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Original Article

Effectiveness of Lecture and Vaccination Centre Visit for Teaching Basics of Immunisation and Cold Chain to Students of Traditional Medicine in Kolkata: A Quasi-Experimental Study

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Abstract

Background
Immunization and cold chain management are integral to public health. Though traditional medicine curriculum includes these topics, students often lack practical exposure. This study evaluates the impact of lecture combined with vaccination center visit on knowledge of immunization and cold chain management among these students.

Materials and Methods
A longitudinal, quasi-experimental study was conducted on traditional medicine students visiting the tertiary care hospital in Kolkata from June to December 2024. The intervention includedtwo-hour lecture followed by two-hour vaccination center visit. Knowledge assessments were conducted pre-intervention, post-intervention, and after one-month using a 20-item e-questionnaire on Vaccination &Adverse Event Following Immunisation, Cold Chain and Biomedical Waste Management.Comparisons between pre-test, post-test, and post-1-month test scores were conducted using Friedman test.

Results
Among the 80 participantscompleting the study, median scores across all domains improved significantly (Friedman test $p < 0.001$). Vaccines &Adverse Event Following Immunisation scores increased from a median of 0 in the pre-test to 9 in the post-test, with a slight decline to 7.5 after 1-month. Cold Chain scores rose from 2 to 5 and remained stable (post-test vs post-1-month test p 0.386). Biomedical Waste Management scores improved from 1 to 4.5 in the post-test, decreasing marginally to 4 after one month. Total scores showed a remarkable rise from a median of 4 to 17, with slight decline to 15 after a month.

Conclusion
Experiential learning combined with lectures enhances knowledge retention among traditional medicine students, highlighting the need for integration of practical training in the curriculum.

Keywords: *Cold Chain, Experiential Learning, Immunization, Traditional Medicine, Vaccination*

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Introduction

An effective cold chain is required to preserve the potency of vaccinesthat protect individuals against infectious diseases [1–4]. Due to limited availability of allopathic practitioners in India, practitioners of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy (AYUSH) are involved in immunisation [5]. Students pursuing Bachelor of Ayurvedic Medicine and Surgery (BAMS) and Bachelor of Homeopathic Medicine and Surgery (BHMS) learn about immunising agents, though most colleges lack cold chain infrastructure [5–9]. Experiential learning, such as visits to vaccination centres, fosters creativity and critical thinking, yet is not recommended by the National Medical Commission (NMC) [8–10]. Studies have validated its utility inimproving awareness of vaccine safety and cold chain management [11–14].

Combining vaccination centre visits with lectures would bridge the gap between medical colleges and communities. This teaching-learning method will deepen understanding of social issues, enhance cognition, and strengthen communication with beneficiaries. Besides, it would boost student participation in the immunisationprogram and encourage reflection on academic concepts and real-world application.

This study aims at examining the effectiveness of lecture and vaccination centre visit for learning basics of immunisation and cold chain to students of traditional medicine in Kolkata.

Materials and Methods

A quasi-experimental educational intervention study, longitudinal in design was conducted. The research was carried out in Infectious Diseases &Beliaghata General (ID & BG) Hospital, Kolkata from June to December, 2024. Data collection was initiated after approval from the institutional ethics committee (IDBGH/IEC/2663, Dated 24.06.24). Besides, informed electronic consents were taken from participants. The study abided by the Declaration of Helsinki and ICMR (Indian Council of Medical Research) guidelines for biomedical research on human subjects. Students of traditional medicine (BAMS, BHMS) posted at Infectious Diseases & Beliaghata General (ID & BG) Hospital, Kolkata during the study period were included, while those who did not give an electronic informed consent were excluded. All the traditional medicine students visiting ID & BG Hospital from 24.06.2024 to 23.12.2024 and satisfying the selection criteria were included. Random selection, random allocation, allocation concealment or blinding was not possible.

Data collection involved assessing students' knowledge before and after the learning sessions, which included a lecture and a visit to a vaccination centerand cold chain point (CCP). Thus, the study utilized a lecture module covering essential topics such as the basics of vaccination (National Immunisation Schedule, details of each vaccine and their temperature and light sensitivity, open vial policy), Adverse Event Following Immunisation (AEFI), Cold Chainsystem and equipments, and Biomedical Waste Management. Additionally, a self-administered e-questionnaire (Google Forms) divided into three sections with 20 items: Section I (Vaccination & AEFI) consisting of 10 items, Section II (Cold Chain Equipment) with 5 items, and Section III (Biomedical Waste Management) with 5 items was utilized for evaluation of the pre/post-test knowledge of the participants. Other tools required were a projector, a laptop, unused intact and used empty vaccine vials and cold chain equipments.

All eligible students who visited the institute during the data collection period were included in the study. The process began with facilitators briefing about the study process followed by participants completing a pre-test knowledge assessment through an e-questionnaire, which was administered before they attended the module-based lecture and Vaccination Centre Visit.The lecture was conducted for two hours and focused on topics including the basics of vaccination, Adverse Event Following Immunisation (AEFI), Cold Chain, and Biomedical Waste Management. Following the lecture, a two-hour visit to the Vaccination Centre was held, where students were introduced to various cold chain equipments and guided through their maintenance procedures, temperature monitoring processes, and the arrangement of vaccines in the equipment. The session and visit were led by the in-charge of the Vaccination Centre, who holds an MD in Community Medicine. During the visit, participants were shown the anaphylaxis kit (designed for use in cases of AEFI), AEFI register, temperature log books, vaccine stock register (Issue and Receipt), Vaccinator's logistics diary and had the opportunity to observe the immunisation procedure. This included the route, site, and dose of different vaccines, as well as the proper disposal of biomedical waste generated during the process. The vaccines were administered by the nursing staff, which comprised the Senior Public Health Nurse, Public Health Nurse, and Staff Nurse.After the teaching-learning session, a post-test knowledge assessment was conducted to measure the participants' learning outcomes. One month later, following a washout period, the same knowledge assessment form was administered again to evaluate knowledge retention among the participants.

The exposure variables or interventions included a two-hours lecture covering the basics of vaccination, Adverse Event Following Immunisation (AEFI), Cold Chain, and Biomedical Waste Management. Additionally, there was a two-hour visit to the Vaccination Centre to familiarize participants with the immunisation procedure and the cold chain equipment. The outcome variable was the knowledge score, which measured understanding in three key areas: Vaccination and AEFI, Cold Chain Equipment, and Biomedical Waste Management.

Data management and statistical analysis: The data were collected and entered into Microsoft Office Excel 2019 (Microsoft Corp, Redmond, WA, USA) and analyzed using Statistical Package for the Social Sciences Version 25.0 (IBM, New York City, USA). The questionnaire comprised 20 items, each scored as 1 point for a correct response and 0 for an incorrect one. It was divided into three sections: Section I (Vaccination & AEFI) with 10 items, offering a maximum score of 10 points; Section II (Cold Chain Equipment) with 5 items, allowing a maximum score of 5 points; and Section III (Biomedical Waste Management) with 5 items, also with a maximum score of 5 points. Thus, the maximum total score for the entire questionnaire was 20 points.The results were presented using both descriptive and inferential statistical methods. Tests for normality were conducted, including the Kolmogorov-Smirnov test (p-value < 0.05) and the Shapiro-Wilk test (p-value < 0.05). To compare the scores of the pre-test, post-test, and post-1-month test, Friedman test was applied. A significant Friedman test was further evaluated using the Wilcoxon matched-pair signed rank test (Post hoc analysis). A p-value of less than 0.05 was considered statistically significant.

Results

Enrolment of eligible students (94 participants)

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Pre-test Knowledge Assessment (e-questionnaire)

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Module-based Lecture (1 hour)
Topics:
- Basics of Vaccination
- Adverse Event Following Immunisation (AEFI)
- Cold Chain
- Biomedical Waste Management

↓

Vaccination Centre Visit (2 hours)
Activities:
- Introduction to Cold Chain Equipment
- Maintenance Procedures & Temperature Monitoring
- Vaccine Arrangement
- Observation: Anaphylaxis Kit and Immunisation Procedure (Route, Site, Dose of Vaccines)
- Biomedical Waste Disposal by Nursing Staff

↓

Post-Test Knowledge Assessment (82 participants completed)

↓

Washout Period (1 month)

↓

Follow-Up Knowledge Assessment (80 participants completed)

Figure 1: Flowchart

Figure 1 depicts the flow of participants in the study. At the start of the study, 94eligible students were enrolled. However, only 80 participants(14.9% attrition rate) completed the post 1-month test, leading to a final analysis of these numbers. Among these 80 students, 29 (36.3%) were pursuing BAMS and 51 (63.8%) BHMS.

Table 1: Socio-demographic characteristics of the participants. (n=80)

	Socio-demographic characteristics	Number	Percentage
A	**Age**		
	18-24 years	37	46.3
	25-29 years	42	52.5
	30 years & above	1	1.3
B	**Gender**		
	Female	34	42.5
	Male	46	57.5
C	**Permanent Residence**		
	Rural	38	47.5
	Urban	42	52.5
D	**Highest Educational Qualification**		
	B. Sc.	1	1.3
	Graduation	2	2.5
	Higher Secondary	77	96.3
E	**Socio-economic status (as per Modified BG Prasad Scale, updated 2024)**		
	Class I	39	48.8
	Class II	15	18.8
	Class III	9	11.3
	Class IV	11	13.8
	Class V	6	7.5

The median age (IQR) was 25 years (26-24), ranging from 18 to 34 years.Majority were aged 25–29 years (52.5%), were males (57.5%) and, and resided in urban areas (52.5%). Most participants educated up to Higher Secondary (96.3%) and belonged to Class I socio-economic status (48.8%) according to the Modified BG Prasad Scale, 2024[15]. [Table 1]

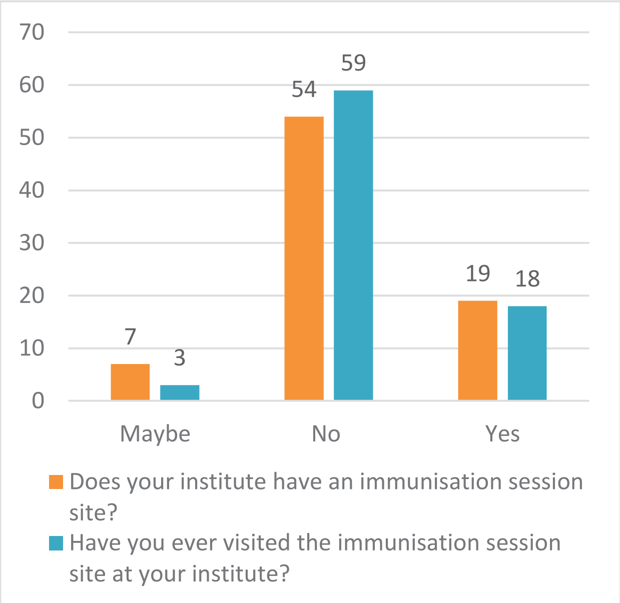

Figure 2: Exposure of the participants to immunisation session site at their institute. (n=80)

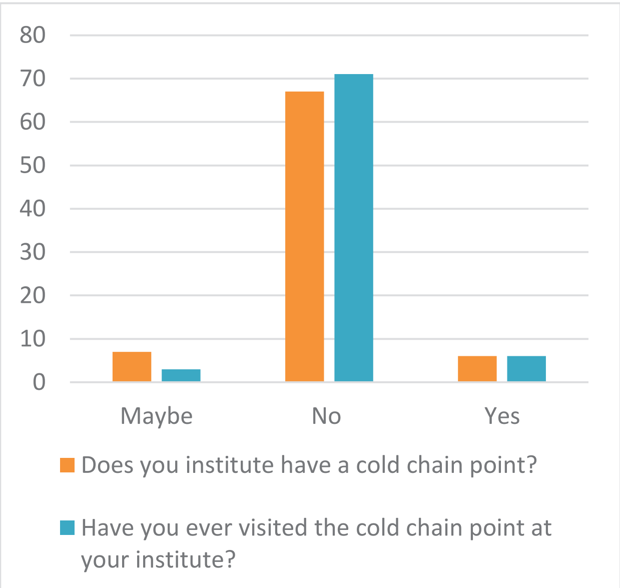

Figure 3: Exposure of the participants to cold chain point at their institute. (n=80)

The majority of respondents reported that their institutes lacked an immunisation session site (67.5%) and a cold chain point (83.8%). Additionally, 8.8% of students were uncertain about the presence of these facilities at their institute. Among the 23.8% of participants who indicated the presence of an immunisation session site at their institute, only 22.5% had visited it. Conversely, all 7.5% of students who confirmed the existence of a cold chain point at their institute reported having visited it. [Figure 2, 3]

Table 2: Percentage of participants responding correctly to each item in pre-test, post-test and post 1-month test. (n=80)

	Item	Correct Response	Pre-test	Post-test	Post 1-month test
A	**Basics of vaccination**				
	Which is the currently used form of rotavirus vaccine? (with images)	d. Rotasiil liquid	17.5	83.8	66.3
	Which vaccine is not eligible for open vial policy?	c. MR	25	71.3	67.5
	Which of the following vaccines under NIS are administered via oral route?	d. Both a & b (a. OPV, b. Rotavirus vaccine)	60	87.5	83.8
	Which of the following vaccines can be used? (with images)	Option 1 (Image- VVM with outer circle darker than inner square)	52.5	96.3	85.0
	Which vaccine is light sensitive?	b. MR	51.3	85.0	73.8
	Which vaccine is freeze sensitive?	c. Pentavalent	26.3	72.5	67.5
B	**Adverse Event Following Immunisation (AEFI)**				
	What is the full form of AEFI?	b. Adverse Event Following Immunisation	22.5	83.8	76.3
	Which of the following is not a type of AEFI as per WHO?	d. All are types of AEFI (a. Vaccine product related reaction b. Immunisation error related reaction c. Immunisation anxiety related reaction)	51.3	91.3	83.8
	Which is the first step in investigation of an AEFI?	b. Confirmation of the AEFI report	10	66.3	58.8
C	**Cold Chain System and Equipments**				
	How much is the temperature of the cabinet inside ILR?	a. +2 to +8℃	61.3	95.0	92.5
	Which cold chain equipment is used for the preparation of ice packs?	b. Deep freezer	46.3	87.5	82.5
	Which is a non-electrical cold chain equipment?	d. Cold boxes	71.3	93.8	88.8
	Which cold chain equipment is used for transportation of vaccines?	d. Cold boxes	61.3	83.8	80.0
	When can an ice pack be used for the immunisation session?	c. Water drops are visible on the surface of the ice pack and crackling sound can be heard on shaking the ice pack	42.5	87.5	88.8
D	**Biomedical Waste Management**				
	After an immunisation session, in which bags are the following items disposed?				
	• Gloves	b. Red	23.8	76.3	57.5
	• Syringe without needle	b. Red	26.3	76.3	66.3
	• Needle of the syringe	e. White	31.3	87.5	61.3
	• Vaccine vial	c. Blue	22.5	83.8	66.3
	• Blood soaked cotton ball	a. Yellow	26.3	82.5	72.5

Table 2 outlines the percentage of participants correctly responding to various items across the pre-test, post-test, and post 1-month test. The data indicates a substantial improvement in correct responses following the educational intervention, as seen in the post-test results. However, after a one-month washout period, a decline in the percentage of participants providing correct responses was observed across most items. Despite this decline, knowledge retention remained relatively high compared to pre-test levels.

Table 3: Comparison between the pre-test, post-test and post 1-month test scores of the participants. (n=80)

	Section [score]	Pre-test [median (IQR)]	Post-test [median (IQR)]	Post 1-month test [median (IQR)]	Friedman test			Post-hoc
					÷²	df	p value	Wilcoxon signed ranks test
1	Vaccines & AEFI [10]	0 (2-0)	9 (10-7)	7.5 (9-6)	117.675	2	<0.001	Pre-test vs post-test: p <0.001; Pre-test vs post 1-month test: p <0.001; Post-test vs post 1-month test: p 0.011
2	Cold chain [5]	2 (3-1)	5 (5-4)	5 (5-4)	111.678	2	<0.001	Pre-test vs post-test: p <0.001; Pre-test vs post 1-month test: p <0.001; Post-test vs post 1-month test: p 0.386
3	Biomedical Waste [5]	1 (2-0)	4.5 (5-3.75)	4 (5-1)	70.021	2	<0.001	Pre-test vs post-test: p <0.001; Pre-test vs post 1-month test: p <0.001; Post-test vs post 1-month test: p <0.001
4	Total [20]	4 (6-2.75)	17 (20-15)	15 (19-12)	119.303	2	<0.001	Pre-test vs post-test: p <0.001; Pre-test vs post 1-month test: p <0.001; Post-test vs post 1-month test: p 0.002

The participants demonstrated significant improvements across all sections following the intervention. In the Vaccines & AEFI section, median scores increased substantially from 0 (IQR: 2-0) in the pre-test to 9 (IQR: 10-7) in the post-test, followed by a slight decrease to 7.5 (IQR: 9-6) after one month (Friedman test $\chi^2 = 117.675$, $p < 0.001$). Similarly, Cold Chain scores showed a notable rise from 2 (IQR: 3-1) to 5 (IQR: 5-4) in the post-test, with scores remaining stable at 5 (IQR: 5-4) even after one month (Friedman test $\chi^2 = 111.678$, $p < 0.001$). In the Biomedical Waste Management section, scores improved from 1 (IQR: 2-0) in the pre-test to 4.5 (IQR: 5-3.75) in the post-test, followed by slight decline to 4 (IQR: 5-1) after one month (Friedman test $\chi^2 = 70.021$, $p < 0.001$). Total scores demonstrated a remarkable increase from 4 (IQR: 6-2.75) in the pre-test to 17 (IQR: 20-15) in the post-test, with a minor reduction to 15 (IQR: 19-12) after one month (Friedman test $\chi^2 = 119.303$, $p < 0.001$). Post-hoc analysis using the Wilcoxon signed ranks test confirmed significant improvements between the pre-test and both post-test stages, with minor declines in the post 1-month test scores. Notably, the Cold Chain section was the only domain where no difference was observed between post-test and post 1-month test scores (Wilcoxon signed ranks test $p = 0.386$), highlighting sustained retention in this area.[Table 3]

Discussion

This quasi-experimental study underscores the role of experiential learning in bridging gaps in practical training, enhancing knowledge retention, and improving vaccine-related practices. In the present study, 80 students (36.3% BAMS, 63.8% BHMS) with a median age of 25 years and a strong educational background participated. Among them 57.5% were males, and 52.5% hailed from urban areas. In contrast, Sebastian et al. (2021) evaluated a much broader, more experienced cohort of 323 healthcare professionals and 271 parents from active clinical settings[12]. Similarly, Thielmann et al. (2020) gathered data from 60 individuals, including 16 physicians and 44 practice assistants[13]. Marotta et al. (2017) also focused on health students, reporting a 68.6% response rate, compared to 85.1% in the present study[14]. Notably, Burch et al. (2019) in their extensive meta-analysis, which synthesized data from 89 studies over 43 years, revealed that age (coefficient = –0.04) and gender (coefficient = –0.03) had negligible impacts on learning gains[11]. These observations suggest that, despite differences in demographics and clinical exposure, experiential educational interventions effectively enhance learning outcomes across diverse groups.

In the present study, most students reported limited exposure to practical immunisation facilities 67.5% stated that their institutes lacked an immunisation session site, and 83.8% reported an absence of a cold chain point. Among those with access, only 22.5% had visited an immunisation site, while all students (7.5%) aware of a cold chain point reported having visited one. Although Burch et al. (2019) did not directly assess facility exposure, their findings demonstrated that experiential learning, particularly via simulations (REM effect size = 0.96 versus 0.70 for non-simulations), can effectively bridge these gaps [11]. Such data emphasize the importance of integrating hands-on, experiential elements into educational programs to address practical skill deficiencies among both students and professionals.

Baseline assessments in the present study revealed low overall correct response rate with particularly low median scores in key domains: Vaccines & AEFI at 0 (IQR: 2–0), Cold Chain at 2 (IQR: 3–1), and Biomedical Waste Management at 1 (IQR: 2–0), resulting in a total median score of 4 (IQR: 6–2.75). Similar deficiencies were reported by Marotta et al. (2017) among health students, while Sebastian et al. (2021) noted that only 32.2% of healthcare professionals correctly managed vaccine transportation, and Thielmann et al. (2020) observed a mean pre-intervention vaccine storage score of 5.6 out of 11 [12-14]. Immediately following the intervention, overall correct responses surged to 77.6% in the present study, with domain-specific gains Vaccines & AEFI increased to a median of 9 (IQR: 10–7) and Cold Chain to 5 (IQR: 5–4), all statistically significant (Friedman test $p < 0.001$). Comparable improvements were reported by Sebastian et al. (2021) and Thielmann et al. (2020), such as a 4.2-point average increase in vaccine storage ($p < 0.001$) and a 27% rise in AEFI reporting ($p = 0.001$)[12,13]. Burch et al. (2019)'s meta-analysis further contextualizes these gains, with effect sizes of $d = 0.43$ (FEM) and $d = 0.70$ (REM) underscoring the substantial impact of experiential learning[11]. At the one-month follow-up, the present study observed some knowledge attrition, the Vaccines & AEFI median score dropped from 9 to 7.5 ($p = 0.011$) and Biomedical Waste Management scores decreased from 4.5 to 4 ($p < 0.001$), while Cold Chain scores remained stable at 5 ($p = 0.386$); overall, the total score declined modestly from 17 to 15 ($p = 0.002$). Although long-term follow-up was not performed by Sebastian et al. (2021), similar minor decay without reinforcement was reported by Thielmann et al. (2020) and Marotta et al. (2017)[12-14]. Moreover, moderator analyses in Burch et al. (2019) indicated that feedback (REM = 0.97 with feedback vs. 0.83 without, $p = 0.07$) and simulation (REM = 0.96 for simulated interventions vs. 0.70 for non-simulated, $p < 0.001$) significantly enhance long-term outcomes[11]. While the immediate improvements validate the effectiveness of the intervention, the slight decline after one month suggests that periodic refresher sessions featuring practical elements are essential.

This study, though insightful, had limitations. It relied on self-reported data through e-questionnaires, which might have introduced response biases. The inclusion criteria limited participants to students who visited the hospital during a specific timeframe and from institutes in and around Kolkata, potentially affecting the generalizability of the findings to the broader population of traditional medicine students. Additionally, a one-month follow-up may not fully capture long-term retention or the enduring impact of the intervention. Future research should address these limitations to enhance the robustness and applicability of the findings.

Conclusion

Combining experiential learning, such as visits to vaccination centres with lectures markedly improves the understanding of immunization and cold chain management among students of traditional medicine. This approach has been shown to enhance knowledge across key areas, including Vaccines and AEFI, Cold Chain and Biomedical Waste Management. While knowledge levels in most domains decreased after a one-month period without reinforcement, understanding of the Cold Chain domain remained strong, indicating better retention in this area.

Recommendations

The study emphasises on the need for refresher trainings at regular intervals to maintain knowledge levels. Italso uncovers the importance of integrating practical exposure into the curriculum to fill the gaps in understanding immunization and cold chain processes. Interdisciplinary collaboration between Traditional Medicine Institutions and Modern Medicine needs to be encouraged for imparting better practical exposure to students across the streams. Future studies forexploring long-term retention strategies and the broader applicability of such interventions across diverse educational contexts should be planned.

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Conflict of interest: None

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