Assessment of knowledge and skills of cold chain handlers in the post-eVIN period in nainital district

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ABSTRACT

Background: Vaccines are among the most sensitive drugs; they are sensitive to heat and freezing; therefore, they must be stored at the recommended temperature. Thus, it is deemed necessary to study staff's knowledge and skill level about the modified cold chain of electronic vaccine intelligence network (eVIN) period. **Aims and Objectives**: The study aims to assess the knowledge and skills of Cold Chain Handlers regarding cold chain, eVIN and vaccine management in district Nainital. **Materials and Methods:** This cross-sectional study was carried out at 34 Cold Chain Points in district Nainital, Uttarakhand. Pre-structured validated questionnaire was used for this study. **Results:** Cold chain handlers were deputed at all cold chain points of which about one-third was contributed by the Haldwani block. All 29 females and five males cold chain handlers were literate and mostly had received eVIN training. It was found that except for knowledge about adverse event following immunization, its primary management, hold over time, and keeping dropper in ice-lined refrigerator rest was correctly answered by all of them and skills about the identification and performing tasks were performed splendidly by all 34 (100°). **Conclusion:** Cold chain handlers need reinforcement in skills and keeping knowledge up to date to keep the cold chain healthy and properly functioning.

Key words: Cold chain handler; Effective vaccine management; Electronic vaccine intelligence network; Knowledge; Nainital; Skills

INTRODUCTION

According to the UNICEF report on Coverage Evaluation Survey 2009, India achieved 61% immunization coverage in 2011.[1] An immunization program in all countries must deliver selected vaccines to the targeted beneficiaries, especially focusing on pregnant women, infants, and children, who are at a high risk of vaccine-preventable diseases.[2] Vaccines are among the most sensitive drugs administered, they are sensitive to heat and freezing; hence, they must be stored at the recommended temperature right from the time they are manufactured till they are administered. Proper temperature charting must be maintained by the vaccine provider and the recipients with a habit of checking those registers before purchasing the vaccines or getting the vaccine administered by the doctor or handlers.[3] The cold chain supply is essential for vaccine storage and logistics services. In a country like India, the last-mile logistics of vaccines is a challenging task.[4] Furthermore, for effective implementation of the Universal Immunization Program, factors like Cold Chain and Vaccine Management need greater focus and attention, and knowledge and skills of the cold chain handler become important for the success of the UIP.[5] Electronic vaccine intelligence network (eVIN) effectively manages the vaccine logistics, in 2015, this technology was rolled-out in 12 states of India. It digitizes that vaccine stocks through a smartphone application and builds the capacity of program

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managers and cold chain handlers to integrate technology into their regular work.[6] It is deemed necessary to study staff's behavior and acceptance level toward eVIN.[7]

There are very limited studies like in the present time. Hence, the present study was conducted among cold chain handlers regarding cold chain, eVIN, and vaccine management skills in district Nainital to identify any shortcomings and suggest recommendations for further improvement.

Aims and objectives

The study aims to assess the knowledge and skills of cold chain handlers regarding cold chain, eVIN, and vaccine management practices in district Nainital.

MATERIALS AND METHODS

An observational and cross-sectional study was carried out from February 2022 to August 2022. Thirty-four out of 40 cold chain points in district Nainital were visited and assessed using a validated pre-structured questionnaire and WHO-UNICEF standardized effective vaccine management assessment tool. Cold chain handlers were interviewed at cold chain points, and knowledge skill assessment was recorded. Both knowledge and skill were classified into Very Good, Good, and POOR based on the score they achieved. Then, the association of knowledge and skill was carried out using the Chi-square value goodness of fit. Later, means of knowledge and skill were compared using an independent mean score. Data were compiled in MS Excel and analyzed using percentages, proportions, and Chi-square. Before data collection, ethical clearance (letter no. 624/GMC/IEC/2021/Reg. No. 584) from the ethical committee of the Government Medical College of Haldwani was taken. Those Cold chain handlers and stakeholders who will be available at center were included and all cold chain handlers with a minimum experience of 1 month. While those who all those who refused to participate were excluded from the study, who have not provided any type of data, not found even after three visits or not through any type of contact method and <1 month of experience as cold chain handlers were excluded from the study.

Operational guidelines

From the maximum score of both knowledge and skills, approximately 90% was taken for very good, half of the remaining taken for the good category, and below 50% has remained for the poor category.

Score	Knowledge level	Score	Skill level
≥20	Very good	≥13	Very good
11–20	Good	6–12	Good
0–10	Poor	0–5	Poor

RESULTS

Approximately one-third of CCPs were from the Haldwani block, followed by Ramnagar, Bhimtal, Ramgarh, Okhalkanda, Kotabagh, Betalghat, and lastly Dhari (Figure 1).

A total of 34 cold chain handlers were agreed on and interviewed from 40 CCPs remaining were excluded due to non-response. It was found that the majority of cold chain handlers were females. Most of the cold chain handlers were in the age group >40 years with a mean age of 48±12. The maximum number of cold chain handlers were intermediate educated. It was also found that half of cold chain handlers have experience of more than 3 years of which almost half had training in eVIN more than a year back, and another half had training in less than a year duration (Table 1).

It was observed that the correct knowledge of internet-based eVIN, vaccine's placement in the freezer compartment of domestic refrigerator, keeping items other than vaccines in Ice-lined refrigerator (ILR) or deep freezer (DF), the conditioning of icepacks, keeping vaccines away from walls in vaccine carriers, and correct place of thermometer in ILR/DF was correctly answered by all 34 (100%) of CCHs, while knowledge about adverse event following immunization (AEFI), its primary management, about a hold over time and keeping dropper in ILR was given least correctly. The mean of knowledge of 34 CCHs is 0.94±0.54 (Table 2).

Among the 34 cold chain handlers the skills in the identification of light-sensitive vaccines, stages of VVM, checking of ice thickness, precautions of using a dropper, arranging vaccines to temperature sensitivity, labeling of open vials both multidose and open vial policy, condition of ice packs, proper disposal of vials, and preventing of vaccines from touching the walls were able to perform splendidly by all 34 (100%) cold chain handlers while in tasks of using eVIN application, placing thermometer, reading of temperature, performing shake test, entry of temperature data into the logs, and preparing AEFI kit was able to perform by few numbers the mean score of skill of 1.8±0.38 (Table 3).

Table 4 depicts that the majority had a good knowledge level. All CCHs below 40 years of age and most of those above 40 years of age had very good knowledge. It was observed that the majority of CCHs whether they were educated till high school, intermediate or graduate and above showed good knowledge level. The majority over half of the CCHs with <1 year of experience, approximately half of CCHs with 1–3-year experience
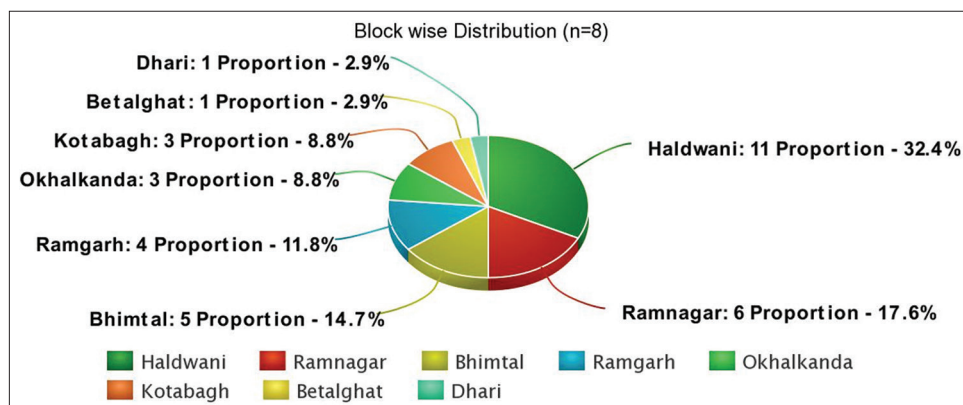
Figure 1: Block-wise distribution of cold chain points in district Nainital

Table 1: Sociodemographic profile of cold chain handlers (n=34)

Variables	Frequency, n (%)
Age (years)	
≤30	3 (8.8)
30–40	9 (26.5)
>40	22 (64.7)
Gender	
Female	29 (85)
Male	5 (15)
Education	
High school	4 (11.5)
Intermediate	14 (41.5)
Graduate and above	16 (47)
Designation	
Pharmacist	1 (2.9)
LHV	13 (38.4)
ANM	12 (35.4)
Staff nurse	1 (2.9)
Others*	7 (20.4)
Work experience (year)	
≤1	12 (35.3)
1–3	5 (14.7)
>3	17 (50)
Training duration (year)	
No training	2 (5.8)
≤1	16 (47.1)
>1	16 (47.1)

*Others: Health inspector, VHW, Manager

and the majority over half CCHs had >3-year experience showed good knowledge. We observed that the majority of CCHs whether without training, less than a year of training or >1 year of training exhibited a good level of knowledge. On statistical analysis, the association of the designation of the CCHs with knowledge score was found to be significant (P<0.05).

All CCHs below 40 years of age and most of those above 40 years of age had very good skills. All CCHs with 1–3 year experience, most of CCHs with <1 year of experience, and CCHs with >3-year experience showed very good skills. We observed that the majority of CCHs

whether without training, less than a year of training or >1-year of training exhibited good skills (Table 5).

While the data obtained have Chi-square, goodness of fit values were obtained and found to be (<0.05 of P-value). Thus, concluding knowledge score and skill score are statistically significant.

DISCUSSION

Cold chain maintenance played an important role in maintaining efficacy of vaccines in routine immunization. Thus, the status of knowledge and skill of cold chain handlers should be sound. In the present study, we studied various aspects of knowledge and skill of cold chain handlers in Nainital District. In the present study, a total of 34 cold chain handlers were agreed on and interviewed from 40 CCP. It was found that most of them were females, approximately half of them were educated till intermediate and experience of more than 3 years.

In the study by Feyisa et al.,[8] showed that approximately half of respondents were female. Majority over half were diploma holders and approximately one-third were nurses by profession. Slightly above half of the respondents did not receive training. Among those who received training, above half of them have received the pre-service type of training. Only one-third have trained as recently as 6 months among those who received the in-service training. In a study by Adebimpe and Adeoye[9] in Nigeria, found that the majority over half had practiced for 1–6 years and were practicing in urban region. Mohammed et al.,[10] found that there were 66.9% male respondents, 37.8% were diplomas, while 62.2% had a degree of work experience ranging from 4 months to 14 years Kumar et al.,[11] in an observational cross-sectional study in Etawah found that all respondents were male and approximately one-third were post-graduate Kumar et al.,[7] showed that among cold chain handlers of all the 29 PHCs, where

Table 2: Knowledge of cold chain handlers regarding vaccine and cold chain management (n=34)

Knowledge assessment question	Correct, n (%)	Incorrect, n (%)	Don't know, n (%)
Is eVIN internet based?	28 (82.4)	2 (5.9)	4 (11.8)
Should the temperature of the ILR lie between 2°C–8°C?	34 (100)	0	0
Why some vaccine vials are amber-coloured?	28 (82.4)	3 (8.8)	3 (8.8)
Is VVM used as an indicator for heat-sensitive vaccines? (VVM)	28 (82.4)	3 (8.8)	3 (8.8)
Knows the stages of VVM?	30 (88.2)	4 (11.8)	0
Knows what is shake test?	20 (58.8)	7 (20.6)	7 (20.6)
For which vaccines shake test can be performed?	14 (41.2)	20 (58.8)	0
Can vaccines be kept in the freezer compartment of a domestic refrigerator?	31 (91.2)	3 (8.8)	0
Should the temperature of CCE's be monitored daily (including holidays)	27 (79.4)	7 (20.6)	0
What is the frequency of charting CCEs temperature?	25 (73.5)	6 (17.6)	3 (8.8)
Do you know about frequency of defrosting the CCEs?	25 (73.5)	2 (5.9)	7 (20.6)
Can we keep dropper in ILR?	1 (2.8)	31 (91.2)	2 (5.9)
Can we keep diluents with vaccines in ILR or vaccine carrier?	21 (61.8)	13 (38.2)	0
Can we keep items other than vaccines in ILR	34 (100)	0	0
What is vaccine open vial policy?	22 (64.7)	7 (14.7)	7 (20.6)
What is conditioning of ice pack?	34 (100)	0	0
What is AEFI?	7 (20.6)	27 (79.4)	0
Knew about AEFI primary management	6 (17.6)	6 (17.6)	22 (64.7)
Knowledge about hold-over time?	7 (20.6)	16 (47.1)	11 (32.4)
Knowledge about disposal of damaged/expired vaccine vials?	26 (76.5)	1 (2.9)	7 (20.6)
Should we keep vaccines away from vaccine carrier walls?	34 (100)	0	0
Where is the thermometer kept in ILR or DF?	32 (94.1)	2 (5.9)	0

eVIN: Electronic vaccine intelligence network, VVM: Vaccine vial monitor, CCEs: Continuous and comprehensive evaluations, ILR: Ice-lined refrigerator, AEFI: Adverse event following immunization, DF: Deep freezer

Table 3: Skills of cold chain handlers regarding vaccine and cold chain management (n=34)

Skills assessment	Able to perform, n (%)	Not able to perform, n (%)
Able to use the eVIN app by her/himself?	26 (76.5)	8 (23.5)
Able to place the thermometer correctly in ILR/DF?	33 (97.1)	1 (2.9)
Able to read temperature correctly in stem thermometer?	27 (79.4)	7 (20.6)
Able to identify light-sensitive vaccines	34 (100)	0
Able to check for VVM status?	34 (100)	0
Able to perform shake test?	32 (94.2)	2 (5.8)
Able to enter digital temperature reading in the temperature logbook?	29 (85.3)	5 (14.7)
Able to check for ice thickness inside ILR/DF?	34 (100)	0
Able to take precautions while using a dropper for immunization?	34 (100)	0
Able to arrange the vaccines in ILR according to their temperature susceptibility?	34 (100)	0
Able to keep multidose vials separate and labelled	34 (100)	0
Ensuring the labelling of open vials during issuing and after return	34 (100)	0
Able to condition the ice packs for the immunization session?	34 (100)	0
Able to prepare medication in AEFI kit ready for use?	15 (44.1)	19 (55.9)
Able to perform disposal of the vial?	34 (100)	0
Able to keep preventing the vaccine from touching the ice pack wall?	34 (100)	0

eVIN: Electronic vaccine intelligence network, VVM: Vaccine vial monitor, ILR: Ice-lined refrigerator, AEFI: Adverse event following immunization, DF: Deep freezer

eVIN was introduced, all the cold chain handlers were literate and had received eVIN training.

In the present study, it was observed that the correct knowledge regarding internet-based eVIN, vaccine's placement in the freezer compartment of domestic refrigerator, keeping items other than vaccines in ILR or DF, the conditioning of icepacks, keeping vaccines away from walls in vaccine carriers, and correct place of thermometer in ILR/DF was correctly given by all of the CCHs, while knowledge about AEFI, its primary management, about a hold over time, and keeping dropper in ILR were given least correctly. Similar studies show that the overall level of good knowledge of vaccine handlers and good status of cold chain and vaccine management was in approximately half of the participants Gebretnsae et al.,[12] Mohammed et al.,[10] found that approximately half of vaccinators and vaccine handlers had satisfactory knowledge, positive attitude, and good practice, Kumar et al.,[11] in an observational and cross-sectional study in Etawah and found that all of the cold chain handlers interviewed had the knowledge of vaccine cold chain and most of them had knowledge of temperature range for vaccine storage.

Table 4: Association of sociodemographic profile with knowledge score (n=34)

Parameters	Knowledge level			P
	Very good	Good	Poor	
Gender				
Male	0	3 (60)	2 (40)	0.40
Female	5 (17.2)	20 (69)	5 (17.2)	
Age (years)				
<30	3 (100)	0	0	0.25
30–40	9 (100)	0	0	
>40	18 (81.8)	4 (18.2)	0	
Education				
High school	0	3 (75)	1 (25)	0.35
Intermediate	3 (21.4)	10 (71.4)	3 (21.4)	
Graduate and above	3 (18.8)	10 (62.5)	3 (18.8)	
Experience (years)				
<1	2 (16.7)	9 (75)	1 (8.3)	0.18
1–3	0	3 (60)	2 (40)	
>3	2 (11.8)	11 (64.7)	4 (23.5)	
Training (year)				
No training	0	1 (100)	0	0.21
<1	1 (6.3)	11 (68.8)	4 (25)	
>1	3 (18.8)	10 (62.5)	3 (18.8)	
Designation				
LHV	4 (28.6)	10 (71.4)	4 (28.6)	<0.01
ANM	3 (25)	8 (66.7)	1 (8.3)	
Staff nurse	0	1 (100)	0	
Pharmacist	0	0	1 (100)	
Others*	1 (16.7)	4 (66.7)	1 (16.7)	

*Others: Health inspector, VHW, Manager"

Table 5: Association of sociodemographic profile with skill score (n=34)

Parameters	Skill score			P
	Good	Average	Poor	
Gender				0.37
Male	5 (100)	0	0	
Female	25 (86.2)	4 (13.8)	0	
Age (years)				0.29
<3	3 (100)	0	0	
30–40	9 (100)	0	0	
>40	18 (81.8)	4 (18.2)	0	
Education				0.54
High school	3 (75)	1 (25)	0	
Intermediate	12 (85.7)	2 (14.3)	0	
Graduate and above	15 (93.8)	1 (6.3)	0	
Experience (years)				0.50
<1	11 (91.7)	1 (8.3)	0	
1–3	5 (100)	0	0	
>3	14 (82.4)	3 (17.6)	0	
Training (year)				0.47
<1	15 (93.8)	1 (6.3)	0	
>1	13 (81.3)	3 (18.8)	0	
No training	0	2 (100)	0	
Designation				0.93
LHV	11 (91.7)	1 (8.3)	0	
ANM	10 (83.3)	2 (16.7)	0	
Nurse	1 (100)	0	0	
Pharmacist	0	1 (100)	0	
Others*	1 (16.4)	5 (83.3)	0	

*Others: Health inspector, VHW, Manager

Among the 34 cold chain handlers the skills in the identification of light-sensitive vaccines, stages of VVM, checking of ice thickness, precautions of using a dropper, arranging vaccines to temperature sensitivity, labeling of open vials both multidose and open vial policy, condition of ice packs, proper disposal of vials, and preventing of vaccines from touching the walls were able to perform splendidly by all of the cold chain handlers while in tasks of using eVIN application, placing thermometer, reading of temperature, performing shake test, entry of temperature data into the logs, and preparing AEFI kit was only be able to perform by approximately a quarter of them. A similar study by, Adebimpe and Adeoye[9] found that majority over half could assemble the ice packs used in the vaccine career box and could assemble the vaccines, while most could assemble the diluents and thermometer with good knowledge to the management systems, Teli et al.,[13] in a cross-sectional and questionnaire-based study found that the participant's knowledge about maintenance of refrigerators with respect to place of vaccine storage, temperature recording in a day and preferable place of DF was satisfactory, Kumar et al.,[7] found that most of the cold chain holders labeled the open vials both during issuing and after return, Bhatnagar et al.,[5] in study of 26 Cold Chain Points found out that all 26 CCH could correctly read and interpret Vaccine Vial Monitor (VVM), know about vaccines that could be damaged by freezing, know the correct storage temperature for vaccines, know about Open Vial Policy and know and correctly identify the diluents of BCG and Measles Vaccines. However, approximately half could demonstrate the correct way of reading the thermometer and only some had knowledge about when and how to conduct a shake test. About majority over half CCH carried out the conditioning of icepacks as per the guidelines.

In the present study, it depicted that the majority of the males and females had good knowledge, majority of CCHs whether they were educated till high school, intermediate, or graduate and above and majority of CCHs whether without training, less than a year training or >1 year training exhibited good knowledge. The pharmacist exhibited poor knowledge. It was found that the association of designation of the CCHs with knowledge was significant. Similar study by Gebretnsae et al.,[12] the overall level of good knowledge of vaccine handlers and good status of cold chain and vaccine management. Receiving training on cold chain and vaccine management was significantly associated with knowledge of vaccine handlers. Asamoah et al.,[14] found the majority of the participants scored ≥70% on knowledge. However, there was a very weak positive and statistically insignificant relationship between participant's

knowledge and attitudes toward cold chain management, Mohammed et al.,[10] revealed that health professionals who received training in cold chain management were about 3.04 times more likely to have satisfactory knowledge on cold chain management compared to those who did not receive training.

In this present study, all CCHs below 40 years of age and most of those above 40 years of age had very good skill. Most of them irrespective of their experience and training showed very good skills. The pharmacist exhibited good skills. It was depicted the association of socio-demographic profile with skill score. The association of gender, age, education, experience, training, and designation with skill score was not found to be statistically significant. Similar result found in Adebimpe and Adeoye[9] depicted an association between the sociodemographic characteristics of respondents and the practice of vaccine logistics management systems. More community health officers were found to have practiced vaccine logistics management systems significantly more than the other cadres. Likewise, health care workers who have spent more than 5 years in practice and being a male health care worker were significant predictors of good practice of immunization logistic management system.

Limitations of the study

The sample size of this study was small, so the various findings in the study would not be used for external validity. The study being a cross-sectional study could not generate the temporal relationship between the various factors. A limited observation period and limited resources were a challenge, like the limitations with funds, it was difficult to follow the outreach areas. Although no foreseen biases were observed this may cause concern in the exact comparison of pre- and post-period estimates for states.

CONCLUSION

Vaccines and most importantly health of millions of beneficiaries are in the hands of cold chain handlers. Most of the handlers had satisfactory knowledge, while almost all handlers had good practice. Receiving training on cold chain management was the determinant of knowledge and skill in cold chain management and increased the odds of having better knowledge. Providing regular training on vaccine cold chain management will improve the knowledge and practice of vaccine handlers. Cold chain handlers need reinforcement in skills in tasks of using the eVIN application, placing thermometer, reading temperature, performing shake test, entry of temperature data into the logs, and preparing the AEFI kit was to be only able to perform. Hence, they need regular training to keep their technical knowledge and skills updated.

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