Available online at *www.ujpronline.com*
Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)

RESEARCH ARTICLE

EVALUATION OF PRACTICES OF HEALTH CARE PERSONNEL IN THE EXPANDED PROGRAM ON IMMUNIZATION IN SA'ADAH, YEMEN, IN MAINTAINING VACCINE EFFICACY

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Article Info:

Article History:
Received: 6 December 2022
Reviewed: 14 January 2023
Accepted: 25 February 2023
Published: 15 March 2023

Cite this article:
Qeran MA, Habour ABA, Hassan EHE. Evaluation of practices of health care personnel in the expanded program on immunization in Sa'adah, Yemen, in maintaining vaccine efficacy. Universal Journal of Pharmaceutical Research 2023; 8(1):7-14.
https://doi.org/10.22270/ujpr.v8i1.891

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Abstract

Background and aim: The effectiveness of any vaccine depends on maintaining it at recommended temperatures from manufacture to administration. Health workers in any health facility play an important and vital role in maintaining the cold chain and vaccine efficiency. Therefore, the aim of conducting this research was to evaluate the practice of health workers working in the Expanded Program on Immunization in Sa'adah, Yemen in the correct procedures to maintain the effectiveness of the vaccine and recording data.
Method: This study was conducted on 60 health facility (H.F) in 11 districts in Sa'adah Governorate, Yemen during the period from 1 June to 30 July 2019. The focus was on the checklist used to assess the general practices of healthcare personnel participating in the immunization program. The location of the refrigerator, the arrangement of the vaccines, the presence of a thermometer, the handling of the syringes, the cleaning of the injection area, the direction of the pentavalent and measles vaccination needle, and the method of storing the vaccines during the sessions were evaluated. Data were entered and cleaned using Microsoft Excel 2019 and exported to SPSS version 26.
Results: The findings show that, the ages of participants ranged from 23-55 years with Mean±SD (34.17±7.310) and 38 (63.3) were male. From a total of health facilities, 43 (91.5%) had a good site of refrigerators, 45 (95.7%) had a good distance from the wall, and 42 (89.4) had thermometers. There is no significant correlation between the socio-demographics of HCPs and score practice, the total practice scores for HCPs were (21.7%, and 78.3%) for right practice and right but not complete practice, respectively.
Conclusion: Only a small percentage of healthcare providers have corrected practice, while a large number have shown correct but not perfect practice. Hence, regular supportive supervision, ongoing technical support, and on-the-job training are highly recommended to improve the healthcare provider's practice with regard to immunization.
Keywords: Cold chain, expanded programme on immunization Practice, Sa'adah, Yemen.

INTRODUCTION

Vaccination is one of the most effective public health interventions, sparing nearly three million people each year from death, according to the United Nations[1]. The Expanded Program on Immunization (EPI) began in 1974 with the goal of providing universal immunization with basic vaccines. In developing countries, children under five years of age are immunized against 10 diseases: tuberculosis, tetanus, whooping cough, diphtheria, polio, measles, Hepatitis B (HepB), Homozygous influenza (Hib), rotavirus, and pneumococcal vaccine (PCV)[2].

To ensure vaccine safety and effectiveness in preventing people from vaccine-preventable diseases (VPDs), all EPI and cold chain workers must know the basics of proper handling and management of vaccines and vaccination supplies at all stages of the cold chain. Also, vaccines are biological products that are sensitive to temperature and freezing, so vaccines and diluents

must be kept at the recommended temperature[3]. A proper cold chain maintenance is one of the most important parts of any immunization programme and the strength of vaccines depends on the maintenance of the cold chain[4]. The World Health Organization (WHO) has progressed a set of guidelines for the proper administration of the EPI service in its organ countries[5]. Primary vaccine failure can be caused by either an inactivated vaccine or an inadequate host response. Malfunction of the cold chain system is a possible cause of initial vaccine failure due to inactivated vaccines[6]. Appropriate vaccination is essential for vaccine safety and optimal efficacy, The Centers for Disease Control and Prevention (CDC) recommends that all vaccine workers receive comprehensive training in the handling, administration, and administration of vaccines before beginning work[7]. In order to achieve coverage and maintain the benefits of vaccination, It is important that the vaccinator follows standard practices before, though, and next vaccination. WHO recommends that standard immunization guidelines include the practice that before vaccination, vaccinators have the ability to identify the right patient at the right time[8]. In Yemen, there is limited research in monitoring the vaccination programme, while several studies have been conducted into the first-year poliovirus vaccine coverage rate[9], hepatitis B virus coverage in children[10], and total maternal tetanus vaccination coverage rate[11], influenza virus vaccine coverage among SARI[12], and the rate of childhood vaccination between 1978 and 2018[13]; and the current study is the first to evaluate the practice of health workers working in the Expanded Program on Immunization in Sa'adah, Yemen in the correct procedures to maintain the effectiveness of the vaccine and recording data[13].

The benefit from vaccination is much higher and the problems of it are less accepted among the population because it administered among health population to prevent diseases unlike drugs which uses among patients to treat disease[14]. Therefore, proper cold chain maintenance is one of the most important parts of a successful immunization programme and there are various studies about knowledge and practice of health care workers in EPI[15-17].

METHODS

The study was approved by the Ethical Committee of the Faculty of Health and Environmental Sciences, Al-Gezira University, an official permission letter was obtained and directed to the Director General of the Public Health and Population Office, Sa'adah Governorate.

Study area

The study was conducted in 60 health facilities in the districts of Sa'adah Governorate, in the north of Republic of Yemen, 11 out of 15 districts in which the study was conducted, two urban districts (Sa'adah and Sahar) which contain 17 health facilities and nine rural districts (As Safra, Baqim, Ghamr, Haydan, Majz, Monabbih, Qatabir, Razih and Saqayn) which contains 43 health facilities.

Time of study

The study was carried out in the time period from June 1 to July 30, 2019.

Study design

Perspective cross-sectional study approach was conducted.

Study population and centers

Health care personnel working in EPI.

Data collection tools and procedures

An observation checklist prepared in cooperation with the main research supervisor and immunization supervisor in the state of Wad Medani, Sudan was used, where a pilot study was conducted to test the reliability and validity of the checklist, estimate the time required to obtain the required data, rephrase and add questions, and identify difficulties and problems that may arise during data collection. This checklist was used for assessing the practices of health care personnel working in EPI and used for assessing the general practices of health care personnel involved in EPI were focused on.

Main outcome variable measurement.

- The answer of each practice questions was scored as follow[18]:
- Score "2" for right.
- Score "1" for right but not complete.
- Score "O" for wrong.

Summation of practice answer scores was done. Then a percent total score was calculated and graded as follows[18]:

- Right practice ≥ 75%
- Right but not complete practice 51% - 74 %
- wrong practices ≤ 50 %

Data collection

Data were collected through field visits to health facility in the targeted districts within a period of two months June, July 2019 and to investigate about all the data required in the checklist mentioned above and to interview the HCWs in the EPI to fill the checklist of HCWs practice. After a pilot study was carried out to pretest the questionnaire elements.

Consideration

This study aims to evaluate the practice of HCWs who work in EPI of Sa'adah province-Republic of Yemen and inform the relevant authorities to avoid deficiencies in any aspects in EPI.

Data Analysis

Statistical analysis was done by the data analysis software Statistical Package Social Sciences (SPSS) version 26, *p* values less than 0.05 was considered significant. Differences in samples means were evaluated by chi-square test.

RESULTS

Socio-demographic characteristics of HCP working in EPI

The majority of HCPs were in their twenties (41.7%), followed by thirties age group (38.3%), while those aged 40+ years was constituted (20%).

Table 1: Distribution of socio-demographic characteristics of HCP working in EPI.

Socio-demographic distribution		Frequency (n=60) N (%)
Age	20-30	25 (41.7)
	31-40	23 (38.3)
	41+	12 (20.0)
Range		23-55
Mean±SD		34.17±7.310
Sex	Male	38 (63.3)
	Female	22 (36.7)
Residence of the center	Urban	3 (5.0)
	Rural	57 (95.0)
Type of health facility	Hospital	8 (13.3)
	Health center	19 (31.7)
	Health unite	33 (55.0)
Job	Physician	1 (1.7)
	Nurse	18 (30.0)
	Health guiders	3 (5.0)
	Midwife	16 (26.7)
	Pharmacist	6 (10.0)
	Health inspector	14 (23.3)
	Lab technician	2 (3.3)
Educational level	University	52 (86.7)
	Secondary	7 (11.7)
	Preparatory	1 (1.7)
Work experience in year	<10	28 (46.7)
	10+	32 (53.3)
Range		1–30
Mean±SD		1.62±0.783
Special training in EPI & cold chain	Yes	50 (83.3)
	No	10 (16.7)
Number of training courses	Range	0–10
	Mean±SD	2.83±2.211

About two-thirds 63.3% of health workers were male. The majority of health facilities (95%) were in the rural. More than half of the health facilities (55.0%) were health units, 31.7% were health centers, while hospitals represented only the percentage of (13.3%). Most of the HCPs (86.7%) were university. The work of experience ranged between 1-30 years with a main of 1.62±0.783 years. More than half (53.3%) of the HCPs had more than 10 years of experience while (46.7%) had less than 10 years of experience. Most HCPs (83.3%) have special training in EPI and cold chain. The number of training courses ranged from 1-10 courses with a main of 2.83±2.211 courses (Table 1).

Practice of HCWs regarding cold chain measurements, peripheral level of the health districts

Table 2 show, (91.5%) of health facility (HF) had a good site of refrigerator in the room while (8.5%) in the bad site. In addition, the refrigerator was placed at the correct distance from the wall (15 cm or more) in (95.7%) of HF. More than two third (76.6%) of HCPs arrange the vaccines in their correct places (nothing on the door), of them (72.3%) do the vaccine packing (air circulation) in a good way. Present of thermometer was observed in (89.4%) of HF while absent in (10.6%) and the temperature was correct in (80.9%) of HF. The temperature was recorded twice per day in (78.7%) of HF. No food or beverages in the refrigerator was observed with (89.4%) of high frequency. One of the disturbing practices identified in this study was that written emergency retrieval and storage procedures were put in place in the event of equipment failure or power failure with only (16.9%) from HF. More than three-quarters of health care providers (75.0%) keep a record of receiving vaccines (inventory management).

Practices of HCPs working EPI

Table 3 reported that 25 (42.4%) of HCWs working in EPI washing hands before any manipulation of the vaccine vials. Majority of the HCPs 57 (95.0%) handling the syringe safely. Also 59 (98.3%) of HCPs used needles one time and 43 (71.7%) of HCPs clean area with swab corrects (spiral).The majority of HCPs (98.3% and 100.0%) correctly directed and location of the needle in DPT and measles vaccine, respectively, All HCPs 60(100.0%) inject in the proper site and 46(76.7%) pull piston to see blood. whereas 54(90.0%) of HCPs correctly compress at site of injection. The majority 59 (98.3%) of HCPs correctly applied the polio doses and most of HCPs 50(83.3%) reconstitute the vaccine vail of measles, MMR, and BCG. The presence of an ice box to keep the vaccine vials throughout the session with ice was noted with all HCPs 100.0% while 49(81.7%) of them replaced the ice box before it melts completely. As regard to general score practice of HCPs, Figure 1 presented that, the most 47(78.3%) of HCPs had right but not complete practice while only 13(21.7%) of HCPs were right practice.

Relation between sociodemographic characteristic of HCP working in EPI and practice score

Table 4 showed no significant correlation between the socio-demographics of HCPs and score of practice, HCPs that working in rural residence achievement the highest 43(71.7%) right practice, 27(81.8%) of HCPs working in health unite achievement the right practice followed by those working in health centers14(73.7%), while the lowest right practice among those working in hospital, physician and pharmacist had the highest percentage (100%) right practices, followed by health inspector (86.7%) and the least right practice was (75.0%, 70.6%, 66.7% and, 50%) for midwife, nurse, health guiders and lab technician, respectively.

Table 2: Practice of HCPs regarding cold chain measurements, peripheral level of the health districts, Sa'adah.

Cold chain facility condition at peripheral level		Frequency corrects practice (n=47) N (%)
Description of vaccination room and refrigerator		
Site of refrigerator in the room	Good	43 (91.5)
Distance from the wall (15 cm or more)	Good	45 (95.7)
Vaccine in the proper site (nothing in the door)	No vaccine	5 (10.6)
	Yes	36 (76.6)
Vaccine packing (air circulation)	No vaccine	5 (10.6)
	Good	34 (72.3)
Thermometer (available)	Yes	42 (89.4)
Is the temperature. Correct? (+2 to +8 c)	Yes	38 (80.9)
	No thermo.	5 (10.6)
Temperature is recorded twice daily	Yes	37 (78.7)
Food item or drinks	Yes	5 (10.6)
Do you have a written emergency retrieval and storage procedures put in place in case of equipment failures or power outages	Yes	10 (16.9)
Do you keep records of received and stored doses of vaccine (inventory management)	Yes	45 (75.0)

Concerning age and practice scores, those aged more than 40 years had the highest (91.7%) right practice followed by those aged 20-30 years (80%) and the lowest (69.6%) right practice were aged 31-40 years, male curried out better practice scores (81.6%) for right scores while female curried out (72.7%) for right scores, university education got more (79.6%) right practice score comparable with secondary education (66.7%).

Table 3: Distribution the practices of HCP working in EPI.

Health care personnel practice		Frequency (n=60) N (%)
Washing hands before any manipulation of the vac. Vials	Yes	25 (41.7)
	No	35 (58.3)
Handling the syringe (touching only safe parts)	Yes	57 (95.0)
	No	3 (5.0)
No used needles retained in vaccine vial	Yes	59 (98.3)
	No	1 (98.3)
Clean area with swab corrects (spiral)	Yes	43 (71.7)
	No	17 (28.3)
Direction and location of the needle in DPT (right thigh angle 90)	Yes	59 (98.3)
	No	1 (1.7)
Direction and location of the needle in the measles vaccine (45 angle of the left forearm bone)	Yes	60 (100.0)
Site of the injection proper	Yes	60 (100.0)
Pull piston to see blood	Yes	46 (76.7)
	No	14(23.3)
Compression at site of injection	Yes	54 (90.0)
	No	6 (10.0)
Correct oral polio dose	Yes	59 (98.3)
	No	1 (1.7)
Time of freeze-dried vaccines reconstitution (if the vaccine administered one of measles, MMR, BCG).		
At the moment of arrival of the first child		50 (83.3)
At the beginning of the session day		10 (16.7)
Presence of ice box to keep the vaccine vials throughout the session with ice	Yes	60 (100.0)
Ice replacing before it melts completely	Yes	49 (81.7)
	No	11 (18.3)

Figure 1: General Score Practice of HCPs Working In EPI.

DISCUSSION

Primary failure of the vaccine can occur after achieving high immunization coverage. The knowledge and practices of HCWs can prevent this failure[19]. The obtained result revealed that, the mean age of respondents was 34.17±7.310, majority of HCPs (41.7%) were in their twenties, followed by thirties age group (38.3%), while those aged 41 to 55 years was constituted 20%. These results are in agreement with the study conducted to assessment of EPI programme at Cairo Governorate, who assessed the main age of HCPs, 33.8±7.7[20] and disagreement with a study conducted in Gurage Zone, Ethiopia that published 25-34 years constitutes (73%)[5]. About two-thirds 63.3% of health workers were male, which varies with the studies conducted by Ogboghodo *et al*., and Adebimpe and Adeoye, they reported (87.3%) and (86.7%) of respondents were female, respectively[21,22]. Current finding may be due to the shortage of females who complete their education. The majority of health facilities (95%) were in the rural, (55.0%) of HF were health units and (31.7%) were health centers, while hospitals represented only the percentage of (13.3%). This result agreed with a study conducted by Rogie *et al*., who revealed that (91.4%) of health facilities in rural settings on the other hand inconsistent with the same study regarding to type of health facilities who revealed that, only (11.2%) were health centers[23].

Table 4: Relation between socio-demographic characteristic of HCP working in EPI and practice score.

Item of socio-demographic	Practice score	Right practice (n=47) No (%)	Right but not complete practice (n=13) No (%)	Test of significance
Residence of the center	Urban	4(6.7)	3(5.0)	FET=0.166
	Rural	43(71.7)	10(16.7)	
Type of health facility	Hospital	6(75.0)	2(25.0)	FET=0.677
	Health Center	14(73.7)	5(26.3)	
	Health unite	27(81.8)	6(18.2)	
Job	Physician	1(100.0)	0(0.0)	FET=0.544
	Nurse	12(70.6)	5(29.4)	
	Health guiders	2(66.7)	1(33.3)	
	Midwife	12(75.0)	4(25.0)	
	Pharmacist	6(100.0)	0(0.0)	
	Health inspector	13(86.7)	2(13.3)	
	Lab technician	1(50.0)	1(50.0)	
Age	20-30	20(80.0)	5(20.0)	FET=0.363
	31-40	16(69.6)	7(30.4)	
	>40	11(91.7)	1(8.3)	
Sex	Male	31(81.6)	7(18.4)	FET=0.520
	Female	16(72.7)	6(27.3)	
Educational level	University	43(79.6)	11(20.4)	FET=0.602
	Secondary	4 (66.7)	2(33.3)	

* FET=Fisher exact test

According to the job of HCPs, nurses were the highest percentage (30.0%), followed by midwives (26.7%). The current study disagreed with a study conducted to assessment knowledge and practices of childhood immunization among primary health care providers in Riyadh City that reported (39.4%) and (60.5%) of respondents were physicians and nurses, respectively[24]. Regarding the level of education, in present study, the distribution according to qualification was divided into two types: everyone who studied after high school, whether he had a bachelor's degree or a diploma, we considered them to be university graduates. The second group was high school and earlier. Most of the HCPS (86.7%) were university, 11.7% were secondary. Obtained results are relatively consistent with study of Al-Ayed and Sheik, 2006; where the secondary status constituted (17.4%) of the participants[24]. The work of experience ranged between 1-30 years with a main of 1.62±0.783 years. A study contacted in Cairo Governorate and Nigeria, showed different results with experience ranged from 1-25 years with an average of 10.9 years and 4.8±2.5 years, respectively[20-22].

Most HCPs (83.3%) have special training in EPI and cold chain. It better than the results of a study conducted in southern Ethiopia, which showed that, only (21.9%) of residences received training on cold chain management[23-25]. on the other hand presents finding agreement with a study conducted in Thailand about HCWs' knowledge and practices regarding EPI, which reflected that about 20% of HCWs have not received training on cold chain systems and immunization[19]. The number of training courses ranged from 1-10 courses with a main of 2.83±2.211 courses. Current study agrees with study contacted in Cairo

Governorate, which indicates that, number of training courses ranged 1–12 courses with average of 3.5±3.1[20].
Regarding practice of HCWs toward cold chain measurements, peripheral level of the health districts, obtained result revealed that, (91.5%) of HF had a good site of refrigerator in the room, in addition, the refrigerator was placed at the correct distance from the wall (15 cm or more) in (95.7%) of HF. Other studies support current finding, Oromia Regional State, Ethiopia study, (92.7% and 92.7%) of refrigerator were away from direct sunlight and distance from wall >10cm, respectively, Menoufia Governorate study, (93.3) of refrigerator were in the right place and position[16,26]. More than two third (76.6%) of HCPs arrange the vaccines in their correct places (nothing on the door), and (72.3%) do the vaccine packing (air circulation) in a good way. The present study is in line with the studies conducted in Oromia Regional State, Ethiopia and Menoufia Governorate that revealed, seven (17.1%) put the vaccines or diluents in the refrigerator door, (95.1%) kept all vaccines in the basket in the refrigerator and (100%) of studied arrange vaccine in a proper site[26]. Present of thermometer was observed in (89.4%), of them (80.9%) the temperature was correct and the temperature was recorded twice per day in (78.7%) of HF. The present finding more than that revealed in Southern Nigeria study, only (34.6%) of HF had thermometer in refrigerators but is in line with study conducting in Kalasin, Thailand, (61.1% and 86.7%) of HCPs record temperature twice per day and keep refrigerator temperature at 2–8°C, respectively and also in relative line with study in Ethiopia, (78.1%, 51.2% and 85.4%), have working thermometers, record temperature twice per day and temperature within the recommended temperature range, respectively, but less than that in Menoufia Governorate study, 100% of the studied PCUs had thermometer, temperature within 2 to +8°C and record temperature twice per day[16,17,19,26]. It was noticed that the absence of food items or drinks in refrigerator of (85.4%) of HF. This finding is less than in Menoufia Governorate, (100%) of the studied PCUs, no food or any drugs other than the vaccines in the refrigerator but mor than that in Ethiopia study, (32.3%) of participants placed food and drinks with vaccines[26,27].
One of the disturbing practices identified in this study was that, existence of a written emergency plan for proper and effective storage and maintenance of vaccines in case of emergency or power failure only in (16.9%) of HF. Three quarters of HCPs (75.0%) keep a record of receiving vaccines (inventory management). The present study corresponds to a study conducted in Ghana that published (16.7%) of HF had vaccine inventory management, but in correspond with study in Ethiopia which revealed (58.3%) of HF had vaccine inventory management[27,28]. The present finding less than that in a study conducted in Oromia Regional State, Ethiopia, (36.6% and 85.4%) of participant have a visible emergency or contingency plan and had recorded all parameters for vaccines, logistics, and diluents, respectively[16]. Concerning the practice of HCPs toward vaccination, current result revealed that, unfortunately only 25 (42.4%) of HCWs working in EPI washing hands before any manipulation of the vaccine vials. This finding agreement with a study in Cairo Governorate, (47.5%) but differs with a study conducted in Menoufia Governorate who reported that, 100% of the studied PCUs reported washing their hands before manipulation of vaccines[18,26].
Fifty-nine (98.3%) of HCPs used needles one time. This finding agreement with a study conducted in Kalasin, Thailand, that reported (93.3%) of participant no used needles retained in vaccine vial[19]. The majority of HCPs (98.3% and 100.0%) directed and location of the needle in DPT and measles vaccine correctly, respectively. This finding agrees with a studies conducted in Menoufia Governorate and Cairo Governorate that presented all HCPs (100%) doing perfectly for DPT and MMR vaccines. On the other hand, obtained results are little more than the results of a study conducted in Ghana, (98.18%, 80.91%) of respondents had the right practice for pentavalent and measles, respectively[20,26,29]. All HCPs 60(100.0%) inject in the proper site. This finding in line with a study conducted in Menoufia Governorate who presented that all HCPs (100%) had a correct site for DPT and MMR and with a study conducted in Ghana, the majority (98.18%) of the HCWs correctly indicated that pentavalent and pneumococcal vaccines should be done per intramuscular route at 90° angle[26,29]. Obtained result more than that in study conducted in Western Maharashtra , (81.31% and 62.63%)of respondents had the correct knowledge about correct site and route of administration of DPT and measles vaccine, respectively[15].
Forty six (76.7%) of HCPs pull piston to see blood. whereas 54(90.0%) of HCPs correctly compress at site of injection. This result varies with studies of El Shazly *et al*., and Mohammed El-Hady Imam Salem *et al*., they published, (100% and 50.0%) of HCPs, respectively do not massage the injection site after the vaccine injection[18,26]. The majority 59 (98.3%) of HCPs correctly applied the polio doses. Obtained result agrees to some extent with a previous study in Menoufia Governorate and Ghana, which reflected that (100% and 97.27%) of HCPs knew the proper dose and route of OPV, respectively[26,28]. Current result is in line with a study conducted in Menoufia Governorate, 100% of the studied healthcare facilities have adequate equipment for vaccination session[26]. As regard to general score practice of HCPs, obtained result revealed that, most 47(78.3%) of HCPs had right but not complete practice while only 13(21.7%) of HCPs were right practice. This finding is less than that in a studies conducted in Jhalawar (Raj), Nigeria, and Southern Nigeria (77.2%, >75%, and 73.9%) of HCPs were good practice[17,22,30]. The current result is considered worst if compared with the results of a study done in Cairo Governorate and Ethiopia that revealed major (92%, 95%) of HCPs have a high level of practice[20,30]. Regarding to relation between sociodemographic characteristic of HCPs and practice score, there is no significant correlation between socio-demographic of HCPs and score practice, HCPs that working in rural residence achievement the highest 43(71.7%) right practice.

Frequent power outages in the rural areas of Sa'adah may make healthcare workers in the rural area more sensitive to the importance of maintaining the cold chain, practicing it more, and getting better knowledge. This finding in agreement with a study conducted in Nigeria, that revealed, practicing in the rural areas were also found to have better knowledge, while it did not agree with the study conducted in Mozambique, The health personnel in the capital of the region know better than those who work in the periphery[22,31].

Twenty seven (81.8%) of HCPs working in health unite achievement the highest right practice comparable with those working in hospitals and health centers, (75.0% and 73.7%), respectively. Obtained result is not consistent with previous studies conducted in Kalasin, Thailand and Isparta, Turkey that was published the overall scores for PCU practices in hospitals were significantly higher than t PCUs practices in health centers[19,32]. The present study showed that, physician and pharmacist had the highest percentage (100%) right practices, followed by health inspector (86.7%). This may be due to higher qualifications and more practice about vaccination. Present study is supported by previous studies conducted in Menoufia Governorate, Jhalawar and Cairo Governorate, that revealed knowledge and practice of health workers increased with qualification[18,26,30] and also with a study conducted in Oromia Regional State, Ethiopia, professional qualification was not statistically significant[16]. The study not consistent with a study conducted in Amhara region, professional qualification had a significant correlation with the practice of HCWs' work in cold chain management[33].

Major (91.7%) of those aged more than 40 years had right practice followed by those aged 20-30 years (80%), this may be due to the increase in years of experience in the field of immunization. A study conducted in Nigeria said that knowledge decreases with increase in age, which is not consistent with current study[22]. Also not consistent with studies conducted in Ethiopia and Southern Nigeria. The age of vaccinating workers had a statistically significant association with the level of cold chain management practice[17,27]. More than three quarter (81.6%) of male curried out better practice scores for right scores. This finding agreement with Ogboghodo *et al*., study, Males are 1.734 times more likely to perform good cold chain management than females[17]. But not agree with previous studies conducted in Nigeria and Cairo Governorate, female had more good practice and knowledge than male[20,22].

More than three quarter (79.6%) of those had university education got more right practice score comparable with secondary education (66.7%). This finding were similar to finding of study in Ethiopia, Graduate degree had a higher good score practice 79 (53.3%) with no statistically significant[16]. Increasing the level of education will also improve cold chain management practice by 5.2 times[26,34]. Thus, structured training and active monitoring are recommended to ensure standard immunization.

Limitation of the study: There are shortcomings in this study as a result of the ongoing war in Yemen in general and in Sa'adah governorate in particular since 2016. The war caused four districts out of 15 (26.6%) to be completely unsafe and was not included in the study. Some districts have limited safe areas that the researchers were able to reach, but not all of them. The presence of temporary health facilities that were built in place of the completely destroyed health centers that are not suitable for work might be affected the results of the study.

CONCLUSIONS

This study indicated that there are some weaknesses in the practice of workers in the EPI: there is no written plan for procedures to be taken in emergency situations to be applied in the event of equipment breakdown or power outage, some workers are not aware of the danger of putting food or drink in the vaccine refrigerator. In addition, nearly half of the workers do not wash their hands before any manipulation with vaccines, there is a failure to record the temperature twice a day, and some prepare freeze-dried vaccines at the beginning of the vaccination session.

In addition to this, only 13(21.7%) of HCPs were right to practice. Hence, regular supportive supervision and constant technical support, and on-the-job training to improve the HCP's practice regarding immunization are substantially recommended.

ACKNOWLEDGEMENTS

We would like to express our appreciation to the Sa'adah Governorate Health Office, the participants in this study, as well as my parents who showered me with prayers for the completion of this work.

AUTHOR'S CONTRIBUTION

Qeran MA: writing original draft, methodology, investigation, conceptualization. **Habour ABA:** formal analysis, conceptualization, supervision. **Hassan EHE:** writing, review, and editing, supervision. All the authors approved the finished version of the manuscript.

DATA AVAILABILITY

The datasets generated during this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

No conflict of interest associated with this work.

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