerke R2) of the variance in the level of AEFI knowledge and correctly classified 75.9% of cases. Respondents aged 30-39 years (AOR = 1.989, P = 0.047) and those trained on AEFI were significant factors affecting knowledge of AEFI (Table 3).

Table 3. Factors Affecting Knowledge of Health Workers on AEFI Reporting in Jigawa State

Variables in the Equation								
Variables	B	S.E.	Wald	df	Sig.	OR	95% CI	
							Lower	Upper
Age (20 – 29 years)-Reference	-	-	3.994	3	.262	-	-	-
Age (30 – 39 years)	**.688**	**.346**	**3.961**	**1**	**.047**	**1.989**	**1.010**	**3.917**
Age (40 – 49 years)	.596	.398	2.247	1	.134	1.815	.832	3.959
Age (50years & above)	.622	.511	1.482	1	.223	1.863	.684	5.071
Received AEFI training	**1.467**	**.528**	**7.718**	**1**	**.005**	**4.337**	**1.540**	**12.210**
Employment (Casual)-Reference	-	-	4.030	2	.133	-	-	-
Employment (Volunteer)	.493	.387	1.626	1	.202	1.638	.767	3.497

Practice of AEFI Reporting

A total of 212 (53.0%) respondents had recently encountered an AEFI of which 174(82.1%) exhibited good practice while 38 (17.9%) respondents exhibited poor practice towards AEFI reporting. The overall mean practice score was 2.03 (+ 2.11SD). 172 (81.1%) only line listed even though 14(6.6%) of them were serious cases, 121 (57.1%) of the respondents treated and reassured the cases. On timeliness of reporting, 179 (52.4%) reported the AEFIs immediately, while 68 (32.1%) reported within 24hrs, and only 131(61.8%) got feedback from the state and LGA, of which 126(96.2%) shared the feedback with the community. Respondents that received training on AEFI X27.31 (p=0.018) and needed AEFI training X24.43 (p=0.035), were significantly associated with reporting an encountered AEFI (Table 4).

Table 4. Association between Health Workers' Characteristics and Reporting of an Encountered AEFI In Jigawa State

Variables	**The practice of AEFI reporting**		**Fisher Exact^{+} or X^2 (p-value)**
	Good N (%*)	**Poor N (%*)**	
N = 212	**174 (82.1)**	**38 (17.9)**	
Age (years)			
20 – 29	33 (82.5)	7 (17.5)	4.76 (0.190)
30 – 39	76 (87.4)	11 (12.6)	
40 – 49	48 (73.8)	17 (26.2)	
≥ 50	17 (85.0)	3 (15.0)	
Gender			
Male	158 (82.7)	33 (17.3)	0.51 (0.547)
Female	16 (76.2)	5 (23.8)	
Designation			
CHW	132 (80.5)	32 (19.5)	1.66^{+} (0.704)
Nurse /Midwife	5 (83.3)	1 (16.7)	
Doctor	1 (100.0)	0 (0.0)	
Others	36 (87.8)	5 (12.2)	
Employment status			
Full time	144 (83.7)	28 (16.3)	4.66 (0.097)
Volunteer	5 (55.6)	4 (44.4)	
Casual (part-time)	25 (80.6)	6 (19.4)	
Received RI training			
Yes	172 (81.9)	38 (18.1)	0.79^{+} (1.000)
No	2 (100.0)	0 (0.0)	
Received AEFI training			
Yes	169 (83.7)	33 (16.3)	**7.31 (0.018)**
No	5 (50.0)	5 (50.0)	
Years of experience			
≤ 6 years	50 (78.1)	14 (21.9)	0.97 (0.324)
> 6 years	124 (83.8)	24 (16.2)	
Years of immunization experience			
≤ 6 years	59 (78.7)	16 (21.3)	0.92 (0.338)
> 6 years	115 (83.9)	22 (16.1)	
Need AEFI training			
Yes	155 (84.2)	29 (15.8)	**4.43 (0.035)**
No	19 (67.9)	9 (32.1)	
Knowledge of AEFI			
Good	170 (81.7)	38 (18.3)	1.60 (1.000)
Poor	4 (100.0)	0 (0.0)	
Perception of AEFI reporting			
High	155 (81.2)	36 (18.8)	1.28 (0.381)
Low	19 (90.5)	2 (9.5)	

* Percentage withing group ** Percentage of total

Of the 328 (82%) respondents who have reported an AEFI routinely from the health facility to the LGA at a point in time, 240 (73.2%) submitted a report within the last month. The methods used to report AEFI from HFs are mostly through the AEFI forms 367 (91.8%) and up to 387 (96.8%) counsel caregivers on AEFI and give them key messages during immunization, while only 15 (3.8%) could manage serious AEFIs. The preferred method of reporting was still the use of paper tools 319 (79.8%).

Respondents' gender (p=0.011), employment status (p<0.001), routine receipt of feedback from the state and LGA (p=0.001), encountering an AEFI recently (p<0.001), and perception of AEFI reporting (p=0.943) had a significant relationship with routine AEFI reporting from the health facility (Table 5).

Table 5. Association between Health worker's characteristics and routine AEFI reporting in Jigawa State

Variables	**Report AEFI routinely**		**Fisher Exact^{+} or X^2 (p-value)**
	Yes (%*)	**No (%*)**	
	328 (82.0)	**72 (18.0)**	
Age (years)			
20 – 29	60 (77.9)	17 (22.1)	2.48 (0.480)
30 – 39	136 (85.5)	23 (14.5)	
40 – 49	104 (80.6)	25 (19.4)	
≥50	28 (80.0)	7 (20.0)	
Gender			
Male	295 (83.8)	57 (16.2)	**6.49 (0.011)**
Female	33 (68.8)	15 (31.2)	
Designation			
CHW	265 (82.8)	55 (17.2)	3.03^{+} (0.341)
Nurse/Midwife	5 (71.4)	2 (28.6)	
Doctor	1 (50.0)	1 (50.0)	
Others	57 (80.3)	14 (19.7)	
Employment status			
Full time	275 (83.8)	53 (16.2)	**18.51 (<0.001**)
Volunteer	16 (53.3)	14 (46.7)	
Casual (part-time)	37 (88.1)	5 (11.9)	
Received RI training			
Yes	324 (82.2)	70 (17.8)	0.82^{+} (0.295)
No	4 (66.7)	2 (33.3)	
Received AEFI training			
Yes	316 (82.7)	66 (17.3)	2.56^{+} (0.110)
No	12 (66.7)	6 (33.3)	
Years of working experience			
≤ 6 years	93 (81.6)	21 (18.4)	0.02 (0.890)
> 6 years	235 (82.2)	51 (17.8)	
Years of RI experience			
≤ 6 years	106 (79.1)	27 (20.9)	1.11 (0.293)
> 6 years	226 (83.4)	45 (16.6)	
Need AEFI training			

Yes	287 (83.2)	58 (16.8)	1.09 (0.132)
No	41 (74.5)	14 (25.5)	
Knowledge of AEFI			
High	235 (83.9)	45 (16.1)	2.35 (0.125)
Low	93 (77.5)	27 (22.5)	
Routinely receive feedback from the state/LGA			
Yes	119 (90.8)	12 (9.2)	**10.31 (0.001)**
No	209 (77.7)	60 (22.3)	
Encountered an AEFI in the last 3 months			
Yes	192 (90.6)	20 (9.4)	**22.42**
No	136 (72.3)	52 (27.7)	**(<0.001)**
Perception of AEFI reporting			
High	297 (82.0)	65 (18.0)	**0.01 (0.943)**
Low	31 (81.6)	7 (18.4)	

Predictors of AEFI Reporting among Healthcare Workers

On reporting of an encountered AEFI, a logistic model was conducted to ascertain the effect of AEFI training and the need for training on reporting an encountered AEFI by health workers. The logistic analysis was statistically significant, $\chi^2(7) = 9.92$, $p = 0.007$. The model explained 7.5% (Nagelkerke R2) of the variance in the level of reporting an encountered AEFI and correctly classified 82.5% of cases. Respondents trained on AEFI were 5.54 times more likely to report encountered AEFI (AOR 5.54, p=0.011), those that were reported to elicit training (required training) were 2.70 times more likely to report an encountered AEFI (AOR 2.70, p=0.031) (Table 6).

Table 6. Predictors of Reporting an Encountered AEFI by Health Workers in Jigawa State

Variables in the Equation								
Variable	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I.for EXP(B)	
							Lower	Upper
Received AEFI training	**1.712**	**.670**	**6.531**	**1**	**.011**	**5.539**	**1.490**	**20.585**
Need AEFI training (Yes)	**.991**	**.461**	**4.627**	**1**	**.031**	**2.695**	**1.092**	**6.649**
Constant	-.898	.766	1.374	1	.241	.408		

a. Variable(s) entered on step 1: trainedaefi, needtraining.

On routine monthly reporting of AEF, logistic regression was conducted to ascertain the effects of gender, employment status, receipt of feedback from states/ LGA, recent AEFI encounter, and HW perception on respondents' practice of routine AEFI reporting from the facilities. The regression analysis was statistically significant with p-value <0.001. The model explained 14.7% (Nagelkerke R2) of the variance in the level of AEFI routine reporting practices from the health facilities correctly classified 82.0% of cases. Female respondents were 0.46 times more likely to routinely report AEFI (AOR 0.46, p=0.035), full-time employees were 0.23 times more likely to routinely report AEFI (AOR 0.227, p=0.019), and those with recent AEFI encounter were 3.08 times more likely to also report on AEFI routinely (AOR 3.087, p=0.007) (Table 7).

Table 7. Predictors of Routine Reporting of AEFI from the Health Facilities in Jigawa State

Variables in the Equation								
	B	S.E.	Wald	df	Sig.	OR	95% CI	
							Lower	Upper
Gender (Female)	**-.771**	**.365**	**4.467**	**1**	**.035**	**.462**	**.226**	**.946**
Employment (Casual)-REF	-	-	10.684	2	.005	-	-	-
Employment (Volunteer)	-.158	.522	.091	1	.763	.854	.307	2.375
Employment (Full-time)	**-1.482**	**.630**	**5.528**	**1**	**.019**	**.227**	**.066**	**.781**
Receives AEFI feedback from the state (Yes)	.084	.487	.029	1	.864	1.087	.418	2.824
anyaefi(1)	**1.127**	**.417**	**7.312**	**1**	**.007**	**3.087**	**1.364**	**6.986**
Constant	1.412	.527	7.195	1	.007	4.105		

a. Variable(s) entered on step 1: sex, employment, fdbckstate_1, anyaefi

Discussion

Adverse events following immunization (AEFIs) is of public health concern since it can lead to public distrust, with a consequent decline in immunization coverage. Surveillance for AEFI remains dependent on healthcare workers' (HCW) ability to timely detect and report cases using the correct reporting tools through an appropriate system [25]. Reporting on AEFI has remained a public health concern [26]. This study assessed predictors of AEFI reporting by healthcare workers, emphasizing their knowledge and practices.

In the present study, majority (70%) of the respondents had good knowledge on AEFI. This is consistent with previous studies in other climes in which over 96.4% of health workers were aware of how to report AEFI [11, 25-27] however, there were mixed reports on who should report as they did not see it as a responsibility for all health workers to report an encountered AEFI but for the RI provider. Though age, being trained on AEFI, full-time employment, and over 6 years of experience were significantly associated with the respondents' level of AEFI knowledge, independent factors affecting knowledge of health workers were age 30-39 years and those who received AEFI training. Unlike studies conducted by Ogunyemi which showed that younger health workers had good knowledge of AEFI [27] and the Sokoto study by Sani in which duration of service was an independent predictor of AEFI knowledge [26] findings in this study were similar to the study in Ghana where there was no significant correlation between the profession of respondents and AEFI knowledge [28]. It was however surprising to find that years of experience do not relate to immunization knowledge. This demonstrates that health workers with longer duration in service should not be assumed to have knowledge of AEFI but should be targeted in capacity-building sessions rather than having their assistants or representative participate in such activities and training.

Good practice of AEFI reporting entails prompt detection and reporting of cases within 24hrs using relevant and approved data tools. Current national AEFI guideline indicates that all AEFIs should be line listed and reported while serious ones are investigated, and feedback shared with the community following review by the national expert review committee [29]. Overall, most respondents who had encountered an AEFI exhibited some good practices of reporting to the next level, using available data tools and counselling clients with the key messages, only 52.4% reported the AEFIs immediately within 24 hours, 43% only line listed, 6.6% only reported serious cases, 57.1% treated and reassured the cases and of

the 61.8% who got feedback from the state and LGA, that was mostly shared with the community. These findings showed clear gaps in the adherence to the current national guidelines of reporting all AEFI cases to the next level and not just the serious cases. This suggests that though health workers had good knowledge of AEFI, with the good overall practice of routine reporting, there was a suboptimal practice of reporting encountered AEFI in line with current guidelines.

Despite the good knowledge and perception of health workers on AEFI reporting only gender, full-time employees, having encountered an AEFI in recent times, were predictors of routine AEFI reporting from the health facilities while full-time employment, being trained or the need for training were predictors of reporting an encountered AEFI. This could be explained by the fact that challenges of AEFI reporting are not just limited to knowledge but attitudinal. Following the review of national AEFI guidelines, the country embarked on a nationwide training of AEFI to strengthen its surveillance system and with the recent outbreak of Covid 19 and the introduction of Covid 19 vaccine and other new vaccines into the RI schedule with the focus of AEFI and AESIs, reporting AEFIs by health workers who recently encountered an AEFI could explain why it had influenced AEFI reporting. Identifying training and reporting to elicit training as factors that influence reporting of AEFI shows the willingness of health workers to support and strengthen AEFI surveillance provided their capacity is built.

Training has been identified as a key step to safety surveillance to enable an appropriate response to detect AEFIs at all levels of the health system [19]. The readiness of the health workers to learn as a predictor of AEFI reporting shows their interest in getting more knowledge on AEFI, as human capacity development is key in strengthening any health system [20]. Bedford et al. as documented by Mehemeti et had demonstrated that healthcare workers engaged in vaccination need to be trained and retrained in the provision high standard of care [20]. Despite the global ramp-down in polio resources, and under-recruitment of health workers, those on full-time pay have shown to influence reporting on AEFI. The presence of many casual and volunteer staff across PHCs mostly used in the immunization sections in the state, could account for the reason behind the nonchalant attitude of health workers on AEFI reporting. Female health workers in the Northern part of the country and most especially in Jigawa state are few, and even though they influence reporting of AEFI, engaging more of these health workers will provide confidence to the caregivers who encounter them daily. The gender-related effect on AEFI reporting needs to be further substantiated.

Conclusion

Overall, only 70% of respondents had good knowledge of AEFI, and of the 53% that recently encountered an AEFI, 82.1% exhibited some good practices. Full-time employees, female health workers, a recent encounter with an AEFI, being trained on specific AEFI module, and reporting to elicit more training were found to be independent factors affecting reporting of AEFI from health facilities and among health workers.

The findings from this study should be used to improve AEFI reporting, which is a step in strengthening AEFI surveillance in the state. This calls for concerted efforts of the National Primary Health Care Development Agency and Jigawa State Primary Health Care Development Agency to address the gaps in the system through training and re-training of healthcare workers, ensuring the availability of AEFI reporting tools at health facilities, and putting in place a strong feedback mechanism for AEFI reporting in line with the national guidelines.

Conflict of Interest

The authors declare no conflict of interest.

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References

[1] Deoja, G., Shanmuganathan, P., Kumarappan, M., 2018, Safety surveillance and causality assessment of adverse event following immunization in children - A vaccine vigilance study. Natl J Physiol Pharm Pharmacol, 8(9), 1209, https://www.njppp.com/.

[2] WHO, Explorations of inequality: Childhood immunization, Accessed: 3 May 2022. https://www.who.int/data/health-equity/report_2018_immunization.

[3] WHO, Immunization and conflict, Accessed: 3 May 2022. https://www.unicef.org/immunization/immunization-and-conflict.

[4] WHO, Vaccines and immunization, Accessed: 23 April 2022. https://www.who.int/health-topics/vaccines-and-immunization.

[5] Al Awaidy, S., Bawikar, S., Prakash, K. P., Al Rawahi, B., Mohammed, A. J., 2010, Surveillance of adverse events following immunization: 10 years' experience in Oman. EMHJ - East Mediterr Health J, 16 (5) 474-480, https://apps.who.int/iris/handle/.

[6] Ekwueme, O. C., 2009, Adverse events following immunization: Knowledge and experience of mothers in immunization centres in Enugu State, Nigeria. Int J Med Health Dev, 14(1), https://doi.org/.

[7] Joshi, N., Prajapati, H., Solanki, K., Sukhlecha, A., Trivedi, H., Gajera, M., et al., 2013, Pattern of adverse events following immunization in an Indian teaching hospital. Int J Med Sci Public Health, 2(1), 62-68, https://doi.org/.

[8] Sadoh, A. E., Nwaneri, D. U., Ogboghodo, B. C., Sadoh, W. E., 2018, Comparison of adverse events following pentavalent and diphtheria-tetanus-pertussis vaccines among Nigerian children. Pharmacoepidemiol Drug Saf, 27(1), 119–122, https://doi.org/.

[9] Williams, S. E., Edwards, K. M., Baxter, R. P., LaRussa, P. S., Halsey, N. A., Dekker, C. L., et al., 2013, Comprehensive Assessment of Serious Adverse Events Following Immunization by Health Care Providers. J Pediatr, 162(6), 1276-1281, https://doi.org/.

[10] Zvanaka, S., Tsitsi, J., Chonzi, P., Shambira, G., Gombe, N. T., Tshimanga, M., 2016, Evaluation of the adverse events following immunizations surveillance system in Harare City, Zimbabwe, 2016: a descriptive cross-sectional study. Pan Afr Med J, 28(1), https://doi.org/.

[11] Mohammed, L. A., Aliyu, A. A., Maiha, B. B., Isa, A., 2018, Knowledge, perception and reporting attitude of adverse effects following immunization among primary healthcare workers in sabon gari local government area Zaria, Kaduna State, Nigeria. Niger J Basic Clin Sci, 15(1), 81, https://doi.org/.

[12] Alvarez-Pasquín, M. J., Heijbel, H., Yarwood, J., Damme, P. V., Partners, V., 2009, VACSATC (Vaccine safety: attitudes, training and communication): Why such a project? Eurosurveillance, 14(16), 19181, https://doi.org/.

[13] Kuçuku, M., 2012, Role of Pharmacovigilance on Vaccines Control. J Rural Med, 27(1), 42–45, https://doi.org/.

[14] Freed, G. L., Clark, S. J., Hibbs, B. F., Santoli, J. M., 2004, Parental vaccine safety concerns: The

experiences of pediatricians and family physicians. Am J Prev Med, 26(1), 11–14, https://doi.org/.

[15] Masika, C. W., Atieli, H., Were, T., 2016, Knowledge, Perceptions, and Practice of Nurses on Surveillance of Adverse Events following Childhood Immunization in Nairobi, Kenya. BioMed Res Int. 2016, 3745298–10, https://doi.org/.

[16] Swarnkar, M., Baig, V. N., Soni, S. C., Shukla, U. S., Ali, J., 2016, Assessment of Knowledge and Practice About Immunization Among Health Care Providers. Natl J Community Med, 7(04), 281–285, https://www.njcmindia.org/.

[17] Aderibigbe, S., Osagbemi, G., Bolarinwa, O., 2010, Adverse event following immunization in a Nigerian tertiary health institution. Am J Sci Ind Res, 1, 496–499, https://doi.org/.

[18] Ogunyemi, R., Odusanya, O., 2016, A survey of knowledge and reporting practices of primary healthcare workers on adverse experiences following immunisation in alimosho local government area, Lagos, Nigeria. Postgrad Med J, 23 (79), https://www.npmj.org/.

[19] Gbenewei, E., Nomhwange, T., Taiwo, L., Ayodeji, I., Yusuf, K., Jean Baptiste, A. E., et al., 2011, Adverse events following immunization: Findings from 2017/2018 measles vaccination campaign, Nigeria AEFI reporting in 2017/2018 measles vaccination campaign. Vaccine. 39, C82–C88, https://doi.org/.

[20] Mehmeti, I., Nelaj, E., Simaku, A., Tomini, E., Bino, S., 2017, Knowledge, practice and approaches of health professionals to adverse events following immunization and their reporting in Albania. Heliyon, 3(6), https://doi.org/.

[21] WHO, Vaccine Safety Basics, Accessed: 21 December 2020. https://vaccine-safety-training.org/investigation.html.

[22] McClenathan, B. M., Edwards, K. M., 2019, Vaccine safety: An evolving evidence-based science. Br J Clin Pharmacol, 85(12), 2649–2651, https://doi.org/.

[23] Principi, N., Esposito, S., 2016, Adverse events following immunization: real causality and myths. Expert Opin Drug Saf, 15(6), 825–835, https://doi.org/.

[24] Lwanga, S. K., Lemeshow, S., 1991, Sample size determination in health studies: a practical manual, World Health Organization. https://apps.who.int/iris/handle/.

[25] Umar, A., Sufiyan, M., Tukur, D., Onoja-Alexander, M., Amadu, L., Bashir, S., 2020, Knowledge of Adverse Events Following Immunization Reporting Tool and System Among Primary Healthcare Workers in Jigawa State, Infect Control Hosp Epidemiol, 41(S1), https://doi.org/.

[26] Sani, U. M., Oche, M. O., Raji, M. O., Ango, U. M., Jiya, N. M., 2019, Knowledge, Attitude and Reporting Practices on Adverse Events Following Immunization among Routine Immunization Service Providers in Health Facilities of Sokoto State, Nigeria. Int J Trop Dis Health, 2019, 1–14, https://doi.org/.

[27] Ogunyemi, R., Odusanya, O., 2016, A survey of knowledge and reporting practices of primary healthcare workers on adverse experiences following immunisation in alimosho local government area, Lagos, Nigeria. Postgrad Med J, 23 (79), https://doi.org/.

[28] Yamoah, P., Bangalee, V., Oosthuizen, F., 2019, Knowledge and Perceptions of Adverse Events Following Immunization among Healthcare Professionals in Africa: A Case Study from Ghana. Vaccines Basel, 7(1), 28, https://doi.org/.

[29] The Global Vaccine Safety Initiative (GVSI), Accessed: 23 April 2022. https://www.who.int/initiatives/the-global-vaccine-safety-initiative.