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## RESEARCH ARTICLE

# KNOWLEDGE AND PRACTICES OF COLD CHAIN HANDLER (CCH) REGARDING COLD CHAIN EQUIPMENT AND VACCINES STORAGE IN CHIRANG DISTRICT, ASSAM

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**ABSTRACT**

**Background:** Vaccination is one of the most effective disease prevention strategies and potency of vaccine is dependent on effective management of cold chain at all levels of vaccine handling by cold chain handler. An effective cold chain maintenance system is the backbone of success of any immunization program. This study was done with objectives to assess the knowledge and practices of Cold chain handler regarding cold chain equipments and vaccines storage.
**Methods: Study design:** Cross-sectional study was conducted during 1st Jan.2015 to 30thJune 2015 in Chirang district of Assam using a pre-structured questionnaire among the cold chain handler.
**Sampling methods:** Chirang district has total of 2 BPHC and total of 12 cold chain point under this 2 BPHC (Block PHC) were selected purposively,6 cold chain point from each block.
**Study population and Sample size:** Cold chain handler of the facilities of Chirang District with cold chain point and thus sample size was 12.
**Results:** Out of total 12 cold chain handler 7(58.33%) were female, 5(41.67%) were male, only 7(58.33%) of cold chain handlers knew properly about cold chain. All 12 (100%) of the cold chain points ILR were functioning and only 5(41.67%) of the respondents practiced of record keeping for power failure and defrosting of ILRs and DFs.
**Conclusion:** There is a need to improve methods of ILR and DF maintenance of temperature and regular defrosting with record keeping.

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## INTRODUCTION

Cold Chain is a system to transport and store vaccine in the potent condition starting from the time it is manufactured to the time it is administered to patients in specified temperature range of 2-8 Celsius.(http://wwwwhoint/vaccines-documents; Azira*et al*., 2013)This system of maintaining the cold life for vaccines is necessary because the vaccines are sensitive to heat and light, i.e. they lose their potency, when exposed to heat and light. Once the vaccine loses the potency, it cannot be restored and it becomes a waste. So care must be taken to see that the vaccine do not lose their potency, before the date of expiry, by maintaining cold chain. All vaccines retain their potency at temperatures between +2 Celsius and +8 Celsius. Polio vaccine (OPV) is the most sensitive and tetanus toxoid is the least sensitive to heat and light. (Suryakantha, 2014; Gupta and Gupta, 2015) The quality of vaccines is one of important factor for success of immunization program which in turn depends on proper storage and handling of vaccines.(Gupta and Gupta, 2015; Carol Bellamy, 2004) Immunization is the most precious gift that a health care worker can give a child (Yakum *et al*., 2015) and it remains the most cost effective preventative health intervention presently known (Yakum *et al*., 2015). Vaccines are sensitive biological substances that gradually lose their potency with time (Yakum *et al*., 2015; World Health Organization, 1998) and this loss of potency can be accelerated when stored out of the recommended range of temperature (Yakum *et al*., 2015; World Health Organization, 1998; World Health Organization, 2004). Any loss of potency in a vaccine is permanent and irreversible. Consequently, a proper storage of vaccines at the recommended temperature conditions is vital so that vaccine's potency is retained up to the moment of administration (Yakum *et al*., 2015; World Health Organization, 1998). Ideally, vaccines must be kept in perforated tray and space around 1-2 cm between vaccine line to allow air movement (http://wwwwhoint/vaccines-documents; Azira *et al*., 2016; Ministry of Health, 2008) and cannot touch the refrigerator plate because it would result in

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vaccine to solidify.(http://wwwwhoint/vaccines-documents; Azira *et al*., 2016; Ministry of Health, 2008) To ensure good ventilation, refrigerator must be located about 40 cm from wall. (Ministry of Health, 2008) A break in cold chain is indicated if the temperature goes above +8 Celsius or falls below +2 Celsius. The cold chain system consists of series of transportation links with equipments and the persons concerned from the manufacturer to the point of use. Longer the chain, greater is the risk of cold chain failure. (Suryakantha, 2014) The cold chain equipments included : Walk in cold rooms (WIC), Cold Boxes, deep freezers (DF), Ice Lined Refrigerators (ILR), Conventional Refrigerator, Vaccine Carrier and Day-Carrier. (Sunder Lal *et al*., 2014) With this back ground, this study was carried out with the objective to study the knowledge and practices of cold chain handler regarding the cold chain equipments, vaccine storage in the Health facility with cold chain point of Chirang District, Assam.

## MATERIALS AND METHODS

This cross sectional study was conducted during 1st Jan. 2015 to 30th June. 2015 in Chirang district of Assam. The study was a part of a project of strengthening Routine Immunization program and RMNCH+A run by Community Medicine Department of Gauhati Medical College, Guwahati in association with UNICEF Assam and Director Medical Education, Assam. The district is served by a district health society with district cold chain point, total of two BPHC (Block PHC) under Chirang district. The study was done in 12 health facility with cold chain point under 2 BPHC, selected purposively and 6 cold chain point under each BPHC selected and one respondent mainly who are linked with the cold chain maintenance and vaccine storage from each cold chain point. All of them participated in the study. Cold chain equipment and cold chain maintenance process was noted following direct observation on uninformed visits. Information was collected on a pre-designed and pre-tested questionnaire regarding demographics, knowledge of electrically powered vaccine storage instruments (e.g. ice lined refrigerators, deep freezers, voltage stabilizer); non electrical vaccine storage equipments (e.g. cold box, vaccine carriers); ice packs, power generator and temperature monitoring chart, set-up and maintenance record of electrical equipment and vaccine storage. Data was compiled analysed using percentages and proportions.

## RESULTS

Total of 12 cold chain handlers, all of whom participated in the study, out of which 7(58.33%) were female and 5(41.67%) were male.8 (66.67%) of them belong to age group 31 to 40 years. Out of the 12 respondents 7(58.33%) respondents trained in cold chain management and 5(41.67%)of the respondents had working experience as cold chain handlers for more than 5 years and rest of them had 1-4 years of experience.Only3(25%) of the respondents used cold chain handler guidelines. (Guidelines for cold chain handlers by Ministry of Health and Family Welfare, Govt. of India)

Only 7 (58.33%) of the respondents answered correctly about cold chain. Knowledge about the cold chain equipments particularly available at the district level cold chain points was found in all 12(100%) cold chain handlers. Only 8 (66.67%) of cold chain handler knew about WIC (Walk- in-coolers) and knowledge regarding WIF (Walk-in-freezers) was found only in 3(25%) of the cold chain handlers.

**Table 1. The characteristics of respondent**

| Variables | No's(% Percentages) |
|---|---|
| **1.Gender** | |
| **Male** | 5(41.67%) |
| **Female** | 7(58.33%) |
| **2.Age group(in years)** | |
| **20—30** | 3(25%) |
| **31—40** | 8(66.67%) |
| **41—50** | 1(8.33%) |
| **51—60** | |
| **3.Training on Cold Chain Handling** | 7(58.33%) |
| **Yes** | 5(41.67%) |
| **No** | |
| **4.Work experience in cold chain handling ( in years)** | |
| **1—4** | 7(58.33%) |
| **5—10** | 4(33.33%) |
| **≥10** | 1(8.33%) |
| **5. Use of Cold Chain Handler Guidelines** | |
| **Yes** | 3(25%) |
| **No** | 9(75%) |

**Table 2. General Knowledge of cold chain handler regarding cold chain equipments**

| Variables | Yes(%) | No(%) |
|---|---|---|
| a)Do you know what a cold chain is ? | 7(58.33%) | 5(41.67%) |
| b) Do you know all the types of equipments used under the cold chain? | 8(66.67%) | 4(33.33%) |
| Electrical cold chain equipment | | |
| WIC (Walk-in-coolers) | 8(66.67%) | 4(33.33%) |
| WIF (Walk-in Freezer) | 3(25%) | 9(75%) |
| ILR (Ice Lined Refrigerator) | 12(100%) | 0 |
| DF (Deep Freezer) | 12(100%) | 0 |
| Non-Electrical cold chain equipment | | |
| Cold boxes | 12(100%) | 0 |
| Vaccine carrier | 12(100%) | 0 |
| Ice packs | 12(100%) | 0 |

It was observed that in most 10 (83.33%) of the cold chain points, ILR and DF were properly placed. ILR and DF were connected to functional Voltage Stabilizer in 9 (75%) cold chain points. A functional thermometer was placed inside every ILR and DF of all the 12(100%) cold chain points. (Table-3) There was no frost or frost less than 5mm on inside walls of ILR in 11 (91.67%) cold chain points. Twice daily recording of temperature in temperature log book by cold chain handler was done in only 10(83.33%) cold chain points. Record of Power failures/cuts (if any) and Defrosting of ILRs & DFs was maintained by only 5(41.67%) cold chain points. (Table-3) It was observed that in all 12 (100%) cold chain points the cabinet temperature of ILR was maintained between +2 C to +8 C. T-series or Hepatitis B vaccine vials were found correctly placed i.e. not placed in the bottom of ILR in

all 12(100%) cold chain points. It was found that in only 9 (75%) CHCs, vaccine vials were correctly arranged inside labelled car-tons. Diluents were placed in ILR, at least 24 hours before distribution in all the 12 (100%) cold chain points. (Table-3) The Cabinet Temperature of DFs was maintained between -15 C to -25 C in only 9 (75%) cold chain points. Only 5(41.67%) of the cold chain points the Correct placement of ice packs inside DF (in crisscross manner) was found. It was also found that in none of cold chain point had vaccines stored inside DFs. Functional generator was available in all 12 (100%) cold chain points (Table-3)

**Table 3. Practices of cold chain handler specific to cold chain equipments and maintenance at each Cold chain point**

| Variables | Yes(%) | No(%) |
|---|---|---|
| ILR and DF | | |
| ➢Placed on wooden blocks and at least 10 cm away from walls and surrounding equipment. | 10(83.33%) | 2(16.67%) |
| ➢Each equipment is connected through functional Voltage Stabilizer? | 9(75%) | 3(25%) |
| ➢Functional thermometer placed inside every ILR and DF | 12(100%) | 0 |
| ➢No frost OR frost less than 5mm on inside walls of every ILR | 11(91.67%) | 1(8.33%) |
| Temperature Log Book | | |
| ➢Twice daily monitoring of temperature in respective log books | 10(83.33%) | 2(16.67%) |
| ➢Record of power failures/cuts (if any) and Record of Defrosting ILRs & DFs | 5(41.67%) | 7(58.33%) |
| Ice Lined Refrigerator (ILR) | | |
| ➢Cabinet Temperature between +2 to +8 C | 12(100%) | 0 |
| ➢All vaccine vials correctly arranged inside labelled cartons (expiry date, batch) | 9(75%) | 3(25%) |
| ➢No T-series or Hepatitis B vaccine vials placed in the bottom of ILR. | 12(100%) | 0 |
| ➢Diluents placed in ILR, at least 24 hours before distribution. | 12(100%) | 0 |
| Deep Freezers (DF) | | |
| ➢Cabinet temperature of DFs between -15 C to -25 C | 9(75%) | 3(25%) |
| ➢Correct placement of ice packs inside DF (in crisscross manner, while freezing) | 5(41.67%) | 7(58.33%) |
| ➢No RI vaccines stored inside DFs (including reconstituted vaccines) | 12(100%) | 0 |
| Generator - Functional generator/Inverter availability | 12(100%) | |

All 12(100%) of the cold chain handlers (CCH) responded correctly regarding the optimal temperature of cold chain between 2 C to 8 C (Table-4). Only 8(66.67%) CCH responded correctly that vaccine shifted to another refrigerator is required if power failure occurs more than 72hours.Knowledge items that were placement of vaccine at refrigerator door12 (100%), placement of vaccine in the lowest compartment in refrigerator 10(83.33%) and Placement of vaccines with food and beverages in the refrigerator 12(100%) (Table-4).

## DISCUSSION

The quality of vaccines is one of important factor for success of immunization program which in turn depends on proper storage and handling of vaccines. (Gupta and Gupta, 2015; Carol Bellamy, 2004) This study was conducted to evaluate availability and functioning of cold chain equipment as well as knowledge and practices of health personnel mainly cold chain handler (CCH) in its monitoring in the Chirang district of Assam. This is considered as one of the most difficult district of Assam included in tribal area. In this study, out of 12 respondents most 7(58.33%) of the respondents were female. Work experienced (1-4 years) as cold chain handler was found only in 7(58.33%). From the above data it was found that only 3(25%) of the respondent used the guidelines for cold chain handler. In the study it was found that only 7(58.33%) of the respondents had proper knowledge of cold chain and only 8(66.67%) of the respondents know all types of cold chain equipments used under cold chain. In the present study it was observed that in 10 (83.33%) cold chain points, ILR and DF were properly placed on wooden blocks and at least 10 cm away from walls and surrounding equipment. ILR and DF were connected to functional Voltage Stabilizer in only 9 (75%) cold chain points. A functional thermometer was placed inside every ILR and DF of all the 12 (100%) cold chain points. There was no frost or frost less than 5mm on inside walls of ILR in 11 (91.67%) cold chain points. In a similar study Santosh M Biradar *et al*. at BijapurKarna-taka found that in only 76.1% health centers ILR and DF were properly placed, ILR and DF were connected to functional Voltage Stabilizer in 91.3% health centers. A functional thermometer was placed inside ILR and DF only in 76.1% health center. (Santosh *et al*., 2013) The proper positioning of ILR/DF is important for correct functioning and improving durability of the equipments. In the present study twice daily recording of temperature in temperature log book by cold chain handler was found in only 10(83.33%) cold chain points.

Record of Power failures/cuts (if any) and Defrosting of ILRs & DFs was maintained by only 5 (41.67%) cold chain points. In a similar study Santosh M Biradar *et al*. found that temperature log books were monitored twice daily in 95.6% health centers. Record of power failures and defrosting of ILRs & DFs was maintained by only 65.2% health centers. (Santosh *et al*., 2013) It was also observed that in all 12 (100%) cold chain points the cabinet temperature of ILR was maintained between +2 C to +8 C. T-series or Hepatitis B vaccine vials were found correctly placed i.e. not placed in the bottom of ILR in all 12(100%) cold chain points.

**Table 4. Knowledge of cold chain handler about vaccine storage**

| Variable (Knowledge) | Items | Correctly answered freq. (%) |
|---|---|---|
| General Aspects | 2-8 C is an optimal temperature for cold chain | 12(100%) |
| | Shifting of vaccine to another refrigerator is required if power failure occurs more than 72 hours | 8(66.67%) |
| Good vaccine care | Vaccines will be spoiled if exposed to frozen state | 9(75%) |
| | Vaccines will be spoiled if exposed to heat | 12(100%) |
| | Placement of vaccines with food and beverages in the refrigerator | 12(100%) |
| | Placement of vaccines at refrigerator door | 12(100%) |
| | Placement of vaccines in the lowest compartment of refrigerator | 10(83.33%) |

In only 9(75%) cold chain points, vaccine vials were correctly arranged inside labelled cartons. Diluents were placed in ILR, at least 24 hours before distribution in all the 12 (100%) cold chain points. In the present study the Cabinet Temperature of DFs was maintained between -15 C to -25 C in only 9 (75%) cold chain points. The Correct placement of ice packs inside DF (in crisscross manner) was found in only 5 (41.67%) cold chain points. It was observed that in none of cold chain point had vaccines stored inside DFs. Good quality icepacks are requisite for field transportation of vaccine in vaccine carrier and these can be obtained from DF only if proper temperature is maintained with correct placement of ice packs (i.e. in crisscross manner).All the 12(100%) respondents agree that vaccines cannot be placed with food and beverages and knew that placement of vaccine at refrigerator door and most 10(83.33%) knew that placement of vaccine at the lowest compartment of refrigerator are dangerous. These indicate that their knowledge regarding effect of heat and freezing are adequate but only 9(75%) of the respondents correctly responded that vaccines will be spoiled if exposed to frozen state. Placing the vaccine at the lowest compartment may cause irreversible damage to heat sensitive vaccine such as oral polio and measles vaccine. Fortunately, all 12(100%) of the respondents knew that exposure to heat can cause vaccine damaged in the present study and only 8(66.67%) of the respondents knew that in case of power failure for more than 72 hours then vaccine should be shifted to another refrigerator.

## Conclusion

In all 12(100%) the cold chain points ILR were functioning. Improper vaccine storage practices and poor knowledge in some fields of cold chain management may adversely affect the quality of administered vaccine. Only 5(41.67%) of the cold chain points maintained the defrosting records. Knowledge regarding vaccine storage was found to be adequate among the cold chain handlers. There is a need to improve methods of ILR and DF temperature maintenance and regular defrosting with record keeping. There should be training and retraining of health staff involved in handling the cold chain at regular interval with continuous supportive supervision. Strengthening immunization services will not only include the cold chain equipment availability but also the right attitude and practice of cold chain handling by the cold chain handlers.

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## Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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