

Maintaining of Vaccine Cold Chain Process and Associated Factors: A Cross Sectional Study to Know Health Professional's Knowledge in West Guji Zone, Southern, Ethiopia.

Girish Degavi ¹, Sarah Ezhil Kelna Edwin ², Sanjay Shinde ¹, Divya Rani Rajan ²

1. Bulehora University, Department of Nursing, College of health and medical science, Hageremaryam, Ethiopia.
2. Bulehora University, Department of Midwifery, College of health and medical science, Hageremaryam, Ethiopia

Corresponding Author:

Girish Degavi,

Bulehora University, Department of Nursing, College of health and medical science, Hageremaryam, Ethiopia, 144.

Email: girishdegavi1984@gmail.com.

Abstract

Introductions: To meet immunization goals, two things must happen: effective vaccines must be delivered through a well-controlled cold chain environment, and maximum utilization must be accomplished. In both developed and developing countries, there is a lack of knowledge about cold chain management. Maintaining vaccine effectiveness is currently one of the most challenging problems facing African immunization initiatives, particularly Ethiopia. But there is very less data related to cold chain management in this part of the world done before.

Methods and materials: An institution based cross sectional study was been conducted. A total of 502 participants those that serve in federal health care facilities in, West Guji zone, Oromia, Southern Ethiopia were included. A semi-structured questioner was used to process the results. Epi Info was used to enter and clean data and the files were exported to SPSS. Using a logistic regression model with a 0.05 degree of significance, the adjusted odds ratio with its 95 percent confidence interval was incorporated to recognize the relationship and classify related variables.

Conclusion: In previous studies in Ethiopia, health professional's awareness of cold chain management remained limited. Knowing the available Knowledge among health workers in vaccination centers in and around West Guji zone is critical, particularly in this pandemic where a COVID-19 Vaccine is urgently needed. This study is being conducted to identify this region of the world's preparedness for managing the possible vaccine that will be available in

the coming days.

Key: Cold chain, vaccine, Ethiopia, West Guji Zone.

Introductions

Establishing the vaccine constant temperature is critical to an effective vaccine campaign since vaccines lose biochemical viability when exposed to high temperatures.^{1,2} as well as to promote vaccine efficacy and avoid detrimental consequences following immunization.³

The cold chain begins in the vaccine manufacturing facilities and then kept in refrigerator or freezer, moves to the vaccine distributor, next to the service provider facility, and eventually to the supply of the vaccine to the recipients.^{4,3} Ambient temperature in the vaccine cold chain is essential in ensuring whether vaccines are stored at predetermined sufficient cold chain temperatures.⁵

The lack of vaccine potency results in permanent and irreversible biochemical changes in the vaccine.^{4, 6} As a result, the success of the EPI is strongly dependent on the cold chain condition, and its handling really shouldn't be treated seriously. As a result, adequate vaccine preservation at the recommended ambient temperature is critical in preserving vaccination coverage until the time of administration.⁶ Recent development in cold chain process have been improved resulting in substantial reduction in cold-chain failures, or else there may have been widespread outbreaks of vaccine-preventable disease.⁷

When properly implemented in all areas of the at-risk community, vaccination is one of the most important disease prevention methods.^{6,8} Vaccines are vulnerable biological agents that lose efficacy over time, but this loss of efficacy can be reduced, If held within the recommended temperature range.⁹

There appear to be no major studies on cold chain sensitivity and factors related in this area of research. As a consequence, assessing healthcare worker's knowledge of cold chain and important outcomes can yield critical information that can be applied to cold chain management especially in this time where number of vaccines are been under development and even some have been approved. It is believed that Ethiopia will be receiving COVID-19 vaccines shortly but the cold chain infrastructure and the health professional's knowledge in handling cold chain equipments rise many questions.

Methods and materials

Study area

The research was performed on 502 health staff members at Bulehora General Hospital, Karcha Hospital, and 27 Health Clinics in West Guji District, Oromia, Southern Ethiopia. These sites were chosen due to its convenience for current study.

From November 1, 2020 to March 30, 2020, an institutional-based cross-sectional approach

had been used. All healthcare providers employed in health centers in West Guji Zone, southern Ethiopia, were the population source. The research population included all health professionals employed in federal health facilities in Ethiopia's study area who've been eligible for collection of data between November 1, 2020 and March 30, 2020.

Inclusion and Exclusion Criteria

The research involved health professionals with more than six months of experience working, and others who were too sick to be assessed or who were unable to communicate with the data collectors in any way were exempt.

Sample size

The sample size was estimated using the single population proportion procedure, with the assumptions mentioned below 95 percent significance rating ($= 0.05$) and a 5 percent margin of error. Based on a study conducted on cold chain monitoring in Ezna District, Gurge Zone, Ethiopia¹⁰ the percentage of health professionals with relevant knowledge of cold chain monitoring was set at 16 percent, with an additional 10 percent added to account for non-response.

The sample size determination:

Factors associated with level of knowledge on cold chain management is calculated based on double population proportion formula by using Epi-info version 7 stat calc programs, through sample size calculation formula final sample size was 409 but the total health professionals who are working in the study area are 512 considering this all the staff were included in the study.

Data Processing and Analysis

Epi Info tool was used for data entry and cleaning. Following that, the information was exported to SPSS Version 20 for bivariate and multivariate analysis. At a 95 percent confidence level, the odds ratio was calculated to measure the degree of correlation between the variables. A logistic regression was used to control possible confounders when the outcome variable was definitive. Knowledge of cold chain management among healthcare professionals was one of the study's dependent variables and Age, gender, place of employment, years of experience, and occupational type, socio-demographic considerations. Institutional factors such as training, resource availability, and the usage of EPI guide lines were reported as independent variables.

Results

A total of 502 responses were obtained from the 512 healthcare professionals who were targeted for the survey, with 10 respondents being disqualified for having less than six months of work experience. As a whole, 98.4% of all health workers responses were collected.

Socio- Demographic Characteristics

According to the survey, HEWs accounted for more than one hundred out of the 502 health staff, while health officer/BSC nurses reported for just above twenty percent and significant rural health facilities constituted for more than 80 percent. Slightly below 50% of health care workers had experience for two to four years, and more than 15% had worked for more than six years. Fifty percent and above of the 166 eligible respondents said they received three to five days of vaccine training, while only four health staff said they received minor refrigerator repair training. The average age of the total respondents was 28 ± 4.2 (SD), and the majority of them, were between the ages of 25 and 34. The majority of the respondents were found to be females, with the remaining, being males. (*Table 1*)

Infrastructure and Cold Chain equipment

Just 12 of the buildings were supplied with refrigerators. Just seven of the remaining hospitals were able to move vaccinations from nearby facilities that had functioning refrigerators. More than a third of hospitals had an automobile to transport vaccines in the case of a refrigerator or power outage. Six of the facilities had access to solar electricity. Five facilities assigned permanent staff to track the cold chain during work hours, but only four facilities assigned personnel during holidays and weekends. (*Table -2*)

Availability and adequacy of cold chain equipment

Many of the facilities we visited had enough ice packs, vaccine bags, and ice boxes to keep the cold chain running smoothly. Foam pads were only used by eight of the participants. A functioning fridge tag was found in eight out of the twelve health facilities with working refrigerators. Six of the eight available fridge tags had temperature readings within the typical range ($2^{\circ}\text{C} - 8^{\circ}\text{C}$) on the day of data collection. most of the facilities with working refrigerators had checked their records in a timely manner. During the data collection time, laboratory reagents and other medicines were discovered to be stored with EPI vaccines in four out of the all health facilities having vaccine storage facility. (*Figure 1*)

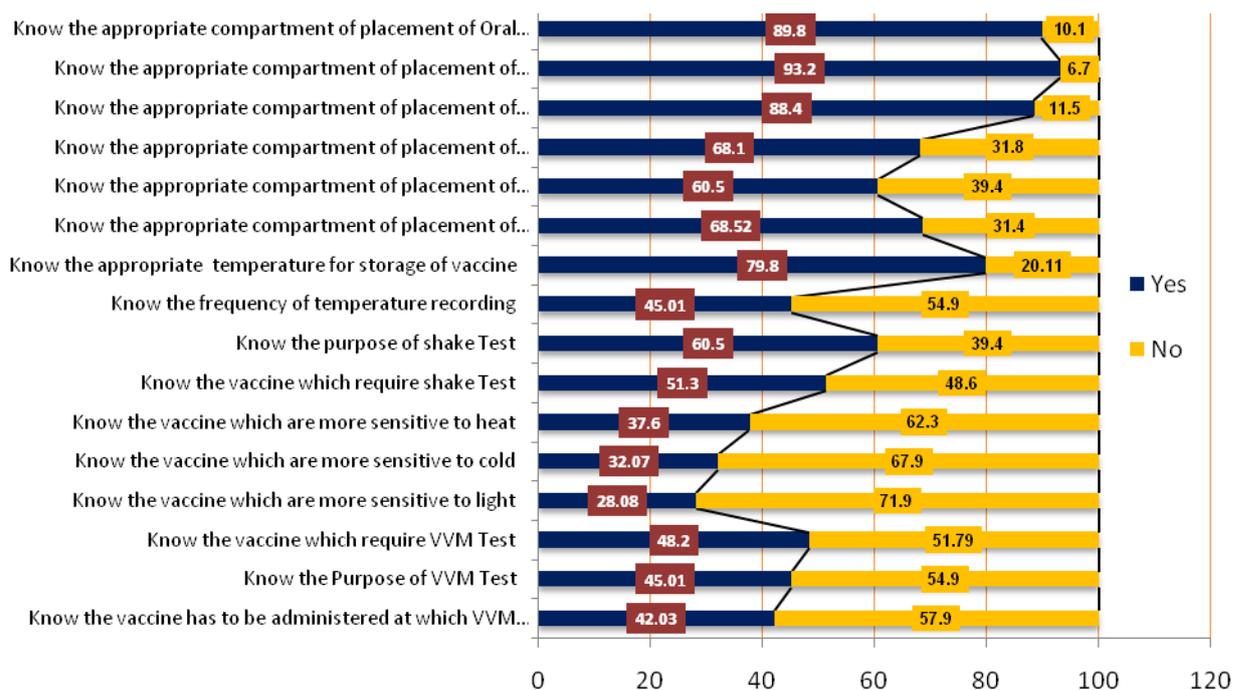


Figure -1:- Availability and adequacy of cold chain equipment in federal health care facilities in, West Guji zone, Oromia, Southern Ethiopia. In the current setting, the figure depicts cold chain transportation and delivery, as well as equipment related to ice packs, vaccine bags, ice boxes, foam pads, and the number of functional fridge tags and refrigerators. Other concerns related to storage of laboratory reagents and drugs with EPI vaccines are also stated.

Knowledge of health professionals on cold chain management in the study area

More than three-quarters of all health workers were aware of the recommended temperature range for vaccine storage, but only about half were aware of the frequency of temperature recording. The majority of health-care staff correctly answered questions about polio vaccine (OPV), tetanus toxoid (TT), pentavalent vaccine, and measles vaccine compartment arrangement. However, there is a significant knowledge gap on how to store pneumococcal conjugate vaccines (PCV) and ROTA vaccines erectly. Just about half of the medical personnel were aware of the three vaccines that include a shake and VVM check. More than half of the health workers were found to have a clear understanding of the shake test and its function. Just about a third of the workers correctly classified vaccinations that were susceptible to heat, severe cold, and light, which was bothersome. Overall, maximum number of health care staff (53.58%) showed satisfactory knowledge where as remaining (46.42%) staff had unsatisfactory knowledge regarding cold chain. (*Figure 2*)

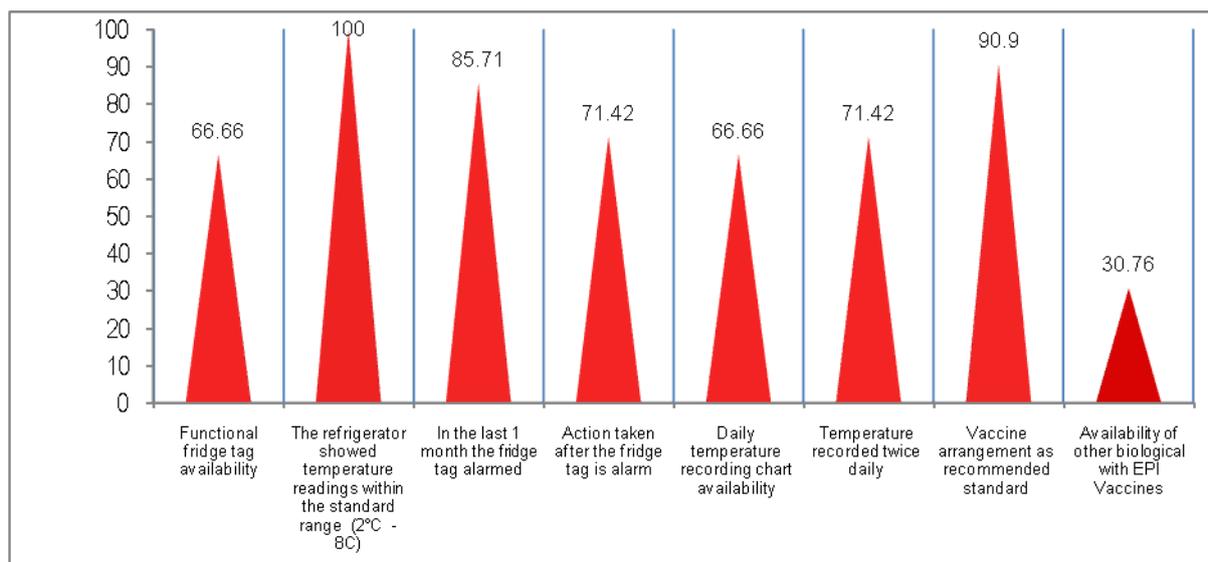


Figure -2:- Knowledge of health professionals on cold chain management working in federal health care facilities in, West Guji zone, Oromia, Southern Ethiopia. The figure depicts the expertise of health workers in the study area regarding vaccine storage at the correct temperature and with the correct tools, as well as their understanding of the requirements of handling vaccines to ensure that their potency is preserved.

Factors associated with level of knowledge on cold chain management

As compared to those who had no training experience, health employees who had immunization training were 6.13 (AOR:6.13, % CI: 1.79-7.06) times more likely to have satisfactory knowledge of cold chain management. According to professional status, BSC/HO is 2.124 (AOR=2.124, % CI: 0.65-4.23) times more likely than other professionals to have sufficient knowledge of cold chain management. Health professionals with more than 6 years of experience were 2.2 (AOR=2.2, 95 % CI: 0.77-17.14) times more likely than those with less than 6 years of experience to have adequate knowledge of cold chain management. As compared to those who had no familiarity with the EPI guide lines, health practitioners who used them were 2.58 (AOR=2.58, % CI:0.212-1.66) times more likely to have satisfactory knowledge of cold chain management.(*Table-3*)

Discussion

This research examines health professional's knowledge of cold chain management and related factors in governmental health facilities in West Guji zone, Oromia, Southern Ethiopia, December 2020. According to this report, the majority of health providers have sufficient knowledge of handling and storage of vaccines. This statistic is virtually identical to one found in an analysis conducted in central Ethiopia.¹¹ It is, however, far less than studies undertaken in Malaysia.¹²

Throughout this research, just below 80% of respondents were aware of the recommended temperature range for vaccine storage. In comparison, a report undertaken in Western India

reached a different conclusion.⁸ However, it is considerably higher than the report of study done in Cameroon.⁶

According to all respondents, the maximum number of health-care staff was aware of where the measles vaccine are stored. This finding closely resembles that of a study conducted in Cameroon's northwestern region.⁶ However, it varies slightly from a study undertaken in central Ethiopia.¹¹

According to the survey, more than 50 percent of health workers were aware of the intent of the shake test. This finding is consistent with research performed in western India⁸ and central Ethiopia.¹¹

More than a third of health providers are aware of the vaccines that are the most heat sensitive. This number corresponds to a point discovered in an analysis conducted in central Ethiopia.¹¹ However, it is observed less consistent in Malaysian study.¹²

Around a third of professionals are aware of the vaccines that are most susceptible to colds. This number is higher in a survey conducted in central Ethiopia¹¹, but lower in a Malaysian research.¹²

The most of the health facilities lacked a working refrigerator. This result is approximately equivalent to that of a study performed in central Ethiopia¹¹ but, it is lower than that of the Cameroon study.⁶

According to the findings, 62.5 percent of health facilities have permanent staff assigned to track the cold chain during operating hours. This number is equivalent to that of a study conducted in central Ethiopia¹¹ and marginally lower than that of a study conducted in Cameroon.⁶

On the day of data collection, the thermometer/fridge tag indicated that the temperature was within the normal range 2°C-8°C. Unlike the research conducted in Saudi Arabia¹³ and central Ethiopia.¹¹

Three-quarters of the health facilities in this study updated their recording/filled twice daily during the data collection period. This is similar to a research carried out in Saudi Arabia.¹³ It is, however, higher than a study conducted in Central Ethiopia¹¹ and Cameroon.⁶

A third of the vaccination centers were discovered to be storing biological material alongside EPI Vaccines. This is supported by research conducted in Central Ethiopia¹¹ and south India.⁸

As per the findings of this report, health workers who have received immunization training 6.13 times have adequate knowledge of cold chain management. This is a better result than the Malaysian report.¹² The findings of this study have indicated that health workers with the professional status of BSC nurse/Health officers are 2.124 times more likely to have sufficient knowledge of cold chain management. This figure is substantially lower than that

found in a study conducted in central Ethiopia.¹¹

The findings of this report states that the health workers with more than 6 years of experience had 2.2 times more satisfied knowledge of cold chain management. This is a lower result than that of a study conducted in central Ethiopia.¹¹

Correspondingly to a cross-sectional analysis, reports from central Ethiopia on providing training, and the use of guide lines in northwestern Cameroon was not statistically correlated with cold chain management awareness.⁶ In the same vein as the Malaysian study.¹²

Another cross-sectional research conducted in Malaysia in 2016 showed that the amount of time spent working in the healthcare sector was significantly related to knowledge of cold chain management resembling with the present study.¹²

The disparity between the current study and their immediately preceding study may be attributable to a lack of or inadequate preparation, or a heavy workload due to a lack of health personnel/staff turnover and difference in the research population and setting. Participants and varied research environments.¹⁴ The studies which are been stated as similar studies show differences due to lack of encouragement and oversight, as well as professional neglect, when it came to the storage of other biological materials along with EPI vaccines.^{15,16} In central Ethiopia, study was conducted on only nurses and health extension staff,¹¹ and in Malaysia it was done on general practitioners while this study is being conducted on all health care workers in the current environment.¹²

Conclusion

According to the findings of this report, health professionals' knowledge of cold chain management is lacking, especially when it comes to storage, since the vaccines that are most susceptible to heat, cold, and light spoil easily. Healthcare workers in Primary care centre must understand cold chain management and receive regular in-service training on it, as it is essential to maintain life-saving vaccines, particularly as the world grapples with the COVID-19 pandemic and gears up for Vaccination against it.

Acknowledgments

The researcher's would like to thank all the participants and everyone who contributed directly or indirectly in the progress of research work.

Competing Interests

No competitive financial interest declaration by any individual or entity or non-financial competing interests, such as political, economic, religious, ideological, scholarly, scientific and commercial or any other competing interests are related in this manuscript.

Author Contributions:

The author(s) have read and approved the final version of the manuscript.

Ethical approval

All studies were conducted in conjunction with the standards for human research as set out in the Helsinki Declaration and the recommendations for the International Conference on Harmonization of Good Clinical Practice. Bule Hora University, institutional review board gave ethical clearance to conduct the study. Respective permission was taken from Hospitals where study was conducted.

Consent

A well-informed written consent was obtained from each research participant after the possible risks and benefits as well as the investigational purpose of the study were identified.

Duplicated publication

The writers affirm that the manuscript is original, that it has not been published in a journal, and that no other journal is presently being considered.

Funding Acknowledgements

The author(s) obtained no financial assistance for this article's analysis, authorship, and/or publishing.

References

1. Evaluation, Awareness, Practice and Management of Cold Chain at the Primary Health Care Centers in Coastal South India. January-April, 2012/ Volume 32/Issue1 <<http://dx.doi.org/10.3126/jnps.v32i1.5946>>
2. The impact of health facility monitoring on cold chain management practices in Lagos, Nigeria. Volume 2(4), pp. 78-81, July 2010
3. P, Manna N, Chakra arty D, Bag chi SN. An intervention study, Assessing cold chain status in a metro city of India:. 2011; 11(1): 128 - 133.
4. Omit K. & Julie Milstein (2014) Tools and approaches to ensure quality of vaccines throughout the cold chain, Expert Review of Vaccines, 13:7, 843-854, DOI: 10.1586/14760584.2014.923761.
5. Omit K., Erida N., Denis M. Improving temperature monitoring in the vaccine cold chain at the periphery; an intervention study using a 30-day electronic refrigerator temperature logger. 28 (2010) 4065-4072.
6. Martin N., Jerome A., E. Walter and Pierre W. Vaccine storage and cold chain monitoring in the North West region of Cameroon: a cross sectional study. (2015)
7. Vaccines: South Africa immunization programme debunked. SAMJ, S. Afr. med. j. vol.106 n.4 April 2016 ISSN 2078-5135 .

8. Naik AK, Rupani MP, Bansal RK. Evaluation of vaccine cold chain in urban health centers of municipal corporation of surat city, Western India. *Int J Prev Med.* 2013;4(12):1395-1401.
9. Ateudjieu, J., Kenfack, B., Nkontchou, B.W. et al. Program on immunization and cold chain monitoring: the status in eight health districts in Cameroon. *BMC Res Notes* 6, 101 (2013). <https://doi.org/10.1186/1756-0500-6-101>
10. 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 (Cairo)*. 2019 Jun 9;2019:6937291. doi: 10.1155/2019/6937291. PMID: 31281711; PMCID: PMC6590539
11. Rogie B, Berhane Y, Bisrat F. Assessment of cold chain status for immunization in central Ethiopia. *Ethiop Med J.* 2013 Jul;51 Suppl 1:21-9. PMID: 24380204.
12. Azira, B., Norhayati, M., & Norwati, D. (2013). Knowledge, Attitude and Adherence to Cold Chain among General Practitioners in Kelantan, Malaysia. *International journal of collaborative research on internal medicine and public health*. Vol. 5 No. 3 (2013).
13. Mugharbel KM, Al Wakeel SM. Evaluation of the availability of cold chain tools and an assessment of health workers practice in dammam. *J Family Community Med.* 2009 Sep;16(3):83-8. PMID: 23012197; PMCID: PMC3377047.
14. Zaffran M, Vandelaer J, Kristensen D, Melgaard B, Yadav P, Antwi-Agyei KO, Lasher H. The imperative for stronger vaccine supply and logistics systems. *Vaccine.* 2013 Apr 18;31 Suppl 2:B73-80. doi: 10.1016/j.vaccine.2012.11.036. PMID: 23598495.
15. Namuhaywa, M. M. (2013). Cold Chain and Logistics Management for Expanded Program on Immunization in Busia and Namayingo Districts. *Open Science Repository Medicine, Online(open-access)*, e23050465. doi:10.7392/openaccess.23050465.
16. Rogie B, Berhane Y, Bisrat F. Assessment of cold chain status for immunization in central Ethiopia. *Ethiop Med J.* 2013 Jul;51 Suppl 1:21-9. PMID: 24380204.

Table 11:Percentage distribution of respondents by Socio-demographic characteristics; among health professionals working in West Guji zone,Oromia,Southern Ethiopia, Dec. 2020.

| Variables | Category | Frequency | Percent (%) |
|-------------------------------------|-----------------------------|-----------|-------------|
| Respondent place of work (N=502) | Urban | 89 | 17.67 |
| | Rural | 413 | 82.32 |
| Responsibilities (N=502) | Health center professionals | 383 | 76.29 |
| | Health post professionals | 119 | 23.7 |
| Age (N=502) | 15-24 years | 110 | 21.98 |
| | 25-34 years | 365 | 72.84 |

| | | | |
|---|---------------------------|-----|-------|
| | 35-44 years | 9 | 1.72 |
| | ≥45 years | 18 | 3.44 |
| Sex (N=502) | Male | 215 | 42.67 |
| | Female | 287 | 57.32 |
| Type of profession (N=502) | Health extension workers | 119 | 23.7 |
| | Diploma nurses | 223 | 44.39 |
| | BSC nurse/ health officer | 104 | 20.68 |
| | Medical doctors | 0 | 0 |
| | Midwifery | 56 | 11.2 |
| Work experience (N=502) | 6 months – 2 years | 95 | 18.96 |
| | 2 years- 4 years | 236 | 46.98 |
| | 4 years- 6 years | 82 | 16.37 |
| | ≥ 6 years | 89 | 17.67 |
| Receiving training on Immunization (N=502) | Yes | 167 | 33.18 |
| | No | 335 | 66.81 |
| Days stay on immunization training (N=166) | Less than 3 days | 44 | 8.62 |
| | 3-5 days | 97 | 19.39 |
| | 6 – 10 days | 17 | 3.44 |
| | ≥ 11 days | 8 | 1.72 |
| Receiving training on fridge maintenance (N=502) | Yes | 4 | 0.86 |

Table 2:Infrastructure and cold chain equipment/resource availability in West Guji zone,Oromia,Southern Ethiopia, Dec. 2020.

| Characteristics | Frequency | |
|--|------------|-----------|
| | Yes (%) | No (%) |
| Availability of refrigerator in the health facility (n=42) | 12 (28.57) | 30 (71.4) |
| Availability of functional refrigerator (n=42) | 12 (28.57) | 30 (71.4) |
| Availability of functional generator/solar (n=7) | 6 (85.74) | 1 (14.28) |

| | | |
|--|-----------|------------|
| Availability of functional car/motorbike in the facilities to use in case of refrigerator failure (n=12) | 4 (33.33) | 8 (66.66) |
| Availability of trained personnel for minor fridge maintenance (n=9) | 6 (66.66) | 3 (33.33) |
| Availability of spare parts for minor fridge maintenance(n=7) | 7 (100) | 0 |
| Availability of permanently assigned personnel for cold chain follow up (n=8) | 5 (62.5) | 3 (37.5) |
| Availability of personnel assigned during holidays/weekend for cold chain follow up (n=7) | 4 (57.14) | 3 (42.85) |
| Availability of kerosene for refrigerator (n=12) | 9 (75) | 3 (25) |
| Using EPI guidelines or manual (n=42) | 4 (9.52) | 38 (90.47) |

Table 33: Bivariate and multivariate analysis knowledge on cold chain management among health professionals in West Guji zone, Oromia, Southern Ethiopia, Dec. 2020.

| Variables | Categories | Level of Knowledge | | COR (95% CI) | AOR (95% CI) |
|--------------------------|-------------|--------------------|------------------|-------------------|------------------|
| | | Satisfactory | Not satisfactory | | |
| Respondent place of work | Urban | 42 | 44 | 0.78(0.26-2.34) | 0.8(0.344-1.36) |
| | Rural | 211 | 206 | 1 | 1 |
| Age | 15-24 years | 66 | 182 | 1 | 1 |
| | 25-34 years | 148 | 182 | 0.37(0.04-1.66) | 0.7(0.34-2.55) |
| | 35-44 years | 4 | 5 | 0.14(0.12-1.25) | 1.4(0.22-4.53) |
| | ≥ 45 years | 12 | 9 | 0.384(0.16-11.72) | 0.54(0.131-8.89) |
| Sex | Male | 155 | 107 | 1.691(0.66-4.527) | 1.62(0.94-2.18) |
| | Female | 148 | 143 | 1 | 1 |

| | | | | | |
|---|--------------------|-----|-----|-------------------|--------------------|
| Type of profession | HEW | 76 | 60 | 1 | 1 |
| | Diploma nurses | 123 | 111 | 1.44(0.33-5.67) | 1.41(0.25-4.16) |
| | BSC / HO | 77 | 52 | 1.63(0.65-4.23) | 2.124(1.46-15.44)* |
| | Midwifery | 44 | 28 | 2.11(0.66-6.01) | 1.4(0.81-5.16) |
| Work experience | 6 months - 2 years | 38 | 47 | 1 | 1 |
| | 2 - 4 years | 133 | 118 | 3(1.74-7.19) | 0.8(0.31-1.9) |
| | 4 - 6 years | 41 | 41 | 1.4(3.71-8.43) | 0.61(0.228-1.28) |
| | ≥ 6 years | 34 | 45 | 3.42(0.77,17.14) | 2.2(1.99,5.16)* |
| Receiving training on EPI | Yes | 91 | 84 | 2.48(1.79-7.06) | 6.13(2.78-11.12)** |
| | No | 144 | 168 | 1 | 1 |
| Availability of functional refrigerator | Yes | 188 | 162 | 2.8(1.34-4.8) | 0.99(0.721-1.6) |
| | No | 69 | 82 | 1 | 1 |
| Used guidelines | Yes | 173 | 108 | 0.721(0.212-1.66) | 2.58(1.47-4.57)* |
| | No | 84 | 136 | 1 | 1 |

Reference * p-value <0.05 **p-value<0.00