**Reviewer’s Comments**

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**EVALUATION PRACTICES OF HEALTHCARE PERSONAL WORKING IN EPI,** **SA’ADAH, YEMEN, 2019**

**Abstract**

*Background:The effectiveness of any vaccine depends on preserved it at the recommended temperatures from its manufacture until administered. Health workers in any health facility play an important and vital role in maintaining the cold chain and the efficiency of the vaccine. Therefore, this research was conducted to evaluate the practice of health workers working in the Expanded Program on Immunization.*

*Method:This cross-sectional study was performed to assess healthcare workers (HCPs) practice regarding EPI. It was conducted on 60 HCWs in 60 H.F of 11 districts in Sa’adah Governorate, Yemen during 1 June – 30 Juley 2019. The checklist used for assessment of general practices of health care personnel involved in EPI were focused on; site of refrigerator, arrange the vaccines, present of thermometer, handling the syringes, cleaning the injection area, direction of the needle for pentavalent and measles vaccination, and way of keeping the vaccines during the sessions. Data entry and cleaning was done using Microsoft excel 2019 and export to SPSS version 26, P. Values less than 0.05 were considered significant. Differences in samples means were evaluated by chi-square test.*

*Results: 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 13(21.7%) of HCPs had a right practice, while a significant number showed right but not complete. Hence, regular supportive supervision and constant technical support, and on-the-job training to improve the HCP's practice regarding immunization are substantially recommended.*

*Key words*:*coldchain*, *Practice, Expanded programme on immunization, Sa’adah, Yemen, 2019.*

**INTRODUCTION**

Vaccination is one of public health’s most effective intervention saves nearly three million lives every year, according to UN.(1) The Expanded Program on Immunization (EPI) was initiated in 1974 with the goal of providing universal immunization with essential vaccines. In developing countries, children under 5 years old are immunized against 10 diseases: tuberculosis, tetanus, pertussis, diphtheria, polio, measles, hepatitis B (HepB), and homophiles influenza (Hib), rotavirus, and pneumococcus vaccine (PCV).(2)

To ensure vaccine safety and effectiveness in protecting individuals from vaccine-preventable diseases (VPDs), all immunization and cold chain staff must know and conduct the correct handling and management of vaccines and immunization supplies at all levels of the cold chain. Also, vaccines are biological products, temperature and freezing sensitive, therefore, 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 developed a set of guidelines for properly managing the EPI service in its member countries.(5)Primary vaccine failure can occur either through an inactive vaccine or insufficient host response. The defect in cold chain system and practices are potential causes of the primary vaccine failure due to inactivated vaccines.(6)

Appropriate vaccination is essential for vaccine safety and optimal efficacy, the CDC recommends that all healthcare workers administering vaccines receive comprehensive, competency-based training on vaccine administration policies and procedures prior to administering a vaccine.(7)

In order to achieve coverage and maintain the benefits of vaccination, it is important that vaccinator follow standard practices before, during and after vaccination. WHO recommends that the standard immunization guidelines in practice ensure that before vaccination, vaccinators have the ability to identify the right patient at the right time, to identify, prepare, and administer the appropriate vaccines using the correct cooling chain practices.(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 [1a], hepatitis B virus coverage in children [2a], and total maternal tetanus vaccination coverage rate [3a], influenza virus vaccine coverage among SARI [4a] and the rate of childhood vaccination between 1978 and 2018 [5a]; 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.

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.(9)

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.(10-12) Despite the interest in the practical evaluation of workers in the EPI, there is no study in this regard conducted in our province.

**METHODS**

 **Study area**

The study was conducted in 60 health facilities in the districts of Sa’adah Governorate, North Yemen, 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 conducted in the time frame from the period of June 1 to July 30, 2019.

**Study design**

 Across-sectional study approach was conducted.

**Study population and centers**

 Health care personnel working in EPI.

**Data Collection Tools and Procedures**

An observation checklist for assessment the practices of health care personnel working in EPI was used for assessment of general practices of health care personnel involved in EPI were focused on; site of refrigerator, arrange the vaccines, present of thermometer, handling the syringes, cleaning the injection area, direction of the needle for pentavalent and measles vaccination, reconstitution of the vaccine and way of keeping the vaccines during the sessions.

**Main Outcome Variable Measurement.**

* The answer of each practice questions was scored as follow:
* 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:

* 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 from 1 Jun to 30 Jul 2019 and to investigate about all the data required in the questionnaires mentioned above and to interview the health workers in the EPI to fill the questionnaire of HCWs practice.

**Consideration**The aim of this study is 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 performed using the data analysis software Statistical Package Social Sciences **(SPSS)** version 26, P. Values less than 0.05 were considered significant. Differences in samples means were evaluated by chi-square test.

**RESULT**

**1-socio-demographic characteristics of HCP working in EPI (Sa’adah, Yemen, 2019)**

From Table (1),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%). 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%). According to the job of HCPs, nurses were the highest percentage (30.0%), followed by midwives (26.7%), then health inspector and pharmacists (23.3%,10.0%) respectively. 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).

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| **Table (1): Distribution of socio-demographic characteristics of HCP working in EPI (Sa’adah, Yemen, 2019)** |
| **socio-demographic distribution:** | **Frequency (n=60)** | **~~Percent~~** |
| 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 |
| Morshedien | 3 | 5.0 |
| Midwife | 16 | 26.7 |
| Pharmacist | 6 | 10.0 |
| Health inspector | 14 | 23.3 |
| lab.tech | 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 |

**2- Practice of HCWs regarding cold chain measurements, peripheral level of the health districts, Sa’adah, Yemen, 2019). (n=47)**

**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.

We noticed the absence of food item or drinks in refrigerator of (89.4%) of HF.One of the disturbing practices identified in this study was that, the written emergency retrieval and storage procedures put in place in case of equipment failures or power outages with only (16.9%)of HF. More than three quarters of HCPs (75.0%) keep a record of receiving vaccines (inventory management).

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| **Table (2) Practice of HCPs regarding cold chain measurements, peripheral level of the health districts, Sa’adah, Yemen, 2019)** |
| **Cold chain facility condition at peripheral level** | **Frequency correct practice (n=47)** | **~~Percent correct practice~~** |
| **Description of vaccination rom 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 temp. 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 |

**3- Practices of HCPs working EPI, Sa’adah, Yemen, 2019. (n=60)**

**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 at the moment of arrival of the first child while only 16.7% mentioned reconstituting at the beginning of the session day. 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.

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| **Table (3)Distribution the practices of HCP working in EPI (Sa’adah, Yemen, 2019)** |
| **health care personnel practice:** | **Frequency (n=60)** | **~~Percent~~** |
| **Washing hands before any manipulation of the vac. Vials** | Yes | 25 | 42.4 |
| No | 35 | 58.3 |
| **Handling the syringe (touching only safe parts)** | Yes | 3 | 5.0 |
| No | 57 | 95.0 |
| **No used needles retained in vaccine vial** | Yes | 1 | 1.7 |
| No | 59 | 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 |

As regard to general score practice of HCPs, fig (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.

**4- Relation between sociodemographic characteristic of HCP working in EPI and practice score (Sa’adah, Yemen, 2019)**

Table (5) showed no significant correlation between the socio-demographics of HCPs and score of practice, HCPs that working in rural residence achievement the highest 34(71.7%) right practice, 27(81.8%) of HCPs working in health unite achievement theright practice flowed 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, Morshedien and lab technician, respectively.

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%).

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| **Table(5): Relation between sociodemographic characteristic of HCP working in EPI and practice score (Sa’adah, Yemen, 2019)** |
|  | **Practice score** | **Right practice** | **Right but not complete practice** | **Test of significance** |
| **Item of sociodemographic** |  | **NO (n=47)** | **~~%~~** | **NO (n=13)** | **~~%~~** |
| Residenceofthe 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 |
| Morshedien | 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 |

\*Significant (p<0.05)

**DISCUSSION**

Primary failure of the vaccine can occur after achieving high immunization coverage. The knowledge and practices of health-care workers are important factors in preventing this failure and to maintain vaccine, immunization effectiveness.(13)

~~Our~~ 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 41to55 years was constituted 20%. These results are in agreement with the study conducted toassessment of EPI programme at Cairo Governorate, who assessed the main age of HCPs, 33.8 ± 7.7.(14) 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.(15, 16) Our 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.(17)

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 assessmentknowledge 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.(18)

Regarding the level of education, in our 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. Our results are relatively consistent with study of Al-Ayed and Sheik, 2006; where the secondary status constituted (17.4%) of the participants.(18)

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 resultswith experience ranged from 1- 25 years with an average of 10.9 years and 4.8 ± 2.5 years, respectively.(14, 16)

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.(19) on the other hand our finding agreement with a study conducted in Thailand abouthealthcare workers’ knowledge and practices regarding expanded program on immunization, which reflected that, approximately 20% had no training regarding EPI and the cold chain system.(13)

The number of training courses ranged from 1-10 courses with a main of 2.83±2.211 courses. Our study agrees with study contacted in Cairo Governorate, which indicates that, number of training courses ranged one – 12 courses with average of 3.5 ± 3.1.(14)

Regarding practice of HCWs toward cold chain measurements, peripheral level of the health districts, our 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 our 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 right place and position.(11, 20)
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. Our 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.(11, 20)
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. Our 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.(11-13, 20)We noticed 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.(20, 21)One of the disturbing practices identified in this study was that, the written emergency retrieval and storage procedures put in place in case of equipment failures or power outages in (16.9%) of HF. Three quarters of HCPs (75.0%) keep a record of receiving vaccines (inventory management).Our study corresponds to a study conducted in Ghana that published(16.7%) of HF had vaccine inventory management, but incorrespond with study in Ethiopia which revealed (58.3%) of HF had vaccine inventory management.(21, 22)Our 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.(11)

Concerning the practice of HCPs toward vaccination, our 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.(20, 23)

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.(13)

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 witha studies conducted in Menoufia Governorate and Cairo Governorate. that presented all HCPs (100%) doing perfectly for DPT and MMR vaccines. On the other hand, our 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.(14, 20, 24)

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 proper site of the for DPT and MMR and with a study conducted in Ghana, majority (98.18%) of the respondents rightly indicated pentavalent and pneumococcal vaccines as given per intramuscular route at 90° angle.(20, 24)Our 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.(10)

Forty-sex (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.(20, 23)

The majority 59 (98.3%) of HCPs correctly applied the polio doses. Our 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.(20, 21)

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. Our result is in line with a study conducted in Menoufia Governorate, 100% of the studied healthcare facilities have adequate equipment for vaccination session.(20)

As regard to general score practice of HCPs, our 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.(12, 16, 25) This finding is considered worse if compared with the results of study done in Cairo Governorate and Ethiopia that revealed major (92%, 95%) of HCPs were high level of practice.(14, 25)

Regarding to relation between sociodemographic characteristic of HCPs and practice score our result revealed no significant correlation between socio-demographic of HCPs and score practice, HCPs that working in rural residence achievement the highest 34(71.7%) right practice. Frequent power outages in the rural areas of Saada 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, health staff at the district capital had a better knowledge than those working in the periphery.(16, 26)

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.Our result is not consistent with previous studies conducted in Kalasin, Thailand and Isparta, Turkey that was published total scores of practices of PCUs in hospitals were significantly higher than those of PCUs in health centers.(13, 27)

Our 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.Our study is supported by previous studies conducted inMenoufia Governorate, Jhalawar and Cairo Governorate, that revealed knowledge and practice of health workers increased with qualification.(20, 23, 25) and also with a study conducted in Oromia Regional State, Ethiopia, professional qualification was not statisticallysignificant.(11) The study not consistent with a study conducted inAmhara region, professional qualification had a statistically significant association with the practice of health workers on cold chain management.(28)

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 our study.(16) Also not consistent with a studies conducted inEthiopia and Southern Nigeria, the age of vaccinators and vaccine handlers had a statistically significant association with the level of cold chain management practice.(12, 22)

More than three quarter (81.6%) of male curried out better practice scores for right scores. This finding agreement withOgboghodo et.al., study, males were 1.734 times more likely to have good practice of cold chain management compared to the females.(12)Butnot agree withprevious studies conducted in Nigeria and Cairo Governorate, female had more good practice and knowledgethan male.(14, 16)

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.(11)Further increasing the level of education will also improve the practice of cold chain management by 5.2.(20, 29)Thus, orderly training and effective monitoring are recommended to ensure standard immunization.

**Conclusion**

The study found that 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.

**Abbreviations**

**EPI**: Expanded programme on Immunity

**HCWs**: Healthcare workers

**BCG**: Calmette-Guerin

**DPT**: diphtheria, pertussis, tetanus vaccine

**MMR:**[Measles, Mumps, and Rubella](https://www.cdc.gov/vaccines/vpd/mmr/public/index.html%22%20%5Ct%20%22_blank)

**Limitation** As a result of the ongoing war in Yemen in general and in Sa’adah Governorate in particular since 2016, it has caused the following:

1. Four directorates out of 15(26.6%), were entirely unsafe.
2. Some directorates have limited safe areas that we were able to reach.
3. Presence of temporary health facilities that were built instead of the destroyed once or out of service due to unsafe areas.

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**Author’s Contribution**

**Conflict of interest**

**References:**

1. UNICEF. Vaccines Work: Vaccines are Safe and Save Lives. UN News Global Perspective; 2019.

2. Desalegn T, Shiferaw MB, Tesfahun E, Moges A, Semunigus T. Vaccination coverage and associated factors among children in Debre Berhan town, Ethiopia. Recent Adv Biol Med. 2019;5(2019):11536.

3. Program DoHNI. VACCINES, COLD CHAIN AND LOGISTICS MANAGEMENT. PHILIPPINES2018 [cited 2022 27-10-2022].

4. Park K. Park’s Textbook of Preventive & Social Medicine 25th edition Jabalpur. India: M/s Banarasidas Bhanot publishers. 2019:269-80.

5. Yassin ZJ, Yimer Nega H, Derseh BT, Sisay Yehuala Y, Dad AF. Knowledge of health professionals on cold chain management and associated factors in Ezha District, Gurage Zone, Ethiopia. Scientifica. 2019;2019.

6. Pannuti CS, Morello RJ, de Moraes JC, Curti SP, Afonso AMS, Camargo MCC, et al. Identification of primary and secondary measles vaccine failures by measurement of immunoglobulin G avidity in measles cases during the 1997 Sao Paulo epidemic. Clinical and diagnostic laboratory immunology. 2004;11(1):119-22.

7. Centers for Disease Control and Prevention (CDC). Vaccine administration guidelines 2012 [Available from: http://www.cdc.gov/vaccines/recs/.

8. World Health Organization(WHO). Mid-Level Management Course for EPI Managers: BLOCK II: Planning/organization 2017.

9. World Health Organization(WHO). Global manual on surveillance of adverse events following immunization. 2014.

10. Teli PT, Kunte R, Yadav AK, Mohan P. A cross-sectional survey on awareness, practice of vaccine administration, and cold chain management in a tertiary health center of Western Maharashtra. Medical Journal of Dr DY Patil Vidyapeeth. 2020;13(3):220.

11. Feyisa D. Cold Chain Maintenance and Vaccine Stock Management Practices at Public Health Centers Providing Child Immunization Services in Jimma Zone, Oromia Regional State, Ethiopia: Multi-Centered, Mixed Method Approach. Pediatric Health, Medicine and Therapeutics. 2021;12:359.

12. Ogboghodo EO, Omuemu VO, Odijie O, Odaman OJ. Cold chain management practices of health care workers in primary health care facilities in Southern Nigeria. Pan African Medical Journal. 2017;27(1).

13. Widsanugorn O, Suwattana O, Harun-Or-Rashid M, Sakamoto J. HEALTHCARE WORKERS’KNOWLEDGE AND PRACTICES REGARDING EXPANDED PROGRAM ON IMMUNIZATION IN KALASIN, THAILAND. Nagoya journal of medical science. 2011;73(3-4):177.

14. Mohammed El-Hady Imam Salem., SASK, Mahmoud MMR. Assessment of Expanded Program of Immunization Provided for Children less than Five Years in Family Health Centers at Cairo Governorate. Acta Scientific Pharmaceutical Sciences. 2018;2(10):67-78.

15. Ogboghodo EO, Omuemu VO, Odijie O, Odaman OJ. Cold chain management: An assessment of knowledge and attitude of health workers in primary health-care facilities in Edo State Nigeria. Sahel Medical Journal. 2018;21(2):75.

16. Adebimpe WO, Adeoye OA. Knowledge and practice of vaccination logistics management among primary health care workers in Nigeria. Human Vaccines & Immunotherapeutics. 2021;17(5):1490-5.

17. Rogie B, Berhane Y, Bisrat F. Assessment of cold chain status for immunization in central Ethiopia. Ethiop Med J. 2013;51(Suppl 1):21-9.

18. Al-Ayed IH, Sheik S. Knowledge & practices of childhood immunization among primary health care providers in Riyadh city: Part ii-precautions and contraindications to vaccination. Journal of family & community medicine. 2006;13(1):19.

19. Woldemichael B, Bekele D, Esmael A. Cold chain status and knowledge of vaccine providers at primary health care of units bale zone, Southeast Ethiopia: cross-sectional study. Immunome Res. 2018;14(1):1-6.

20. El Shazly HM, Khalil NA, Ibrahem RA, Wahed SAA. Knowledge and practice of healthcare providers as regards routine children vaccination in primary healthcare facilities of Quewisna District, Menoufia Governorate. Menoufia Medical Journal. 2016;29(4):1018.

21. Asamoah A, Ebu Enyan NI, Diji AK-A, Domfeh C. Cold Chain Management by Healthcare Providers at a District in Ghana: A Mixed Methods Study. BioMed Research International. 2021;2021:7559984.

22. Mohammed SA, Workneh BD, Kahissay MH. Knowledge, attitude and practice of vaccinators and vaccine handlers on vaccine cold chain management in public health facilities, Ethiopia: Cross-sectional study. PLoS One. 2021;16(2):e0247459.

23. ME-HI S, SAS K, MMR M. Assessment of expanded program of immunization provided for children less than five years in family health centers at Cairo Governorate. Acta Scientific Pharmaceutical Sciences. 2018;2(10).

24. Ansong D, Osei F, Enimil A, Boateng K, Nyanor I. Knowledge and Competencies of Vaccinators on Routine Childhood Vaccination in Ghana. . J Vaccines Vaccin. 2018;13:3.

25. Swarnkar M, Baig VN, Soni SC, Shukla US, Ali J. Assessment of knowledge and practice about immunization among health care providers. National Journal of Community Medicine. 2016;7(04):281-5.

26. João C, Gunnar B. Cold chain management: knowledge and practices in primary health care facilities in Niassa, Mozambique. Ethiopian J Health Dev. 2007;21.

27. Uskun E, Uskun SB, Uysalgenc M, Yagız M. Effectiveness of a training intervention on immunization to increase knowledge of primary healthcare workers and vaccination coverage rates. Public Health. 2008;122(9):949-58.

28. Bogale HA, Amhare AF, Bogale AA. Assessment of factors affecting vaccine cold chain management practice in public health institutions in east Gojam zone of Amhara region. BMC public health. 2019;19(1):1-6.

29. Brown VB, Oluwatosin OA, Ogundeji MO. Impact of training intervention on immunization providers’ knowledge and practice of routine immunization in Ibadan, south-western Nigeria: a primary health care experience. Pan African Medical Journal. 2017;26(216).