Knowledge, perceptions, and practice towards adverse events following immunization surveillance among vaccination workers in Zhejiang province, China

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ABSTRACT

Objective: To access the level of knowledge, perceptions, and practice towards adverse events following immunization (AEFI) surveillance among vaccination workers in Zhejiang province, China.

Methods: This was a cross-sectional survey involving 768 vaccination workers. Data were collected using self-administered questionnaires and analyzed by using SAS 9.3 software. Knowledge, perceptions, and practice on AEFI surveillance were summarized using frequency tables. The mean±SD value was used as the cut-off for defining good (values≥mean) and poor (values<mean) knowledge, perceptions or practice. Binary logistic regression analysis was used to determine sociodemographic variables associated with knowledge, perceptions, and practice towards AEFI.

Results: The proportions of good knowledge, perceptions and practice on AEFI surveillance were 78.13%, 57.81% and 66.15%, respectively. Having a higher education background, longer years of experience, previous training on AEFI and ≥30 years of age were factors associated with good knowledge, perceptions and practice on AEFI surveillance among vaccination workers.

Conclusions: Over half of the respondents had good knowledge, perceptions and practice on AEFI surveillance work. Interventions on improving the vaccination workers' knowledge, perceptions and practice on AEFI surveillance should be considered in order to develop a more effective surveillance system.

KEYWORDS: Adverse events following immunization; Surveillance; Knowledge; Perception; Practice

1. Introduction

Immunization against serious infectious diseases is one of the most successful and cost-effective intervention in preventative health care[1,2]. However, immunization occasionally leads to undesirable effects including adverse reactions that are referred to as adverse events following immunization (AEFI). An adverse event following immunization is defined as any untoward medical occurrence which occurs after immunization and which does not necessarily have a causal relationship with the usage of the vaccine[3]. The commonly encountered AEFIs include local reactions (pain, redness and swelling at injection site), and systemic reactions (pyrexia, nausea, dizziness, diarrhea, vomiting, fatigue and headache). Of these reactions, the injection site pain and mild systemic reaction occurred

Significance

Vaccination workers play a pivotal role in gaining and maintaining public confidence in the vaccine safety through the operational adverse events following immunization surveillance. Over half of the respondents in our study had good knowledge, perceptions and practice on adverse events following immunization surveillance work and it could help us develop a more effective surveillance system.

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most commonly[4].

Due to the successes of vaccines, vaccine-preventable diseases (VPDs) have become less frequent, or even rare, and public attention often shifts from VPDs to the safety of vaccines and adverse events associated with vaccines. Widespread concern on the occurrence of AEFI may lead to the loss of confidence in vaccine safety, vaccination hesitation, and even a resurgence of VPDs[5,6]. The safety of vaccines is assessed extensively through the pre-licensure clinical trials and the post-licensure surveillance[7]. The post-licensure surveillance on vaccine safety has relied primarily on passive reporting system or epidemiological study. The key elements of an effective surveillance system include rapid notification and effective evaluation of the basic information, rapid and effective response, and ensuring appropriate outcome of action[8]. Globally, many countries have established national monitoring systems to carry out the surveillance on AEFI[7].

Although the China Ministry of Health issued guidance for handling AEFIs in 1980, nationwide AEFI surveillance was not implemented until 2005[9]. In 2009, the online national AEFI surveillance system (NAEFISS) was expanded to cover all 31 provinces in China. All vaccines marketed in mainland China are covered by NAEFISS. The responsible reporters or units of AEFI include vaccination clinics, center for disease control and prevention at all administrative levels, adverse drug reaction, and vaccine manufacturers. The expanded program on immunization was initiated in 1978, and it continued with 14 types of vaccines up to date and over 25 million vaccination doses were administered every year. Since 2009, Zhejiang province joined in the NAEFISS, which was upgraded in 2012 for adding variables of the case reporting form and rules of data logic verification.

Vaccination workers play a pivotal role in gaining and maintaining public confidence in the vaccine safety through the operational AEFI surveillance[10,11]. These responsibilities include direct involvement in AEFI detection, reporting, investigation and management. However, studies on their knowledge, perceptions, and practice regarding AEFI surveillance are limited, especially from China. We were not clear whether the vaccination workers in Zhejiang province were knowledgeable and well-trained in the AEFI surveillance. Furthermore, their perceptions and practice towards the AEFI surveillance also remained unknown. As such, we aimed to evaluate the knowledge, perceptions, and practice of vaccination workers on the AEFI surveillance.

2. Subjects and methods

2.1. Ethical approval and informed consent

The study was approved by the Institutional Ethics Committees of Zhejiang provincial center for disease control and prevention (TR-009). A written informed consent was obtained from participant prior to proceeding to the survey. No personal identifier was collected.

2.2. Study setting and participants

This cross-sectional clinic-based survey was conducted in December, 2021 among all 11 cities in Zhejiang province, targeting vaccination workers who practice in the vaccination clinics. The inclusion criterion consisted of being a vaccination worker practicing in the vaccination clinic of the community health service center, township health facility, or hospital in Zhejiang province for at least one year. Other practitioners from these institutions were excluded. Routinely, vaccination workers in these clinics administered vaccines, monitor vaccine storage and the risks associated with AEFIs. The vaccines administered consisted the 14 types of vaccines included in the expanded program on immunization, as well as those self-paid vaccines.

2.3. Sample size

The sample size was estimated on the primary outcome of the good knowledge, perceptions, and practice on AEFI surveillance among vaccination workers and the calculation formula as follow: $N_{min}=deff \times z^2_{(1-\alpha/2)} \times p \times (1-p)/d^2$. Since there is no similar results reported from China yet, we assumed a conservative estimate of 50% for the proportion of good knowledge, perceptions, and practice on AEFI surveillance to ensure the biggest sample size. Other parameters for the calculation were set as follows: a two-tailed α error of 5%, a permissible error (d) of 0.05. To account for the expected high correlation between healthcare workers in the adjacent area and non-response, we assumed a design effect ($deff$) of 2. Finally, the sample size was 768, randomly selecting from 768 vaccination clinics, which represented the situation in 57.53% of the vaccination clinics in Zhejiang province.

2.4. Questionnaire

The survey was developed using a secure platform (Questionnaire Star) and consisted of a structured online questionnaire. The format consisted of mainly the closed-ended questions with multiple choice answer options. The questionnaire was developed with expertise from center for disease control and preventions at provincial and city levels, and included specific questions on vaccination workers' sociodemographic characteristics and their knowledge, perceptions, and practices towards AEFI. In order to ensure reliability and

reproducibility, the questionnaire was pilot tested in two vaccination clinics, which had the characteristics similar to those of other facilities studied. All questionnaires were submitted anonymously online.

Knowledge levels were determined using a series of ten questions on AEFI, its causes, management of AEFI, investigation of AEFI, and reporting of AEFI. Perceptions towards AEFI surveillance was assessed using six positive and six negative statements on a 3-point Likert scale. The highest possible score was 36 and the lowest possible score was 12. The practice of respondents on AEFI surveillance was assessed using eight questions.

2.5. Recruitment

A simple random sample of 768 vaccination workers were recruited from 768 vaccination clinics. First, we needed to select 768 vaccination clinics from the total 1 335 vaccination clinics registered with the Zhejiang provincial health committee through random number table method.

One vaccination worker who was responsible for the AEFI surveillance would be invited to participate in this study in each selected vaccination clinic. The participation was voluntary. If he/she refused to participate, the adjacent vaccination clinic would be selected as the alternative one till we recruit enough vaccination workers for AEFI surveillance.

Before the survey, informed consent from each vaccination worker was obtained and the personnel information would be kept confidential. After being informed about the study, the selected vaccination workers received an online survey link also through e-mail. Up to two reminders were sent over the next two days, followed by a final phone reminder on the third day.

2.6. Statistical analyses

Data was analyzed using SAS, version 9.3 (SAS Institute, North Carolina). Descriptive statistics were used to report the distribution of the respondents' characteristics. Knowledge, perceptions, and practice of vaccination workers on AEFI surveillance were summarized using frequency tables. The mean±SD value was used as the cut-off for defining good (values≥mean) and poor (values<mean) knowledge or practice. The mean of the cumulative scores was used as the cut-off for good perceptions (values≥mean) and poor perceptions (values<mean) towards AEFI surveillance. *Chi*-square test was used to examine differences in proportions between sociodemographic variables and each of the dependent variables (knowledge, perceptions, and practice). Binary logistic regression analysis was used to determine associations between the dependent variables (knowledge, perceptions, and practice) and independent variables (education, years of experience, AEFI training, and AEFI training modality used). Statistical significance was set at 0.05, and the analyses were not weighted.

3. Results

3.1. Characteristics of the respondents

A total of 768 vaccination workers were recruited into the study. The mean age of respondents was (39.2±6.2) years, with an average of (9.5±2.3) years of experience. 86.98% of the respondents were female and 71.35% had the education background of undergraduate. Almost 80% of the respondents had received the training on AEFI surveillance (Table 1).

Table 1. Sociodemographic characteristics of respondents (*N*=768).

Characteristics	n (%)
Age, mean±SD, years	39.2±6.2
20-29	168 (21.88)
30-39	292 (38.02)
40-49	220 (28.65)
50-59	88 (11.46)
Sex	
Male	100 (13.02)
Female	668 (86.98)
Levels of education	
Junior college	92 (11.98)
Undergraduate	548 (71.35)
Postgraduate	128 (16.67)
Years of experience, mean±SD	9.5±2.3
0-9	464 (60.42)
10-19	188 (24.48)
20-29	80 (10.42)
≥30	36 (4.69)
Training on AEFI	
Yes	612 (79.69)
No	156 (20.31)

AEFI: adverse events following immunization.

The overall knowledge score on causes of AEFI and identification, investigating, managing, and reporting of AEFI was (8.5±1.7) out of a maximum of 10. Thus, 42 (21.87%) of the respondents had poor knowledge whereas 150 (78.13%) had good knowledge on AEFI surveillance. The cumulative Likert scores on the perceptions scores for beliefs on detection, reporting, investigating, and managing AEFI was (24.4±5.1) out of a maximum of 36. Thus, 81 (42.19%) of the respondents had poor perceptions and 111 (57.81%) of the respondents had good perceptions. The cumulative practice scores on practice towards detecting, reporting, investigating, and managing AEFI was (6.4±2.3) out of a maximum of 8. Thus, 65 (33.85%) of the respondents had poor practice and 127 (66.15%) of

Table 2. Knowledge levels of respondents on adverse events following immunization surveillance (*N*=768).

Aspects of knowledge on AEFI surveillance	*n* (%)
1. AEFI as a medical condition is not limited to vaccination only	652 (84.90)
2. AEFI can be caused by vaccine reaction; inappropriate route or injection technique; vaccines stored beyond expiry date; or contaminated vaccine diluents	700 (91.15)
3. Adrenaline should not be administered intramuscular during anaphylaxis	604 (78.65)
4. During anaphylaxis, patient's legs are raised above trunk and given oxygen	540 (70.31)
5. CDC receives AEFI reports from vaccination workers	712 (92.71)
6. AEFI investigation examines operational aspects of the program	660 (85.94)
7. Investigation of an AEFI should be commenced within 48 hours	648 (84.38)
8. All the minor reactions ought to be reported	664 (86.46)
9. Treatment of a coincidental illness falsely attributed as a vaccine reaction should not be delayed until investigations are confirmed	628 (81.77)
10. AEFI surveillance aims at early detection and response to adverse reactions	688 (89.58)

AEFI: adverse events following immunization.

Table 3. Perception of respondents towards adverse events following immunization surveillance [*N*=768, *n* (%)].

Aspects of perceptions towards AEFI surveillance	Agree	Neutral	Disagree
1. Believing that reporting an AEFI cannot lead to personal consequences	352 (45.83)	188 (24.48)	228 (29.69)
2. Believing that enhancing surveillance of AEFI can help build public trust in immunization program	388 (50.52)	180 (23.44)	200 (26.04)
3. Believing that vaccination workers play a vital role in diagnosing, reporting, investigating, and managing AEFI	252 (32.81)	196 (25.52)	320 (41.67)
4. Desiring to learn more about how to report, investigate, and manage AEFI	584 (76.04)	80 (10.42)	104 (13.54)
5. Believing that every vaccination worker at a vaccination clinic should know AEFI	364 (47.40)	144 (18.75)	260 (33.85)
6. Believing that poor AEFI surveillance can cause reduction of vaccination coverage	348 (45.31)	228 (29.69)	192 (25.00)
7. Believing that reporting an AEFI will make him/her feel guilty about having caused harm and be responsible for the event	244 (31.77)	168 (21.88)	356 (46.35)
8. Believing that vaccination workers are reluctant to report an AEFI when they are not confident about the diagnosis	408 (53.13)	112 (14.58)	248 (32.29)
9. Believing that investigation of AEFI should be done by doctors but not vaccination workers	532 (69.27)	104 (13.54)	132 (17.19)
10. Believing that the process of reporting an AEFI is long and tedious	148 (19.27)	208 (27.09)	412 (53.64)
11. Believing that even if AEFIs are reported, no feedback is sent back	532 (69.27)	80 (10.42)	156 (20.31)
12. Believing that he/she is always busy and there is no time to report AEFI	324 (42.19)	192 (25.00)	252 (32.81)

AEFI: adverse events following immunization.

Table 4. Practice level of respondents towards adverse events following immunization surveillance (*N*=768).

Aspects of practice towards AEFI surveillance	*n* (%)
1. Ruling out contraindications to vaccine prior to administration	756 (98.44)
2. Recording vaccine batch number and expiry date during vaccination	744 (96.88)
3. Informing the possible adverse reactions and how to treat them	748 (97.40)
4. Having an anaphylactic pack with adrenaline in the immunization room	752 (97.92)
5. Having ever come across an adverse reaction and considered it as an AEFI	500 (65.10)
6. Reporting a detected AEFI	380 (49.48)
7. Participating in AEFI investigation for detected AEFI cases	368 (47.92)
8. Having AEFI reference guidelines materials at workstation	628 (81.77)

AEFI: adverse events following immunization.

the respondents had good practice towards AEFI surveillance. The responses to the specific indicators of knowledge, perceptions and practice on AEFI surveillance were presented in Tables 2-4.

3.2. Association of respondent's characteristic and knowledge, perceptions and practice on AEFI surveillance

Univariate analysis showed that age, level of education, years of experience, training on AEFI were significantly associated with the good level of knowledge, perceptions and practice (Table 5).

Additional binary logistic regression analyses revealed that respondents with previous AEFI training were 6.27 times more likely to have good knowledge towards AEFI surveillance (A*OR* 6.27, 95% *CI* 4.92-15.20; *P*<0.01); 9.65 times more likely to have good perceptions (A*OR* 9.65, 95% *CI* 5.56-15.63; *P*<0.01); 3.53 times more likely to have good practice (A*OR* 3.53, 95% *CI* 2.27-8.51; *P*<0.01). Vaccination workers practicing in their 30s were 1.68 times more likely to have good knowledge towards AEFI surveillance (A*OR* 1.68, 95% *CI* 1.26-2.71; *P*=0.03); 1.68 times more likely to have good perceptions towards AEFI surveillance (A*OR* 3.10, 95% *CI* 1.83-6.25; *P*<0.01); 2.05 times more likely to have good practice towards AEFI surveillance (A*OR* 2.05, 95% *CI*

Table 5. Association of respondents' characteristics with knowledge, attitude, and perception classifications [n (%)].

Variables	Knowledge				Perception				Practice			
	Good	Poor	χ^2	P	Good	Poor	χ^2	P	Good	Poor	χ^2	P
Age, years												
20-29	104 (61.90)	64 (38.10)	12.61	0.01	44 (26.19)	124 (73.81)	7.62	0.02	68 (40.48)	100 (59.52)	5.69	0.02
30-39	248 (84.93)	44 (15.07)			208 (71.23)	84 (28.77)			232 (79.45)	60 (20.55)		
40-49	184 (83.64)	36 (16.36)			164 (74.55)	56 (25.45)			168 (76.36)	52 (23.64)		
50-59	64 (72.73)	26 (27.27)			28 (31.38)	60 (68.62)			40 (45.45)	48 (54.55)		
Sex												
Male	76 (76.00)	24 (24.00)	3.55	0.32	56 (56.00)	44 (44.00)	2.02	0.53	64 (64.00)	36 (36.00)	1.63	0.33
Female	524 (78.44)	144 (21.56)			388 (58.08)	280 (41.92)			444 (66.47)	224 (33.53)		
Level of education												
Junior college	60 (65.22)	32 (34.79)	13.96	<0.01	24 (26.09)	68 (73.91)	13.49	<0.01	36 (39.13)	56 (60.87)	19.60	<0.01
Undergraduate	428 (78.10)	120 (21.90)			332 (60.58)	216 (39.42)			368 (67.15)	180 (32.85)		
Postgraduate	112 (87.50)	16 (12.50)			88 (68.75)	40 (31.25)			104 (81.25)	14 (18.75)		
Years of experience												
0-9	340 (73.28)	124 (26.72)	15.22	<0.01	264 (56.90)	200 (43.10)	9.34	0.01	288 (62.07)	176 (37.93)	13.99	<0.01
10-19	156 (82.98)	32 (17.02)			92 (48.94)	96 (51.06)			128 (68.09)	60 (31.91)		
20-29	80 (90.00)	8 (10.00)			60 (75.00)	20 (25.00)			60 (75.00)	20 (25.00)		
≥30	32 (88.89)	4 (11.11)			28 (77.78)	8 (22.22)			32 (88.89)	4 (11.11)		
Training on AEFI												
Yes	556 (90.85)	56 (9.15)	29.67	<0.01	432 (70.59)	180 (29.41)	22.93	<0.01	460 (75.16)	152 (24.84)	38.22	<0.01
No	44 (28.21)	112 (71.79)			12 (7.69)	144 (92.31)			486 (30.77)	108 (69.23)		

AEFI: adverse events following immunization.

Table 6. Logistic regression of knowledge, perception, and practice with respondent's characteristics.

Variables	Good knowledge		Good practice		Good perception	
	AOR (95% CI)	P	AOR (95% CI)	P	AOR (95% CI)	P
Age, years						
20-29	Reference		Reference		Reference	
30-39	1.68 (1.26-2.71)	0.03	2.05 (1.69-3.33)	<0.01	3.10 (1.83-6.25)	<0.01
40-49	1.65 (1.19-2.28)	0.02	2.01 (1.52-3.27)	<0.01	3.27 (2.27-6.81)	<0.01
50-59	1.36 (0.88-2.08)	0.18	1.82 (1.29-2.18)	<0.01	1.10 (0.86-2.31)	0.38
Level of education						
Junior college	Reference		Reference		Ref	
Undergraduate	1.19 (0.81-1.95)	0.23	1.59 (1.10-2.62)	<0.01	4.21 (2.50-5.89)	<0.01
Postgraduate	1.77 (1.17-2.59)	0.01	2.37 (2.01-4.60)	<0.01	4.84 (2.65-6.15)	<0.01
Years of experience						
0-9	Reference		Reference		Reference	
10-19	1.08 (0.75-1.59)	0.42	1.08 (0.91-1.67)	0.48	1.06 (0.82-1.39)	0.39
20-29	1.55 (1.08-2.64)	0.02	1.22 (0.85-2.09)	0.32	1.83 (1.37-2.98)	0.02
≥30	1.60 (1.11-2.90)	0.02	1.57 (1.11-3.92)	0.01	1.96 (1.52-3.15)	0.01
Training on AEFI						
Yes	6.27 (4.92-15.20)	<0.01	3.53 (2.27-8.51)	<0.01	9.65 (5.56-15.63)	<0.01
No	Reference		Reference		Reference	

AOR: adjusted odds ratio.

1.69-3.33; P<0.01). On the other hand, vaccination workers with postgraduate degree were 1.77 times more likely to have good knowledge towards AEFI surveillance (AOR 1.77, 95% CI 1.17-2.59; P=0.01); 4.84 times more likely to have good perceptions towards AEFI surveillance (AOR 4.84, 95% CI 2.65-6.15; P<0.01); 2.37 times more likely to have good practice towards AEFI surveillance (AOR 2.37, 95% CI 2.01-4.60; P<0.01). Furthermore, vaccination with≥30 years of experience were 1.60 times more likely to have good knowledge towards AEFI surveillance (AOR 1.60, 95% CI 1.11-2.90; P=0.02); 1.96 times more likely to have good perceptions towards AEFI surveillance (AOR 1.96, 95% CI

1.52-3.15; P=0.01); 1.57 times more likely to have good practice towards AEFI surveillance (AOR 1.57, 95% CI 1.11-3.92; P=0.01) (Table 6).

4. Discussion

The knowledge, perceptions, and practice of vaccination workers on AEFI surveillance could influence the quality and safety of vaccination service as well as monitoring AEFI[12]. In this study, the respondents had a high overall knowledge level on AEFI

surveillance, consistent with the previous reports from U.S.[10] and Nigeria[13], which could be attributed to the consistently high knowledge responses recorded on most of the aspects of AEFI knowledge. However, two important aspects of knowledge on the treatment of anaphylaxis were poorly understood among the respondents in spite of the anaphylaxis following immunization being life-threatening. This was undesirable since management of AEFI often relied on knowing the appropriate treatment to the common AEFI or the emergencies. This finding suggested an urgent need for initial and refresher training on the treatment of anaphylaxis following immunization.

Association analyses showing that knowledge level of the vaccination workers on AEFI surveillance increased with their education background, years of experience and previous AEFI training might be explained in part by accrual of knowledge through training exposure and their abundant working experience. Our results were consistent with the study from India[12] showing that the work-related experience determine the knowledge levels on the drug-associated adverse reactions. However, our study was different to the report from the United Arab Emirates[14] which indicated that age did not influence the knowledge levels on vaccine-induced adverse reactions. Compared to other studies, most of the vaccination workers in this study had received AEFI training prior to the survey. It was higher than similar report from Zimbabwe (42%)[15]. Our finding confirmed the need to provide adequate education to vaccination workers, before or during their vaccination service. One efficient way to address it would be to incorporate AEFI surveillance into vaccination workers' continuing medical education programs.

The overall proportion of respondents with good perceptions towards AEFI surveillance in this study constituted a reasonable fraction of vaccination workers willing to carry out AEFI surveillance. However, there was a need to reassure vaccination workers that reporting AEFI was not to be punitive or to apportion blame since half of the respondents in this study believed that reporting AEFI could lead to personal consequences, which was consistent with the finding from the previous reports[16–18]. Our finding highlighted the importance of a no blame culture in strengthening the AEFI surveillance system. This barrier could be ameliorated through providing supportive supervision to address fear on the negative consequences, implementing a supportive policy to protect vaccination workers. Besides, rewarding strategy on the AEFI reporting should be considered. The high proportion of respondents ready to learn more about AEFI surveillance as shown in this study would be essential to manager of immunization program, especially at health center level, to seize this positivity and offer AEFI training opportunities. The findings of this study on vaccination workers' perceptions towards AEFI surveillance were similar to studies in the U.S.[10] and Zimbabwe[15] where 18% and 11.5% of the respondents believed that reporting AEFI was not

part of their responsibilities, respectively. This result emphasized the need for manager of immunization program to clearly sensitize vaccination workers on their role in AEFI surveillance. Although 40% of the respondents cited the lack of time as a hindrance to participate in AEFI surveillance, study from the U.S.[19] indicated the similar proportion of vaccination workers citing lack of time.

Similar to the results on the determinants on the knowledge of AEFI surveillance[13,20,21], the age of respondent, duration of working-time, education background and former training experience could influence the perceptions of AEFI surveillance. These findings were different with the reports from United Arab Emirates[14] where no difference on perceptions on AEFI surveillance was observed between vaccination workers with education background and training. However, we still believed that the longer working duration would induce a positive attitude on AEFI surveillance through enriching the work experience and having more training opportunities. Besides, higher education background would help vaccination workers easily understand the requirements of AEFI surveillance and its significant meaning of the frontline guardians to protect vaccinated individuals and the public.

Generally, the practice aspects towards AEFI surveillance were optimal in the contraindication of immunization, good practice on vaccination, treating common adverse reaction and essential drug preparation. Post-immunization anaphylactic reactions, though uncommon, were likely to occur during administration of most vaccines[22]. Our result indicated that the vaccination workers had well prepared for the handling of the anaphylactic reactions, and our finding were higher than a similar study from Zimbabwe (33%)[15]. Even though inaccessibility to AEFI reference guideline materials was cited by majority of respondents in U.S[19]. as a hindrance to AEFI reporting, only 19% of the respondents stated that they did not have these guidelines materials at workstation in our survey. However, fewer vaccination workers in our study had even detected an adverse reaction and considered as an AEFI, which was similar to the report from U.S[19]. The proportion of the respondents who had ever participated in AEFI investigation was quite low despite the WHO recommendation[23] that health care providers who detect an AEFI ought to report and commence investigations immediately. Almost only half of the respondents had reporting AEFI cases in this survey, which was consistent with the findings from Nigeria, Australia and U.S[13,19,20]. It could be explained by the sensitization that occurred a year prior to the survey in Zhejiang province. Furthermore, our findings were consistent with the reporting trend at the national level as the number of AEFI cases reported to the surveillance system has increased by approximately 30% year by year since 2005[9].

Based on the association analyses between respondent's characteristics and practice, there was a need to encourage vaccination workers having many years of experience to mentor

the ones with fewer years of experience since good AEFI practice increases with years of experience. The findings of this study indicated that having longer years of experience and previous training in AEFI among respondents was a predictor of good practices in AEFI surveillance. However, in a similar study in Nigeria[13], there was no statistically significant association between health care worker characteristics and good practices in AEFI surveillance.

There were still several limitations regarding this study. First, the study was conducted in 14% of the vaccination clinics using an unweighted analysis, and thus the generalizable value would be insufficient. Second, self-reported information from vaccination workers might be skewed towards compliance with AEFI surveillance guidelines or socially desirable responses. Third, participation bias might be existed. Although the vaccination clinics were selected randomly, the participation of healthcare workers was voluntary. It might reasonably be assumed that those who agreed to take the survey had generally more favourable attitude and better understanding and practice on AEFI surveillance.

Over half of the respondents in this study had good knowledge, perceptions and practice on AEFI surveillance work. The impact factors that influenced the knowledge, perceptions and practice on AEFI surveillance included the education background, years of experience and previous AEFI training. Interventions on improving the vaccination workers' knowledge, perceptions and practice on AEFI surveillance should be considered, such as the refreshing training, enhancing the continuing medical education, constructing a no blame culture on reporting as well as the on-job mentorship.

Conflict of interest statement

The authors declare no conflict of interest.

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Authors' contributions

Conceptualization by YH and HL; methodology by HL and XP; formal analysis by HL; investigation by HL and YW; original draft by YH; review and editing by HL. All authors have read and agreed to the published version of the manuscript.

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