



RESEARCH ARTICLE

KNOWLEDGE OF HEALTHCARE PROVIDERS IN EXPANDED PROGRAM ON IMMUNIZATION, SA'ADAH, YEMEN

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Article Info:



Article History:

Received: 2 December 2022
 Reviewed: 8 January 2023
 Accepted: 24 February 2023
 Published: 15 March 2023

Cite this article:

Qeran MA, Habour ABA, Hassan EHE. Knowledge of healthcare providers in expanded program on immunization, Sa'adah, Yemen. Universal Journal of Pharmaceutical Research 2023; 8(1):42-48.

<https://doi.org/10.22270/ujpr.v8i1.896>

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Abstract

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

Method: This prospective cross-sectional study was performed to assess healthcare providers (HCPs) knowledge regarding EPI. It was conducted on 60 HCPs in 60 H.F of 11 districts in Sa'adah Governorate, Yemen during 1 June – 30 July 2019. Appropriate interviewing pre-tested questionnaire was used to collect data from HCPs 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 entering and cleaning were done using Microsoft Excel 2019 and exported to SPSS version 26, *p*-value 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 poor knowledge, respectively.

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

Keywords: Expanded programme on immunization, knowledge, Sa'adah, Yemen.

INTRODUCTION

Immunization is one of the most effective public health interventions, Immunization has saved millions of lives¹. 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, therefore all immunization and cold chain staff must know and conduct the correct handling and management of vaccines and immunization supplies². Also, 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 chain³. The World Health Organization (WHO) has progressed a set of guidelines for the proper administration of the EPI service in its organ countries⁴. Three key factors for achieving the full

interest of immunization include; Extensive immunization coverage, timely administration of vaccines, and guaranteeing the effectiveness of vaccines through suitable maintenance of the vaccine cold chain⁵. The "Cold chain" refers to the network of personnel, equipment, and processes that ensure that vaccines are transported and stored at suitable temperatures between (+2°C to +8°C) from the manufacturer to the beneficiary, ensuring that they remain effective⁶.

Incorrect vaccine storage practices and bad knowledge of cold chain administration affect the goodness of administered vaccine⁷. High knowledge and a positive attitude increase the implementation of cold chain administration⁸. HCPs must have sufficient knowledge to manage the cold chain⁹. Various studies revealed that, different factors influence the level of knowledge of cold chain management: Age and Location of

Practice, profession, work experience and receiving training on EPI¹⁰⁻¹⁴. 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 the goal to obtain 90 % coverage for OPV3, DPT3, and measles and to obtain 80 % coverage for hepatitis B3 before the age of 12 months by the end of 2005¹⁵. Recommended immunization schedule includes vaccines against tuberculosis, poliomyelitis, measles, diphtheria, pertussis, hepatitis B, and diseases caused by Hemophilus influenza, 1979 Yemen was declared free from smallpox¹⁶. In 1982 UNICEF launched the Child Survival and Development which included immunization along with other cost-effective high impact interventions¹⁷, in 1998 introduced hepatitis B vaccine, in June 2009 Yemen was declared polio-free, 2011 Pneumococcal 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 women¹⁸.

In Sada,ah governorate during the period of Jan to Dec 2020, Among 15 districts, 13 (87%) detected 114 cases of acute flaccid paralysis (AFP) of which 26% were confirmed as Vaccine Derived Polio Virus type 1 (cVDPV1) AFP cases. 75% (21) were < 5 years, 73% (20) had zero doses of Oral Polio Vaccine (OPV)¹⁹.

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 done in 60 health facilities of the districts in 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.

Duration of study

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

Study design

Prospective cross-sectional study.

Study population and centers

Health care providers working in Expanded Programme of Immunization.

Data collection tools and procedures

An interviewing questionnaire 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 questionnaire, 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 questionnaire was used to conduct interviews to collect data from HCPs working in the 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 follow²⁰:

Score "2" for correct, "1" for incorrect. "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 follows²⁰: Good $\geq 75\%$; fair 51-74 %; wrong $\leq 50\%$.

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 self-designed questionnaires mentioned above and to interview the health workers in the EPI to fill the questionnaire of HCPs knowledge. After a pilot study was carried out to pretest the questionnaire elements. The aim of this study is to evaluate the knowledge of HCPs 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 done by the data analysis software Statistical Package Social Sciences (SPSS) version 26, *p*-value less than 0.05 was considered significant. Differences in samples means were evaluated by chi-square test.

RESULTS AND DISCUSSION

Socio-demographic characteristics of HCPs

Table 1 showed socio-demographic characteristics of HCPs working in EPI. The respondents consisted of 23 - 55 years with age of mean 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%). Concerning 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 administration).

Knowledge of HCPs working in EPI program.

Table 2 shows, 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 and 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 aforesaid the recommended range of temperature (2–8°C) for vaccine storage and the frequency of temperature recordings, respectively.

Table 1: Socio-demographic characteristics of HCPS working in EPI.

Socio-demographic profile		Frequency (n=60) N (%)
Age	20-30	25 (41.7)
	31-40	23 (38.3)
	41-55	12 (20.0)
	Range Mean±SD	23-55 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 Mean±SD	1 – 30 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)

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 If 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. As regard to general score of knowledge of HCPs working in EPI (N60) Figure 1 explains the summary of total knowledge percentage, only (26.7 %) of HCPs scored a

high-level wile (65%) scored fair knowledge, poor knowledge was the lowest percentage (8.3%).

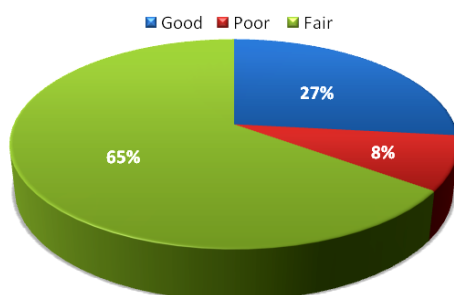
Relation between socio-demographic characteristic of HCPS working in EPI and knowledge score.

Figure 1 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.

Table 2: Knowledge of HCPS working in EPI.

Item of HCPS knowledge	Frequency (n=60)	
	Correct	Incorrect
	Frequency N (%)	Frequency N (%)
Immunization schedule dose & 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)
Temperature of keeping DPT (pentavalent vaccine)	58 (96.7)	2 (3.3)
Temperature of keeping polio	58 (96.7)	2 (3.3)
If a child develop convulsion after giving pentavalent vaccine. What you will do when becomes next time for vaccination	21 (35.0)	39(65.0)
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)

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%. With regard to knowledge score and years of experience, no significant correlation, 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.

**Figure 1: General score of knowledge of HCPS working in EPI.**

Knowledge 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. Achieving the safety and efficacy of vaccines is essential, and this should be done through appropriate administration. The current work documented that most (96.7%) of the HCPSs knew the immunization schedule dose and 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 HCPSs knew the proper dose and route of OPV, BCG, DPT, and HBV vaccines (98.6, 97.1, 87.1, and 95%, respectively)^{21,22}.

The percentage of knowledge of HCPSs 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. This finding in different with a study conducted by Widsanugorn *et al.*, (63.2%) and (64.1%)²¹. On the other hand consistent with a study done in Qewisna District of Menoufia Governorate, (97.1%) and (91.4%)²². Concerning the frequency of temperature registration, (96.7%) was mentioned correctly in the present study. It was slightly more than the results of a study conducted in Cairo Governorate, (80.0%) of PHCs, was noted temperature twice daily²³.

All HCPSs (100%) knew the optimal 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 HCPSs knowing correctly and pretty much agree with a study conducted in Ethiopia, 2019, that the correct answer was (96.9%)^{13,24}. One of the disturbing answers identified in this study was that, only (5.0% and 6.7%) of HCPSs 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^{25,26}. The majority of HCPSs (96.7%) knew correctly temperature for keeping

DPT and polio vaccines. The current results are relatively similar to those study conducted in Thailand, (95.6%) and much higher than the study conducted in Ethiopia (34.6%)^{13,21}. Most HCPs (85%) refuse to use the frozen pentavalent vaccine, current results were similar to Azira *et al.*, (88.8%), Pangalo *et al.*, most of health officers know that vaccines will break if frozen^{8,27}. 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.

The current study inconsistency with Rogie *et al.*, who documented that only (12.9%) of HCPs knew the vaccines required a shake test, and (36.2%) correctly mentioned the purpose for the application of the shake test also inconsistency with a study conducted in Oromia Regional State, Ethiopia, more than two-third a demonstrated the shake test correctly, current finding is higher than the finding of João and Gunnar they revealed (9%) of respondent knew shake test correct²⁸⁻³⁰. As regard to General score of knowledge of HCPS working in EPI (N60) Figure 1 showed the total knowledge percentage, (65%, 26.7% and 8.3%) of the HCPs scored fair, good and poor knowledge, respectively.

Table 3: Relation between socio-demographic characteristic of HCPS working in EPI and knowledge score.

Knowledge score		Score						Test of significant
		Poor		Fair		Good		
Item of sociodemographic		No (n=5)	%	No (n=39)	No (%)	No (n=16)	No (%)	
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	

* FET=Fisher exact test

The current study somewhat agree 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%), Gurage zone (51.3%) Ethiopia and Bale zone (54.3%) had satisfactory knowledge^{4,12,23,31}.

Relation between socio-demographic characteristic of HCPS working in EPI and knowledge score.

In current 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). Current result was in agreement with studies conducted in Nigeria, Ethiopia which revealed there is a statistically significant association with the level of cold chain management^{10,13}. On the other hand, current study differs with a study conducted in pastoral and

semipastoral areas of Ethiopia, which showed a significant association³². 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 inconsistencies with a study in Gurage Zone, Ethiopia, place of work is a statistically significant⁴. 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 with a study conducted in kalasin, Thailand, which showed that healthcare workers in hospitals have better knowledge than healthcare workers in health centers²¹. 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 inconsistency with a study of Mohammed *et al.*, while in consistency with a studies conducted in Cairo Governorate and in central Ethiopia that reported, a statistically significant association between knowledge and job of participants^{12,13,23}.

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

Ethiopia¹³. On the other hand, its inconsistency 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^{32,33}. 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%. Current finding is inconsistency with a study of Mohammed El-Hady Imam Salem *et al.*, Rogie *et al.*, and Esa, who concluded there is a significant positive correlation between knowledge scores and experience of HCPs^{12,23,34}. On the other hand, it consistent with a study by Swamkar *et al.*, who reported a negative correlation between knowledge ($p=-0.106$) of health workers and years of experience³⁵.

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

As per our study, the majority of HCPs knew correctly how DPT, BCG, and Mesles are administered, but a few of them knew the reason correctly for this practice. In addition to the lack of a written emergency plan. As regards the HCPs' knowledge of the most sensitive vaccines to heat and freezing, and the workers' knowledge of the shaking test to identify damaged and healthy vaccines, the result was unsatisfactory. Also, the study found that only (26.7%) of HCPs had a good knowledge score. There is regular technical support and on-the-job training to improve the HCP's knowledge about immunization is highly recommended.

ACKNOWLEDGEMENTS

Authors are thankful to the Sa'adah Governorate Health office, to the participants in this study. Dr. Mohammed Ali Qeran wishes to express his gratitude to his wife for support during this work.

AUTHOR'S CONTRIBUTION

Qeran MA: writing original draft, methodology.
Habour ABA: research design, data collection,
Hassan EHE: statistical analysis, conceptualization.
 Final manuscript was read and approved by all authors.

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.

REFERENCES

1. Organization WH. Immunization coverage: World Health Organization; 2022 [updated 14 July 2022; cited 2022 27-Oct]. <https://www.who.int/news-room/fact-sheets/detail/immunization-coverage>
2. Program DoHNI. Vaccines, cold chain and logistics management. Philippines 2018 [cited 2022 27-10-2022].
3. Park K. Park's Textbook of preventive and social medicine 25th edition Jabalpur. India: M/s Banarasidas Bhanot publishers 2019:269-80
4. 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. <https://doi.org/10.1155/2019/6937291>
5. Weir E, Hatch K. Preventing cold chain failure: Vaccine storage and handling. Canadian Med Assoc J 2004; 171(9):1050. <https://doi.org/10.1503/cmaj.1041565>
6. Patel N, Unadkaat S, Sarkar A, Rathod M, Parmar DV. Assessment of cold chain maintenance for routine immunization in Jamnagar district, Gujarat. Int J Med Sci Public Health 2018; 7:1-5. <https://doi.org/10.5455/ijmsph.2018.1130419112017>
7. Rao S, Naftar S, Unnikrishnana B. Evaluation, awareness, practice and management of cold chain at the primary health care centers in Coastal South India. J Nepal Paed Soc 2012; 32(1):19-22. <https://doi.org/10.3126/jnps.v32i1.5946>
8. Pangalo P, Sapiun Z, Ischak WI, Goi M, Hartati H. Knowledge, attitude, and implementation of cold chain management in Boalemo District, Gorontalo, Indonesia. J Health Policy Manag 2020;5(2):139-45. <https://doi.org/10.26911/thejhpm.2020.05.02.06>
9. Shah J, Agarwal M, Patel J, Trivedi A. Quality assessment of immunization services: A cross sectional study at UHCs of Ahmedabad Municipal Corporation. Int J Health Sci Res 2015;5(7):21-5
10. Adebimpe WO, Adeoye OA. Knowledge and practice of vaccination logistics management among primary health care workers in Nigeria. Human Vacc Immunotherap 2021;17(5): 1490-5. <https://doi.org/10.1080/21645515.2020.1827609>
11. Najwa L, Minhat H. Knowledge on maintaining cold chain for childhood immunisation vaccines at the primary healthcare setting Malaysia. Int J Public Health Clin Sci 2016; 3(4).
12. 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. PMID: 24380204
13. 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. <https://doi.org/10.1371/journal.pone.0247459>
14. Yakum MN, Ateudjieu J, Walter EA, Watcho P. Vaccine storage and cold chain monitoring in the North West region of Cameroon: a cross sectional study. BMC research notes. 2015; 8(1):1-7. <https://doi.org/10.1186/s13104-015-1109-9>
15. WHO USA, Yemen. Guidelines for safe immunization practices and monitoring immunization programs at the facility and district levels in Yemen, Ministry of public health and Pop. First Edition ed. Yemen 2005:12.

16. MOPHP, Yemen. National Program for Expanded Health Immunization 2017 Jan [cited 11 Oct 2017]. <http://www.mophp-ye.org/arabic/Immunization.html#M1>
17. Grant JP. A child survival and development revolution. *Assignment Children* 1983. <https://doi.org/10.1542/pir.8-6-163>
18. Ministry of Health. Immunisation Handbook 2017. In: Ministry of Health, editors. *Immunisation Handbook 2017*. 2nd ed. Wellington 2017.
19. Al-Qassimi MA, Al Amad M, Anam L, Almoayed K, Al-Dar A, Ezzadeen F. Circulating vaccine derived polio virus type 1 outbreak, Saadah governorate, Yemen, 2020. *BMC Infect Dis* 2022; 22(1):414. <https://doi.org/10.1186/s12879-022-07397-0>
20. 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 Sci Pharm Sci* 2018; 2(10).
21. Widsanugorn O, Suwattana O, Harun-Or-Rashid M, Sakamoto J. Healthcare workers' knowledge and practices regarding expanded program on immunization in Kalasin, Thailand. *Nagoya J Med Sci* 2011; 73(3-4):177. PMID: 21928699; PMCID: PMC4831226.
22. El Shazly HM, Khalil NA, Ibrahim RA, Wahed SAA. Knowledge and practice of healthcare providers as regards routine children vaccination in primary healthcare facilities of Qewisna District, Menoufia Governorate. *Menoufia Med J* 2016; 29(4):1018. <https://doi.org/10.4103/1110-2098.202507>
23. 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 Sci Pharm Sci* 2018; 2(10):67-78.
24. 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. <https://doi.org/10.1186/s12889-019-7786-x>
25. Krishnappa L, Anniappan AB, Voderhobli NH, Krishna SK, Yathiraj S, Sreekantaiah P. Evaluation of cold chain practices in urban health centers of a metro city in India. *National J Comm Med* 2014; 5(03):288-92.
26. 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. <https://doi.org/10.4172/1745-7580.1000152>
27. Azira B, Norhayati M, Norwati D. Knowledge, attitude and adherence to cold chain among general practitioners in Kelantan, Malaysia. *Int J Collab Res Int Med Public Health* 2013; 5(3).
28. 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.
29. 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, Med Therap* 2021; 12:359. <https://doi.org/10.2147/PHMT.S312039>
30. João C, Gunnar B. Cold chain management: knowledge and practices in primary health care facilities in Niassa, Mozambique. *Ethiopian J Health Dev* 2007; 21. <https://doi.org/10.4314/ejhd.v21i2.10040>
31. 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 Res Int* 2021; 2021:7559984. <https://doi.org/10.1155/2021/7559984>
32. Asres M, Wachiso A, Bisrat F, et al. Immunization service providers' knowledge, attitude and practice in primary health care units in pastoral and semipastoral areas of Ethiopia: CORE Group Polio Project. *Ethiopian J Health Dev* 2019;33.
33. 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 Med J* 2018; 21(2):75. https://doi.org/10.4103/smj.smj_45_17
34. Esa AMS. Assessment of nurse's performance in vaccination session at Zagazig city, Zagazig 2007:114.
35. Swarnkar M, Baig VN, Soni SC, Shukla US, Ali J. Assessment of knowledge and practice about immunization among health care providers. *National J Comm Med* 2016; 7(04):281-5.