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Assessment of Vaccine Storage and Cold Chain Management Practices in Rewa District of Madhya Pradesh

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ABSTRACT

Background: Strengthening routine immunization requires not only increased coverage but also improved cold chain management and supportive supervision. Efficient management of cold chain equipment (CCE) and logistics is essential to maintain vaccine potency. This study assessed the status of cold chain equipment, logistics management practices, and the knowledge and practices of Cold Chain Handlers (CCHs) in cold chain points (CCPs) of Rewa district, Madhya Pradesh.

Methods: A cross-sectional facility-based study was conducted from March 2021 to March 2022 across 18 CCPs in Rewa district. Data were collected on equipment placement and maintenance, temperature monitoring, vaccine storage practices, and CCHs' knowledge of cold chain and logistics management.

Results: All CCPs had properly installed and maintained ILRs and DFs with temperatures within the recommended range, and temperature recording was done at all sites. Temperature logs were reviewed by the District Immunization Officer in 88.9% of CCPs and by facility in-charges in 55.6%. Vaccines were stored correctly with proper labels, valid expiry dates, and usable VVMs. Ice packs were correctly filled in 88.9% of CCPs, but only 44.4% were stored according to the recommended criss-cross method. While CCHs showed good knowledge of VVM and reconstituted vaccines, awareness of the Open Vial Policy (55.6%) and shake test (22.2%) was limited.

Conclusion: While basic cold chain infrastructure and practices were satisfactory, gaps were identified in record-keeping, supervision, and CCH knowledge. Regular training and stronger monitoring are necessary to improve cold chain management and ensure vaccine quality.

Key-words: Cold chain, vaccine, Cold Chain Handler (CCHs), Cold Chain Points (CCPs), Cold Chain Equipment (CCE), ILRs, DFs

INTRODUCTION

Vaccines are antigenic substances that, when administered to an individual, stimulate the production of specific antibodies and protect the individual against that particular disease.[1]

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In India, there is a high prevalence of Vaccine-Preventable Diseases (VPD). VPD not only increase morbidity and mortality in children but also affects their nutritional status. The burden of VPD can be easily reduced through effective immunisation programs.[2]

4 years after the launch of the Expanded Program on Immunisation (EPI) by the WHO in May 1974, the Government of India (GOI) also initiated EPI in 1978 against the 6 most common VPD to reduce mortality and morbidity amongst children. Later on, the GOI prioritize the needs of infants and pregnant mothers and revised the program as the Universal Immunization Program

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(UIP) in 1985.[2] GOI runs one of the largest UIPs in the world, concerning population and geographical area covered, the number of vaccines used, and the number of healthcare workers involved. As a result, a significant decline was observed in morbidity and mortality due to VPD in children.[3] However, significant proportions of vulnerable children remain unimmunized. According to NFHS 5, the prevalence of fully vaccinated children aged 12-23 months is 76.4%, indicating that 23.6% of vulnerable children are still not vaccinated.[4]

Maintenance of the cold chain during storage, transport, and distribution of vaccines is the most significant step in the success of an immunization program, as the potency of the vaccine is lost when the cold chain is broken. There is a break in the cold chain when the temperature exceeds $+8^0$ Celsius or falls below 2^0 Celsius. Once the vaccine's potency is lost, it cannot be regained. Effective immunization against any VPD is achieved only when a potent vaccine is administered.[4] The present study was conducted to assess vaccine storage and cold chain management practices in Rewa district, Madhya Pradesh.

MATERIALS AND METHODS

Study Design and Setting- This study was a **cross-sectional observational study** conducted in the Rewa district of Madhya Pradesh. Rewa is a district situated in the Vindhya region of Madhya Pradesh, with an area of 6341 square kilometers and a population of 23,63,744, as per the 2011 census. The district is served by one allopathic medical college, one ayurvedic medical college, one district hospital, 11 community health centers, and 35 primary health centers. There is a total of 9 blocks in the Rewa district and 24 Cold Chain Points (CCP). From each block 2 CCP were selected by the lottery method (simple random sampling). Hence, 18 of the 24 CCPs were selected.

Data Collection- Information was collected using a pre-designed, pre-tested questionnaire. Cold Chain Equipment (CCE) and cold chain maintenance practices were assessed through direct observation and by asking related questions to Cold Chain Handlers (CCH). The standard checklist for monitoring the cold chain, used by the health department, was used to collect the data. Regarding equipment, monitoring was conducted using an observatory-standard checklist by the principal investigator, and to assess the CCH's knowledge, a standard questionnaire was used. Interviews were conducted by the investigator, which took about 15 minutes each. The visits were not pre-informed to the CCH, to prevent bias during data collection**.** Information was collected using pre-designed, pre-tested questionnaires provided by UNICEF on CCE, vaccines, and other logistics.

Inclusion and Exclusion Criteria

Inclusion criteria- All functional Cold Chain Points (CCPs) in Rewa district that were actively involved in routine immunization services during the study period were included. Cold Chain Handlers (CCHs) present at the time of visit and willing to participate were also included in the study.

Exclusion criteria-- Cold Chain Points that were non-functional or not involved in immunization activities during the study period were excluded. Cold Chain Handlers who were absent at the time of the visit or unwilling to participate were also excluded.

Statistical Analysis- Data were compiled and analyzed using percentages and proportions. Descriptive statistics were used to summarize the data. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Appropriate statistical tests were applied wherever required, and a p-value <0.05 was considered statistically significant.

Ethical Considerations- Approval for the study was obtained from the Institutional Ethics Committee (IEC).

RESULTS

As depicted in Table 1, all 18 CCPs had dedicated rooms or spaces for the cold chain. However, only 4 (22.22%) CCP had a dedicated room/space for dry storage. A dedicated table for conditioning icepacks was available in 4 CCPs; however, no CCP had dedicated clean clothes for wiping icepacks after conditioning. Y Power back-up was available only in 8 (44.44%) CCPs.

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Table 1: Description of cold chain infrastructure

Parameter	Yes (%)	No (%)
Dedicated room/space for cold chain	18(100)	0 (0)
Dedicated room/space for dry storage	4 (22.22)	14 (77.78)
Dedicated table for conditioning of icepacks	4 (22.22)	14(77.78)
Dedicated clean clothes for wiping of icepacks after conditioning	0 (0)	18(100)
Power back up	8 (44.44)	10 (55.56)

As mentioned in Table 2, ice-lined refrigerators (ILR) and deep freezers (DF) were properly placed on a wooden stand at a distance of 10 cm from the wall and adjacent equipment and a functional thermometer were placed inside every ILRs and DFs all 18 CCP. ILRs and DFs were connected to separate functional voltage stabilisers in only 10 equipment units (55.56%).

Table 2: Description of vaccine storage practices

Vaccine storage practices	Yes (%)	No (%)
Placement of ILR and DF		
Cold Chain Equipment (CCE) (ILRs and DFs) Placed on wooden blocks	18(100)	0(0%)
CCE (ILRs and DFs) at least 10 cm away from walls and adjacent equipment	18(100)	0(0%)
Separate functional thermometer inside every functional equipment	18(100)	0(0%)
Each equipment is connected through functional Voltage Stabilizer	10(55.56)	8 (44.44)
ILR		
Functional ILR within the temperature range (+2^{o}C to +8^{o}C)	18(100)	0(0)
Correct placement of vaccine from top to bottom inside ILRs	18(100)	0(0)
Diluents placed in ILR at least 24 hours before distribution	18(100)	0(0)
DFs		
DF within the normal temperature range (-15 to -25)	18(100)	0(0)
Correct placement of ice packs inside DFs (criss-cross)	8 (44.44)	10(55.56)
Ice packs are filled up to the mark and capped	16(88.89)	2(11.11)

ILR - Ice lined refrigerator, DF- Deep freezer

As mentioned in Table 3, each CCE had a separate logbook. Recording of temperature twice a day, including Sundays and holidays, in the temperature log book was done in all 18 (100%) CCPs. Still, records of power failures/cuts and defrosting of ILRs and DFs were maintained in only 8 (44.44%) CCPs. Periodic checking of temperature logbooks by the District Immunisation Officer (DIO) was conducted in 16 (88.89%) CCPs, but review of the logbooks by the facility in charge was conducted only in 10 (55.56%) CCPs. It was found that in all 18 (100%) CCPs, the cabinet temperatures of ILR and DFs were maintained within the normal range. T-series and Hepatitis B vaccine vials were found correctly placed and diluents were placed in ILRs at least 24 hours before distribution.

Ice packs were filled to the mark in 16 (88.89%) CCPs, and in only 8 (44.44%) CCPs were ice packs stored in DFs in a criss-cross manner.

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It was noted that in all (100%) CCPs, all vaccine vials have proper, readable labels within expiry dates, with usable Vaccine Vial Monitoring (VVM) (I and II). No vaccine was found in frozen condition. Open vaccine vials were stored in a separate box, and the date and time of opening were written on each vial. All open vaccine vials were less than 28 days old since opening.

Table 3: Description of vaccine handling practices

Vaccine handling practices	Yes (%)	No (%)
Temperature Log Book		
Each CCE has a separate temperature log book	18(100)	0(0)
Temperature is recorded twice daily	18(100)	0(0)
Temperature is recorded on Sundays and holidays	18(100)	0(0)
Record of power failure maintained in temperature log book	8 (44.44)	10(55.56)
Records of defrosting/cleaning maintained in temperature log book	8 (44.44)	10(55.56)
Temperature Log book reviewed by DIO in last three months	16(88.89)	2(11.11)
Temperature Log book reviewed periodically by facility in charge	10(55.56)	8 (44.44)
Vaccines		
All vaccine vials have proper readable labels	18(100)	0(0)
All vaccine found within expiry dates	18(100)	0(0)
All the vaccines with usable VVM (I & II)	18(100)	0(0)
Any vaccine found in frozen condition	0(0)	18(100)
Any open vaccine vial stored inside ILRs	10(55.56)	8 (44.44)
Open vaccine vial is stored in separate box/zipper bag (out of 10)	10(100)	0(0)
Date and time of opening is written on the vial (out of 10)	10(100)	0(0)
All open vaccine vial is of <28 days duration (out of 10)	10(100)	0(0)

In the present study, among all 18 (100%) CCPs, Cold Chain Handlers (CCHs) had knowledge of VVM and the time of use of the reconstituted vaccine. In 16 (88.89%) CCPs, CCHs knew the timing of diluent placement in ILRs, the timing of vaccine-requiring diluent addition, and the timing of ice pack conditioning. In 14 (77.78%) CCPs, CCHs knew freeze and temperature-sensitive vaccines. However, CCHs were aware of the open vial policy and the shake test in only 10 (55.56%) and 04 (22.22%) CCPs, respectively (Table 4).

Table 4: Correct knowledge of Cold Chain Handlers

Parameter	Yes (%)	No (%)
Vaccine Vial Monitor	18(100)	0 (0)
Shake test	4 (22.22)	14(77.78)
Time of use of reconstituted vaccine	18(100)	0 (0)
Timing of placement of diluent inside ILR	16(88.89)	2(11.11)
Vaccine requiring diluents	16(88.89)	2(11.11)
Open vial policy	10(55.56)	8 (44.44)
Freeze sensitive vaccines	14(77.78)	4 (22.22)
Temperature sensitive vaccines	14(77.78)	4 (22.22)
Conditioning of ice packs	16(88.89)	2(11.11)

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DISCUSSION

Immunization is one of the most effective public health interventions for preventing vaccine-preventable diseases. However, the success of immunization programs depends not only on coverage but also on the maintenance of vaccine potency through an efficient cold chain system. The present study assessed cold chain infrastructure, logistics management, and knowledge of Cold Chain Handlers (CCHs) in Rewa district and identified both strengths and gaps in the system.

In the present study, all Cold Chain Points (CCPs) had a dedicated room or space for cold chain, which is consistent with findings reported by Panika *et al.* [6], Kamble *et al.* [5], Mendhe *et al.* [7], and Sinha *et al.* [8]. This indicates satisfactory infrastructure availability in the study area. However, only 22.22% CCPs had a dedicated space for dry storage, which is lower than findings reported by Mendhe *et al.* [7] and Sinha *et al.* [8], but similar to observations by Panika *et al.* [6] and Kamble *et al.* [5], where limited dry storage facilities were reported. This gap suggests the need for strengthening infrastructure for proper storage of logistics.

Proper placement and maintenance of cold chain equipment are essential for maintaining vaccine potency. In the present study, all Ice-Lined Refrigerators (ILRs) and Deep Freezers (DFs) were correctly placed on wooden stands and maintained at appropriate distances from walls and adjacent equipment. Similar findings were reported by Panika *et al.* [6], Pradeep *et al.* [9], Sanghavi *et al.* [10], and Gupta *et al.* [11]. Sharma *et al.* [12] also reported comparable findings, while Biradar *et al.* [13] and Mallik *et al.* [14] observed relatively lower adherence to proper placement guidelines.

The presence of functional thermometers in all equipment in the present study is encouraging and higher than findings reported in studies by Panika *et al.* [6], Mendhe *et al.* [7], and Biradar *et al.* [13], where some gaps were noted. However, Patel *et al.* [16] and Pandey *et al.* [17] reported significantly lower availability of thermometers, indicating variability across different settings.

Only 55.56% of the equipment was connected to functional voltage stabilizers in the present study. Similar findings were reported by Panika *et al.* [6] and Gupta *et al.* [11], whereas Biradar *et al.* [13], Sharma *et al.* [12], and Choudhury *et al.* [15] reported higher availability of voltage stabilizers. The lack of stabilizers may expose equipment to voltage fluctuations, which can compromise vaccine storage conditions.

Temperature monitoring practices were satisfactory in the present study, with all CCPs recording temperature twice daily, including Sundays and holidays. Similar findings were reported by Panika *et al.* [6], Naik *et al.* [18], and Kamble *et al.* [5]. Slightly lower compliance was observed in studies by Biradar *et al.* [13], Rao *et al.* [19], and Mendhe *et al.* [7]. Other studies by Gupta *et al.* [11], Mallik *et al.* [14], Patel *et al.* [16], Pandey *et al.* [17], and Sachdeva *et al.* [20] reported even lower levels of compliance, highlighting the relatively better performance in the present study.

However, only 44.44% CCPs maintained records of power failures and defrosting. Similar findings were reported by Choudhury *et al.* [15], while Panika *et al.* [6] and Gupta *et al.* [11] reported even lower levels of documentation. In contrast, Sanghavi *et al.* [10], Biradar *et al.* [13], Patel *et al.* [16], and Rao *et al.* [19] reported better record maintenance. Sharma *et al.* [12] reported nearly complete compliance. Poor documentation in the present study indicates a need for improved record-keeping practices.

Supervisory practices showed that temperature logbooks were reviewed by the District Immunization Officer (DIO) in 88.89% CCPs, which is comparable to findings by Patel *et al.* [16], while Panika *et al.* [6] and Mendhe *et al.* [7] reported lower levels of review. However, review by the facility in-charge was observed in only 55.56% CCPs in the present study. This is higher than findings reported by Panika *et al.* [6] but lower than those reported by Biradar *et al.* [13], Patel *et al.* [16], Rao *et al.* [19], Gupta *et al.* [11], and Sharma *et al.* [12]. This suggests that local-level supervision needs strengthening.

The present study found that all CCPs maintained the recommended temperature range in ILRs and DFs. Similar findings were reported by Panika *et al.* [6], while Mendhe *et al.* [7] and Biradar *et al.* [13] reported slightly lower compliance. Choudhury *et al.* [15] observed adequate temperature maintenance in ILRs but not in all DFs. Gupta *et al.* [11] reported lower compliance, indicating variability across studies.

Vaccine storage practices in the present study were appropriate, with correct placement of vaccines and proper storage of diluents. Similar findings were reported by Panika *et al.* [6], Pradeep *et al.* [9], and Choudhury *et al.* [15]. Mendhe *et al.* [7] and Sanghavi *et al.*

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[10] reported slightly lower adherence, while Sharma *et al.* [12] and Biradar *et al.* [13] also noted some deficiencies. Gupta *et al.* [11] reported lower levels of correct placement.

Correct criss-cross placement of ice packs in deep freezers was observed in only 44.44% CCPs in the present study. Similar findings were reported by Choudhury *et al.* [15], while higher compliance was reported by Panika *et al.* [6], Mendhe *et al.* [7], Gupta *et al.* [11], and Patel *et al.* [16]. Improper placement of ice packs may compromise temperature maintenance and highlight the need for training.

All vaccine vials in the present study had proper labels, were within expiry dates, and had usable VVMs. No frozen vaccines were found. Similar findings were reported by Panika *et al.* [6], Pradeep *et al.* [9], and Sinha *et al.* [8]. In contrast, Mendhe *et al.* [7] reported issues such as vaccines beyond expiry, frozen vaccines, and improper labeling.

Knowledge assessment of CCHs showed that all handlers were aware of VVM and use of reconstituted vaccines, consistent with findings from Panika *et al.* [6] and Gupta *et al.* [11]. However, knowledge regarding vaccines requiring diluents and timing of diluent placement was slightly lower compared to Panika *et al.* [6] and Bhatnagar *et al.* [21], where higher awareness was reported.

Awareness regarding freeze-sensitive and temperature-sensitive vaccines was observed in 77.78% CCPs, similar to findings by Sinha *et al.* [8], but lower than those reported by Mendhe *et al.* [7] and Bhatnagar *et al.* [21]. Awareness of the open vial policy was observed in 55.56% CCPs, which is lower than findings reported by Bhatnagar *et al.* [21] but comparable to Panika *et al.* [6].

Only 22.22% of CCHs were aware of the shake test in the present study. Bhatnagar *et al.* [21] reported even lower awareness, while Panika *et al.* [6] and Mendhe *et al.* [7] reported higher awareness. Lack of knowledge regarding the shake test is a critical gap, as it is essential for detecting freeze-damaged vaccines.

Overall, the present study demonstrates that while cold chain infrastructure and vaccine storage practices are largely satisfactory, gaps exist in documentation, supervision, and knowledge of certain key practices. Strengthening training programs, improving supervision, and ensuring proper infrastructure and documentation will be essential to further enhance the effectiveness of immunization services.

CONCLUSIONS

Though we found that vaccine management and handling practices were adequate in the Rewa district of Madhya Pradesh with respect to most of the standards, there were a few criteria that require improvement for the successful implementation of UIP. The practices should be improved with regard to the conditioning of ice packs. Adequate space should be provided for a dry storage facility. A separate functional voltage stabiliser should be provided for better maintenance of the cold storage. Awareness programs for CCHs should be undertaken regularly to ensure they are aware of correct vaccine handling practices, especially regarding the open vial policy and the shake test. Regular monitoring of records where vaccine management and handling practices are documented will also be very helpful in the successful conduct of UIP.

CONTRIBUTION OF AUTHORS

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REFERENCES

[1] Suryakantha AH. Community Medicine with Recent Advances. 6th ed. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd; 2022; pp. 351.

doi: 10.21276/SSR-IIJLS.2026.12.3.8

[2] Park K. Park's Textbook of Preventive and Social Medicine. 26th ed. Jabalpur: Banarsidas Bhanot Publishers; 2021; pp. 122.

[3] Department of Health and Family Welfare, Ministry of Health and Family Welfare, Government of India. Handbook for Vaccine and Cold Chain Handlers. 2nd ed. 2016.

[4] Ministry of Health and Family Welfare, Government of India. National Family Health Survey (NFHS-5) 2019–21. 2021 [cited 2025 May 08]; Available from: https://main.mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf.

[5] Kamble NH, Singh D, Mendhe HG, Makade K. Assessment of vaccine management in cold chain points of Jashpur and Sarguja districts of Chhattisgarh. Int J Community Med Public Health, 2020; 7: 148-52.

[6] Panika RK, Prasad P, Nandeshwar S. Evaluation of vaccine storage and cold chain management practices during intensified Mission Indradhanush in community health centers of Tikamgarh district of Madhya Pradesh. Int J Community Med Public Health, 2019; 6(2): 823-28.

[7] Mendhe H, Makade K, Bhawanani D, David R, al. Cold chain maintenance in Rajnandgaon and Bilaspur districts of Chhattisgarh: A process evaluation. J Family Med Prim Care, 2018; 7: 1510-14.

[8] Sinha A, Verma A, et al. Evaluation of cold chain and logistics management practice in Durg district of Chhattisgarh: Pointer from Central India. Int J Community Med Public Health, 2017; 4(2): 390-95.

[9] Pradeep RP, Viral RS, Naresh RM, Dipesh P. Structure and process evaluation of cold chain management and routine immunization services in rural Western Gujarat. J Basic Appl Res Biomed., 2020; 6(2): 70-74.

[10] Sanghavi M. Assessment of routine immunization program at primary health centre level in Jamnagar district. Natl J Med Res., 2013; 3(4): 319-23.

[11] Gupta A, Gupta R. Study of cold chain practices at community health centers of Damoh district of Madhya Pradesh. Natl J Community Med., 2015; 6(4): 528-32.

[12] Sharma D, Varun A, Patel R, Singh U. Process evaluation of immunization component in Mamta Diwas and support services in Kheda district, Gujarat. Natl J Community Med., 2013; 4(1): 81-85.

[13] Biradar S, Biradar M. Evaluation of vaccine storage practices in primary health centres of Bijapur district of Karnataka. Int J Pharm Bio Sci., 2013; 4: 1290-93.

[14] Mallik S, Mandal P, Chatterjee C, Bagchi S, Dasgupta S. Assessing cold chain status in a metro city of India: An intervention study. Afr Health Sci., 2011; 11(1): 128-33.

[15] Choudhury D, Baruah R, Ojah J. Knowledge and practices of cold chain handler regarding cold chain equipment and vaccine storage in Chirang district, Assam. Int J Curr Res., 2016; 8(7): 35464-67.

[16] Patel N, Unadkat SV, 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): 43-47.

[17] Pandey S, Singh CM, Ranjan A, Kumar Y, Kumar P, et al. Assessment of cold chain system for routine immunization of primary health centres of Bhojpur district of Bihar. Indian J Community Health, 2018; 30(2): 120-26.

[18] Naik AK, Rupani MP, Bansal RK. Evaluation of vaccine cold chain in urban health centres of Municipal Corporation of Surat City, Western India. Int J Prev Med., 2013; 4: 1395-01.

[19] Rao S, Naftar S, Baliga S, Unnikrishnan B. Evaluation, awareness, practice and management of cold chain at the primary health care centers in coastal South India. J Nepal Paediatr Soc., 2012; 32(1): 19-22.

[20] Sachdeva S, Datta U. Status of vaccine cold chain maintenance in Delhi, India. Indian J Med Microbiol., 2010; 28: 184-85.

[21] Bhatnagar P, Chopra H, Garg S, Bano T, Kumar A, et al. Status of knowledge and skills of cold chain handlers in district Meerut, Uttar Pradesh, India. J Dent Med Sci., 2018; 17(2): 44-48.