**Original Research Article**

# Knowledge of healthcare workers in Expanded program on immunization (Sa’adah, Yemen, 2019)

***Abstract***

***Background****: After achieving high vaccination coverage, vaccine failure may occur. The sufficient knowledge of the workers in the expanded program of immunization is one of the factors that affect in preventing this failure. In Saada, Yemen, there is no information about the knowledge of workers in the expanded program of immunization. This study seeks to assess the knowledge of those in charge of immunization in Saada, Yemen.*

***Method:*** *This cross-sectional study was performed to assess healthcare workers (HCPs) knowledge 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. Appropriate interviewing pre-tested questionnaire was used to collect data from HCWs working in EPI. It includes the following: socio-demographic characteristics, knowledge about; cold chain and the method and time of administration of the vaccine and shake test. Face to face interview used to collect information. 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****: Age is one of the determining factors for knowledge of cold chain management (FET=0.040\*), and the total knowledge score for of HCPs was (26.7 %, 65% and 8.3%) for good, fair, and poorknowledge, respectively.*

***Conclusion****: Only twenty-six-point seven of HCPs had a good knowledge score. Regular technical support and on-the-job training to improve the HCPs knowledge about immunization are highly recommended.*

*Key words*:*knowledge, Expanded programme on immunization, Sa’adah, Yemen, 2019*

**IN TR OD UCTION**

Immunization is one of the most effective public health interventions, Immunization has saved millions of lives, global coverage dropped from 86% in 2019 to 81% in 2021, In 2021, the number of completely unvaccinated children increased by 5 million since 2019.(1), vaccines are biological products and temperature-sensitive thus, recommended storage temperatures for all vaccines and diluents should be minute at all levels of the cold chain, 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.(2), also, 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.(3). The World Health Organization (WHO) has developed a set of guidelines for properly managing the EPI service in its member countries.(4)

Three key factors for achieving the full benefit of immunization include; Extensive immunization coverage, timely administration of vaccines and ensuring the effectiveness of vaccines through proper maintenance of the vaccine cold chain.(5).The "Cold chain" refers to the network of personnel, equipment and processes that ensure that vaccines are transported and stored at appropriate temperatures between (+2°C to +8°C) from the manufacture to the recipient, ensuring that they remain effective.(6)

Improper vaccine storage practices and poor knowledge of cold chain management affect the quality of administered vaccine.(7), high knowledge and positive attitude increase implementation of cold chain management.(8), HCWs must have sufficient knowledge to manage the cold chain.(9)

Various studies revealed that, different factors influence the level of knowledge of cold chain management: Age and Location of Practice.(10) profession.(10-12) work experience and receiving training on EPI.(11, 13, 14)

In Yemen, 1970 no vaccinations were available and no immunization program exists before, 1970-1976 only smallpox vaccine for all age groups, 1977s establishment of EPI with goal to achieve 90 % coverage for OPV3, DPT3, and measles and to achieve 80 % coverage for hepatitis B3 before the age of 12 months by the end of 2005. The recommended vaccination schedule includes vaccines against tuberculosis, poliomyelitis, measles, diphtheria, pertussis, hepatitis B, and diseases caused by Hemophilus influenza, 1979Yemen was declared free from smallpox.(15). In 1982 UNICEF launched the Child Survival and Development which included immunization along with other cost-effective high impact interventions.(16), in 1998 introduced hepatitis B vaccine, in June 2009Yemen was declared polio-free, 2011Pneumococcal vaccine was introduced, rotavirus vaccine (Rota) introduced in 2012, in 2015 Rubella vaccine and Inactivated Polio vaccine(IPV) was introduced to become 12 vaccines for children and one for women.(17)

In Sada,a governorate during the period of Jan to Dec 2020, a total of 114 cases of acute flaccid paralysis (AFP) were reported from 87% (13/15) districts, and Vaccine Derived Polio Virus type 1 (cVDPV1) was confirmed among 26% (30) AFP cases. 75% (21) were < 5 years, 73% (20) had zero doses of Oral Polio Vaccine (OPV).(18)

**METHODS**

**Study area**

The study was conducted in 60 health facilities of the districts in 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 from June 1 to July 30, 2019.

**Study design**

Across-sectional study approach.

**Study population and centers**

Health care personnel working in EPI  
**Data Collection Tools and Procedures**

Appropriate interviewing pre-tested questionnaire was used to collect data from HCWs working in EPI. It includes the following: socio demographic characteristics, knowledge about; immunization schedule (dose and time), method of BCG and pentavalent administration, time of measles vaccination given, temperatures required for keeping of polio and pentavalent vaccines, partially used polio vial (opened) and shake test.

**Main Outcome Variable Measurement.**

The answers of each knowledge questions were scored as follow:

1. Score "2" for correct.
2. Score "1" for incorrect.
3. Score "0" for don't know

Summation of knowledge answer scores was done. Then a percent total score was

calculated. The total sum of knowledge was graded as follows:

* Good≥ 75%
* Fair 51%-74 %
* wrong ≤ 50 %

**Data collection**

Data were collected through field visits to hospitals, health centers and units 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 knowledge.

**CONSIDERATION**The aim of this study is to evaluate the knowledge of HCWs who work in expanded program of immunization (EPI) in 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 HCPs**

**Table (1) Showed s**ocio-demographic characteristics of HCPs working in EPI. The respondents consisted of 23 - 55 years with a mean age and standard deviation (SD) of 34.17 ±7.310. About two-thirds 63.3% were male. The majority of health facilities (95%) were in the rural, more than half of the health facilities (55.0%) were health units and 31.7% were health centers, while hospitals constitute (13.3%). Among HCPs included in the study, nurses were the highest (30.0%), followed by midwives (26.7%). Regarding the level of education, most of the HCPs (86.7%) were university. Among these HCPs, more than half (53.3%) of respondent had experience more than 10 years with a main of 1.62±0.783 years.

Most HCPs (83.3%) have special training in EPI and cold chain with a main of 2.83±2.211 courses. Only 16.9% of HCPs have a written emergency plan and more than three quarters (75.0%) keep a record of receiving vaccines (inventory management).

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| **Table (1): Socio-demographic characteristics of HCPS working in EPI (Sa’adah, Yemen, 2019)** | | | |
| **socio-demographic profile** | | **Frequency (n=60)** | **Percent (%)** |
| **Age** | 20-30 | 25 | 41.7 |
| 31-40 | 23 | 38.3 |
| 41-55 | 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 | | 10.73 ± 7.696 | |
| **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 | |
| **Have a written emergency plane** | Yes | 10 | 16.9 |
| No | 50 | 83.3 |
| **Keep records of received and stored doses of vaccine (inventory management)** | Yes | 45 | 75.0 |
| No | 15 | 25.0 |

1. **Knowledges of HCPs working in EPI program.**

Table (2) showed, among HCPs (60) working in EPI were interviewed by researcher for their knowledge concerning EPI, fifty-eight (96.7%) of interviewers knew the immunization schedule dose & Time correctly and (98.3%) knew how BCG is administered but only (23.3%) of them knew the correct reason for this practice.

All HCPs (100%) knew correctly how DPT is administered and when measles is given on the other hand, only more than half (51.7%) knew the reason correctly for this practice. Sixty (100%) and (96.7%) health workers correctly mentioned the recommended range of temperature (2°C–8°C) for vaccine storage and the frequency of temperature recordings, respectively.

The disturbing that the only (5.0% and 6.7%) of HCPs knew which vaccines is the most heat sensitive and sensitive to freezing respectively. The majority of HCPS (96.7%) knew correctly temperature for keeping DPT and polio vaccines. Only 35.0% of HCPs knew correct measure to be taken 1f a child develop convulsion after giving pentavalent vaccine in the next time for vaccination.

Most HCPs (85%) refuse to use the frozen pentavalent vaccine and 65.5% know why we should not use the frozen pentavalent vaccine. Most HCPS (93.3%) use the rest of the polio vaccine vial the next day, more than half of HCPs testified to know what shake test is while only (31.7%) of them knew what is the Shake test and most of them (75%) knew correctly the vaccines can the shake test be carried out.

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| **Table (2): Knowledge of HCPS working in EPI (Sa’adah, Yemen, 2019)** | | | | |
| **Item of HCPS knowledge** | **Frequency (n=60)** | | | |
| **Correct** | | **Incorrect** | |
| **Frequency** | **Percent** | **Frequency** | **Percent** |
| **Immunization schedule douse & Time** | 58 | 96.7 | 2 | 3.3 |
| **How BCG is administered** | 59 | 98.3 | 1 | 1.7 |
| **Why** | 14 | 23.3 | 46 | 76.7 |
| **How DPT is administered** | 60 | 100.0 | 0 | 0.0 |
| **Why** | 31 | 51.7 | 29 | 48.3 |
| **When measles is given** | 60 | 100.0 | 0 | 0.0 |
| **Why** | 31 | 51.7 | 29 | 48.3 |
| **How many times should the temperature of the refrigerator monitored and recorded** | 58 | 96.7 | 2 | 3.3 |
| **At what temperature range are vaccines generally stored at the health center** | 60 | 100.0 | 0 | 0.0 |
| **Which of these vaccines is the most heat sensitive** | 3 | 5.0 | 57 | 95.0 |
| **Which of these vaccines is most sensitive to freezing** | 4 | 6.7 | 56 | 93.3 |
| **Temp. of keeping DPT (penta)** | 58 | 96.7 | 2 | 3.3 |
| **Temp. Of keeping polio** | 58 | 96.7 | 2 | 3.3 |
| **1f a child develop convulsion after giving penta. What you will do when becomes next time for vaccination** | 21 | 35.0 | 39 | 65.o |
| **Will you give frozen DPT** | 51 | 85.0 | 9 | 15.0 |
| **Why** | 39 | 65.5 | 21 | 35.0 |
| **Partially used polio vial (open) Could be used next day** | 56 | 93.3 | 4 | 6.7 |
| **Do you know what shake test is** | 34 | 56.7 | 26 | 43.3 |
| **What is the Shake test** | 19 | 31.7 | 41 | 68.3 |
| **On which of the following vaccines can the shake test be carried out** | 45 | 75.0 | 15 | 25.0 |

As regard to general score of knowledge of HCPs working in EPI (N60) Fig (1) shows a summary of the total knowledge percentage, only (26.7 %) of HCPs scored a high-level wile (65%) scored fair knowledge, the lowest percentage was for the poor knowledge by percentage of (8.3%).

1. **Relation between socio-demographic characteristic of HCPS working in EPI and knowledge score (Sa’adah, Yemen, 2019).**

Table (4) shows that the total knowledge score was significantly higher among the age group 40+ years (50.0%) compared to other age groups (FET=0.040\*).

As for the relationship between knowledge and gender, males had the highest good score (12) 31.6% with no statistically significant (FET=0.335), regarding residence, health facilities in the urban showed higher in good score (1) 33.3% with no statistically significant (FET=0.141), good knowledge score were high among health unites (9) 27.3% with no statistically significant (FET=0.926).

Regarding the correlation between job of participants' and knowledge score, physician had the highest rated (1) scored 100.0% compared to health inspector, nurse and midwife were (35.7%, 27,8% and 25.0%) respectively. The difference was not statistically significant (FET=0.884), level of education was not statistically significant (FET= 0.196) as the percentage of good knowledge scores among secondary graduated was the most (4) scores 50%.

There was no significant correlation between total knowledge score and years of experience, more than ten years of experience were the highest good knowledge scores (10) 31.3% (FET=0.196) with a main of 1.53±0.503.

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| **Table (4):** **Relation between socio-demographic characteristic of HCPS working in EPI and knowledge score (Sa’adah, Yemen, 2019)** | | | | | | | | |
| **Knowledge score** | | **Score** | | | | |  | **Test of significant** |
| **Poor** | | **Fair** | | **Good** | |
| **Item of sociodemographic** | | **NO (n=5)** | **%** | **NO (n=39)** | **%** | **NO (n=16)** | **%** |
| **Age** | 20-30 | 3 | 12.0 | 17 | 68.0 | 5 | 20.0 | FET =  0.040\* |
| 31-40 | 0 | 0.0 | 18 | 78.3 | 5 | 21.7 |
| 41+ | 2 | 16.7 | 4 | 33.3 | 6 | 50.0 |
| **Sex** | Male | 2 | 5.3 | 24 | 63.2 | 12 | 31.6 | FTE = 0.335 |
| Female | 3 | 13.6 | 15 | 68.2 | 4 | 18.2 |
| **Residence of the center** | Urban | 1 | 33.3 | 1 | 33.3 | 1 | 33.3 | FET = 0.141 |
| Rural | 4 | 7.0 | 38 | 66.7 | 15 | 26.3 |
| **Type of health facility** | Hospital | 0 | 0.0 | 6 | 75.0 | 2 | 25.0 | FET= 0.926 |
| Health center | 1 | 5.3 | 13 | 68,4 | 5 | 26.3 |
| Health unite | 4 | 12.1 | 20 | 60.6 | 9 | 27.3 |
| **Job** | Physician | 0 | 0.0 | 0 | 0.0 | 1 | 100 | FET= 0.884 |
| Nurse | 1 | 5.6 | 12 | 66.7 | 5 | 27.8 |
| Physician Assistant | 0 | 0.0 | 3 | 100 | 0 | 0.0 |
| Midwife | 2 | 12.5 | 10 | 62.5 | 4 | 25.0 |
| Pharmacist | 1 | 16.7 | 4 | 66.7 | 1 | 16.7 |
| Health inspector | 1 | 7.1 | 8 | 57.1 | 5 | 35.7 |
| lab.tech | 0 | 0.0 | 2 | 100 | 0 | 0.0 |
| **Educational level** | University | 4 | 7.7 | 36 | 69.2 | 12 | 23.1 | FET= 0.196 |
| Secondary | 1 | 14.3 | 3 | 42.9 | 4 | 50.0 |
| **Work experience in year** | <10 | 3 | 10.7 | 19 | 67.9 | 6 | 21.4 | FET= 0.658 |
| 10+ | 2 | 6.3 | 20 | 62.5 | 10 | 31.3 |
| **Main ± SD** | | 1.53 ± 0.503 | | | | | | |

\*Significant (p<0.05)

**DISCUSSION**

1. **Knowledges of HCPS working in EPI program.**

From Table (2) number of 60 of HCPS working in EPI were interviewed by researcher for their knowledge concerning EPI. Appropriate vaccine administration is essential for the optimal safety and efficacy of vaccines. The current work documented that most (96.7%) of the HCPs knew the immunization schedule dose & Time correctly. This finding contrast with a study done in Thailand (55.6%), and in a garment with a study done in Menoufia Governorate that reported the most of the HCPs knew the proper dose and route of OPV, BCG, DPT, and HBV vaccines  (98.6, 97.1, 87.1, and 95%, respectively).(19, 20)

The percentage of knowledge of HCPs about BCG and DPT vaccines as regards to route of administration were (98.3%) and (100%) respectively and reason of this practice were (23.3%) and (51.7%) respectively. This discrepancy may be due to the lack of continuous refresher training for the staff. Our finding in different with a study conducted by Widsanugorn et al., (63.2%) and (64.1%).(19) On the other hand consistent with a study done in Quewisna District of Menoufia Governorate, (97.1%) and (91.4%).(20)

Regarding the frequency of temperature recording, (96.7%) was correctly described in the present study. It wase slightly more than the results of a study conducted in Cairo Governorate,(80.0%) of PHCs, was noted temperature twice daily.(21)

All HCPs (100%) knew theoptimal temperature for vaccines is 2-8° C, which was considered to be better when compared to the findings of Bogale et al. study, who reported that, (48.3%) of HCPs knowing correctly and pretty much agree with a study conducted in Ethiopia, 2019, that the correct answer was (96.9%).(13, 22)

One of the disturbing answers identified in this study was that, only (5.0% and 6.7%) of HCPS knew which vaccines is the most heat sensitive and sensitive to freezing respectively. This finding is very low when compare with studies by Krishnappa et al., and Woldemichael et al., those revealed (100%, 92%) and (60.1%, 89.6%) respectively.(23, 24)

The majority of HCPS (96.7%) knew correctly temperature for keeping DPT and polio vaccines. Our results are relatively similar to those study conducted in Thailand, (95.6%) and much higher than the study conducted in Ethiopia (34.6%).(13, 19)

Most HCPs (85%) refuse to use the frozen pentavalent vaccine, our results were similar to Azira et al., (88.8%), Pangalo et al., most of health officers know that vaccines will break if frozen.(8, 25). Most HCPS (93.3%) use the rest of the polio vaccine vial the next day. This finding more than the studies conducted in Ethiopia (64.6%), central Ethiopia (62.9%).(12, 13)

More than half (56.7%) of HCPS testified to know what shake test is while only (31.7%) of them knew what is the Shake test and most of them (75%) knew correctly the vaccines can the shake test be carried out.

Our study inconsistence with Rogie et al., who documented that only (12.9%) of HCPs knew the three vaccines that required a shake test and (36.2%) correctly mentioned the purpose for application of the shake test also inconsistence with a study conducted inOromia Regional State, Ethiopia, more than two-third a demonstrated the shake test correctly, our finding is higher than the finding of João and Gunnar they revealed (9%) of respondent knew shake test correct.(26-28)

As regard to General score of knowledge of HCPS working in EPI (N60) table (3) showed the total knowledge percentage, (65%,26.7% and 8.3%) of the HCPs scored fair, good and poor knowledge, respectively.

This finding was in line with a study done in Cairo Governorate, in which the total knowledge percentage were (71.1%,26.7 % and 2.2%) of the HCPs scored average level, high-level and low level, respectively, but in different with a study conducted in District in Ghana, were (68.6%), Guragie zone (51.3%)Ethiopia and Bale zone (54.3%) had satisfactory knowledge.(4, 12, 21, 29)

1. **Relation between socio-demographic characteristic of HCPS working in EPI and knowledge score (Sa’adah, Yemen, 2019).**

In our study, it was found that age is one of the determining factors for knowledge of cold chain management, with (FET=0.040\*), as knowledge increases with increasing age. This finding agrees with a studies conducted in Nigeria, 2021, Ethiopia,2021 and Ethiopia,2019, in which published age is a statistically significant association with the level of cold chain management.(4, 10, 13)

As for the relationship between knowledge and gender, males had the highest good score (12) 31.6% with no statistically significant (FET=0.335).

This result was in agreement with a studies conducted in Nigeria, Ethiopia which revealed their is a statistically significant association with the level of cold chain management(10, 13). On the other hand, our study differs with a study conducted in pastoral and semipastoral areas of Ethiopia, whichshowed a significant association.(30)

The relation between residence of health facilities with the knowledge score of HCPs was not statistically significant (FET=0.141), health facilities in the urban showed higher in good score (33.3%), this finding inconsistences with a study in Gurage Zone, Ethiopia, place of work is a statistically significant.(4)

Knowledge score concerning to type of health facility, health unites had the highest good scores (9) 27.3% and the difference not statistically significant (FET=0.926). This finding not compatible witha study conducted in kalasin, Thailand, which showed that healthcare workers in hospitals have better knowledge than healthcare workers in health centers.(19)

Regarding the relationship between job of participants' and knowledge score, physician had the highest rated (1) scored 100.0% with no statistically significant (FET=0.884).This finding is inconsistence with a study of Mohammed et al.,, while in consistence with a studies conducted in Cairo Governorate and in central Ethiopia that reported,a statistically significant association between knowledge and job of participants.(12, 13, 21)

This study revealed that 50% of secondary graduated had good knowledge with no significant correlation (FET= 0.196). It was consistent with a study done in Ethiopia.(13). On the other hand, its inconsistence with a studies conducted in. pastoral and semi pastoral areas of Ethiopia, and Edo State Nigeria, they revealed that the difference in knowledge of cold chain management observed that increasing level of education was statistically significant.(30, 31)

The present study showed no significant relationship between those with less than and more than ten years of experience (FET=0.196), more than ten years of experience were the highest good knowledge 31.3%. Our finding is inconsistence with a study of Mohammed El-Hady Imam Salem. et al.,, Rogie., et al., and Esa., who concluded there is asignificant positive correlation between knowledge scores and experience of HCPs. (12, 21, 32). On the other hand, it consistent with a study by Swamkar et al., who reported a negative correlation between knowledge (P = -.106) of health workers and years of experience.(33)

**Conclusion**The study found that, only (26.7%) of HCPs had a good knowledge score. A regular technical support and on the job training to improve the HCPs knowledge about immunization is highly recommended.

**Abbreviations**

**EPI**: Expanded programme on Immunity

**VPDs**: Vaccine preventable diseases

**HCWs**: Healthcare workers

**BCG**: Calmette-Guerin

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

(**cVDPV1**): Circulating Vaccine Derived Polio Virus type 1

**Limitation**

As a result of the ongoing war in Yemen in general and in Sa'ada 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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