

Assessment of an online certificate course on plasma exchange in Rodenticidal hepatotoxicity

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Abstract

Background: Rodenticide-induced hepatotoxicity is an important cause of acute liver failure in developing countries. Plasma exchange has emerged as a promising supportive therapy, but awareness among healthcare professionals remains limited.

Aim: To assess the effectiveness of an online certificate course of 8-weeks duration in improving the knowledge and self-efficacy regarding plasma exchange in Rodenticidal hepatotoxicity.

Methods: A quasi-experimental pre & post interventional study was conducted among the participants enrolled in an online certificate course of 8-weeks duration delivered using the ECHO platform mode. Pre- and post-test scores were compared across all the modules. Statistical analysis included descriptive statistics and the Wilcoxon signed-rank test.

Results: A total of 16 participants were included. Overall knowledge scores improved significantly (mean difference = 0.9, $p < 0.05$). Modules 1, 3, and 7 showed statistically significant improvement. Self-reported knowledge improved markedly and 97% of participants have expressed very high satisfaction and confidence in applying knowledge.

Conclusion: The course significantly has improved the knowledge and self-efficacy. Online structured training programs are effective in bridging knowledge gaps in specialized clinical domains.

Keywords: Key Words: Plasma Exchange; Rodenticide Poisoning; Therapeutic Intervention; Clinical Outcomes; Critical Care Medicine

1. Introduction

Rodenticide poisoning remains a significant public health concern, particularly in low- and middle-income countries due to easy availability and high toxicity of these compounds ^{1,2}. Many rodenticides, including phosphides and anticoagulants, can cause severe hepatotoxicity leading to acute liver failure ^{3,4}. Acute liver failure is associated with high morbidity and mortality, requiring timely and advanced management strategies ^{5,6}.

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Plasma exchange (plasmapheresis) has emerged as an important supportive therapy in acute liver failure. It works by removing the circulating toxins, inflammatory mediators, and the metabolic by-products, thereby improving patients outcomes ^{7,8}. Evidence suggests that high-volume plasma exchange improves the survival rate in acute liver failure ⁹.

Despite its clinical importance, awareness and practical knowledge of the plasma exchange among healthcare professionals remain limited, particularly in resource-constrained settings.

The Extension for Community Healthcare Outcomes (ECHO) model has been widely used to enhance the knowledge and capacity among healthcare providers through virtual learning platforms ^{10,11}. Studies have shown that ECHO-based programs improve clinical knowledge, confidence, and patient care outcomes apart from convenience and time saving ¹².

This study evaluates the effectiveness of an online certificate course of 8-weeks duration in improving the knowledge and self-efficacy regarding plasma exchange for rodenticidal hepatotoxicity.

Aim

To assess the effectiveness of an online certificate course of 8 weeks duration in improving the knowledge of plasma exchange in rodenticidal hepatotoxicity.

Objectives

- To assess the overall knowledge improvement after undergoing the course
- Analyzing the effectiveness of each individual module by comparing pre- and post-test scores.
- To measure the participants' satisfaction and the perceptions of the course.
- To assess the self-reported knowledge levels before and after the intervention and assess the self-efficacy in applying the acquired knowledge in clinical practice.

2. Methodology

This study employed a quasi-experimental pre & post interventional design to assess the effectiveness of an online certificate course of 8-weeks duration on plasma exchange in rodenticidal hepatotoxicity. The study was conducted as part of a structured online training program organised by the Tamil Nadu Dr M.G.R. Medical University, utilising the Extension for Community Healthcare Outcomes (Project ECHO) model, which facilitates the knowledge dissemination through virtual & interactive learning.

The study participants include the healthcare professionals who have voluntarily enrolled themselves in the online certificate course. A total of 16 participants attended all the sessions and 16 post-session survey responses were analysed. The course comprised of eight modules (Table 1,) delivered over eight weeks, each focusing on different aspects of plasma exchange and its application in managing rodenticidal hepatotoxicity.

Table 1 Details of Modules

Online Module	Topic
Module - 01	Rodenticide- Extent of problem
	Need for a dedicated Team to manage patients
Module - 02	Assessing the severity of liver injury in rodenticide poisoning, How and What to monitor, When to refer for PLEX
	Introduction to PLEX: Technical Aspects of delivering PLEX - I. Types of PLEX, Replacement fluid, Machine Handling, Troubleshooting
Module - 03	Prescription of PLEX – Reporting format. Dose, Flow rate, Individualizing the prescription
	Technical Aspects of Delivering PLEX- II.
	Anticoagulation, Calcium replacement

Module - 04	VWF levels: a biomarker of interest in rodenticidal hepatotoxicity	
	Histology: is there a traffic jam in liver sinusoids in ALF?	
	Electron microscopy of rodenticidal hepatotoxicity	
Module - 05	Patient with Rodenticidal hepatotoxicity, <i>not on inotropes</i> is optimal candidate for PLEX.	
	PLEX to treat patients of HAV ALF <i>not on inotropes</i>	
	Avoiding sepsis in patients of rodenticidal hepatotoxicity on PLEX	
Module - 06	How does PLEX work in liver failure?	
	Efficacy of PLEX in liver failure caused by varied aetiologies and in rodenticidal hepatotoxicity	
Module - 07	Static and Dynamic scores	to predict survival in patients of rodenticidal hepatotoxicity
	AI	
Module - 08	Cost-effectiveness of PLEX to treat rodenticide (Yellow Phosphorus) poisoning in Tamil Nadu	
Contact sessions for Hands on Training		

Data were collected using a combination of pre-test and post-test assessments administered for each module, along with post-session surveys. The pre- and post-tests were designed to evaluate participants' knowledge before and after each session, enabling module-wise comparison. The post-session survey collected the information on participants satisfaction, self-reported knowledge levels, and self-efficacy in applying the acquired knowledge. Satisfaction level was assessed based on the likelihood of recommending the course to others, while self-efficacy was measured by participants' confidence in applying the learned concepts in day-to-day clinical practice.

Quantitative data were analysed using descriptive and inferential statistical methods. Descriptive statistics, including mean, median, frequencies, and percentages were used to summarise the data. Normality of the data distribution was assessed using graphical methods such as Q-Q plots. Given the distributional characteristics and the relatively small sample size, the Wilcoxon signed-rank test was used to compare pre- and post-test scores within each module. For modules where normality assumptions were not met or the sample size was insufficient, nonparametric methods were preferred over parametric tests to ensure robust results. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations were maintained throughout the study. Participation in the course and evaluation was purely voluntary and data were analysed anonymously to ensure confidentiality. No personal identifying information was collected, and the study adhered to standard ethical guidelines for educational research.

3. Results

The organization, the Tamil Nadu Dr M.G.R Medical University, Tamil Nadu, conducted a total of 8 modules under the program namely "Online Certificate Course on Plasma Exchange in Rodenticidal Hepatotoxicity" - ECHO, engaging 16 unique participants. The mean (Sd) age of the participants was 36.25.0(6.01). Among them 11 were Women and 5 were Men

3.1. Satisfaction

A very high proportion (97%) of participants reported being "Likely" or "Very Likely" to recommend the program indicating strong satisfaction. 3% were neutral, with no negative responses recorded (Figure 1).

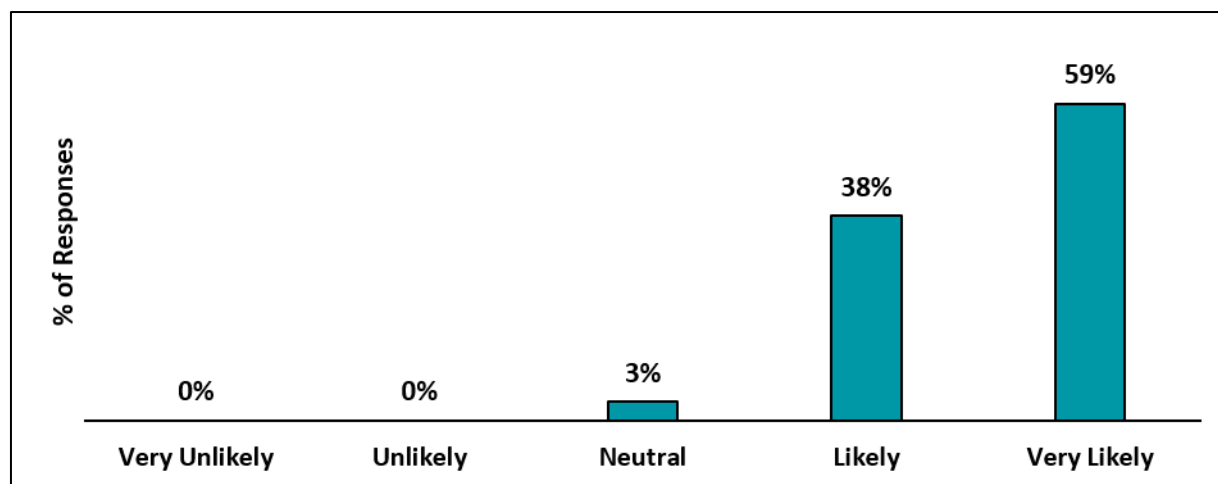


Figure 1 Likely to recommend, [Instrument: Post-session survey (n=16)]

3.2. Knowledge

There is a significant improvement in the acquired knowledge levels after the ECHO online sessions, with the proportion of participants reporting as “Very knowledgeable” increasing to 66% and “Extremely knowledgeable” to 10%. The proportion of participants reporting as lower knowledge categories declined substantially, indicating an overall improvement in acquiring knowledge (Figure 2).

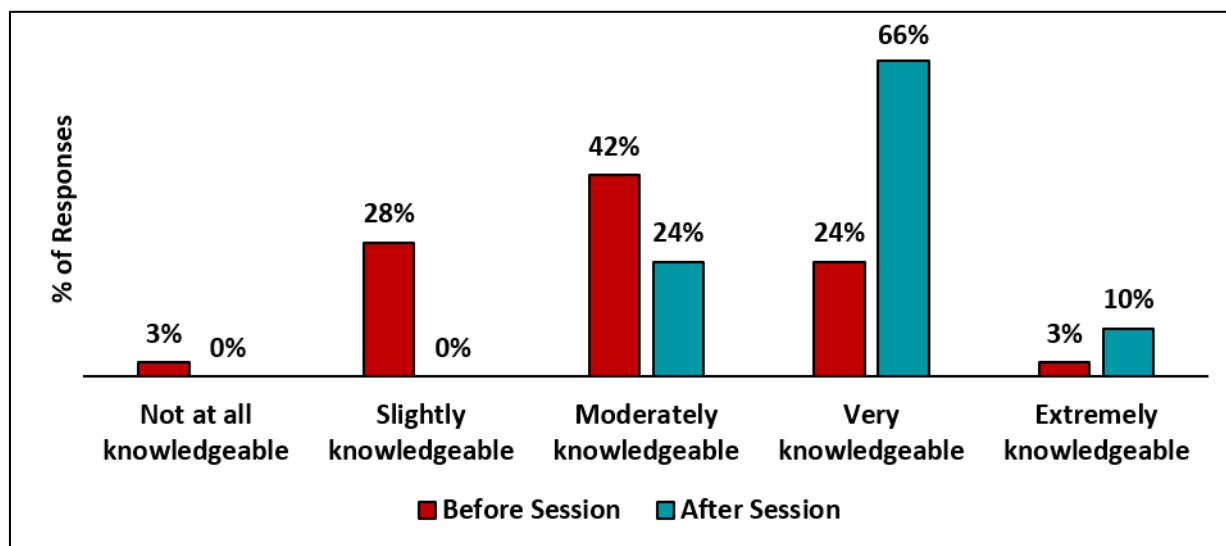


Figure 2 Knowledge Change Before and After the Sessions (Self-reported), [Instrument: Post-session survey (n=16)]

3.3. Self-efficacy

Self-efficacy levels were very high, with 97% of the participants reporting “Probably yes” or “Definitely yes”. 3% expressed a lower confidence, with no negative responses observed, indicating strong improvement in the participants confidence to apply learning (Figure 3).

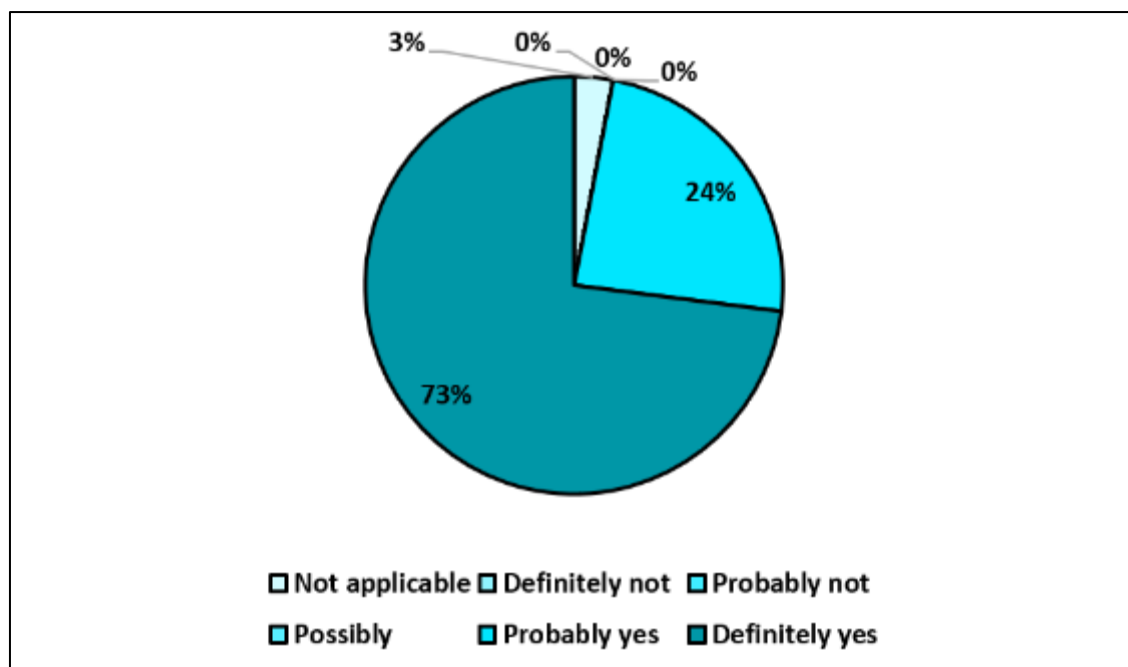


Figure 3 Intention to Apply Knowledge (Self-efficacy), [Instrument: Post-session survey (n=16)]

A comprehensive analysis of the training program based on the comparisons of pre- and post-training scores across the sessions was conducted. Normality assessments were supported through Shapiro wilks test. Statistical significance was assessed using session-specific tests selected based on distributional characteristics.

The Wilcoxon signed-rank test was applied to all modules since Shapiro wilks test showed that normality assumptions were not met. For Modules 1 to 7, the normality assumption was considered as unreliable due to small sample size, therefore, the Wilcoxon signed-rank test was used instead of the paired t-test (Table 1).

Table 2 Analysis of the Pre & Post assessments

Modules	Pre-test		Post-test		Difference		P-Value	Interpretation
	Mean	Median	Mean	Median	Mean Difference	Median Difference		
Module - 01	5.2	5.0	8.4	9.0	3.2	4.0	0.001	Significant
Module - 02	7.3	8.0	8.0	8.0	0.7	0.0	0.071	Not Significant
Module - 03	3.5	4.0	4.1	4.0	0.6	0.1	0.015	Significant
Module - 04	4.2	4.0	4.8	5.0	0.6	1.0	0.105	Not Significant
Module - 05	2.7	3.0	2.9	3.0	0.2	0.0	0.149	Not Significant
Module - 06	2.6	3.0	2.8	3.0	0.2	0.0	0.424	Not Significant
Module - 07	1.6	2.0	2.6	3.0	1.0	1.0	0.033	Significant
Module - 08	1.8	2.0	2.2	3.0	0.4	1.0	0.281	Not Significant
Overall	3.7	3.0	4.6	4.0	0.9	1.0	<0.05	Significant

Although the overall score comparison has yielded the statistical significance (p-value < 0.05), the pre-post knowledge score differences were significant in only three sessions (modules 1, 3, and 7). Consequently, the robustness and generalizability of the findings are constrained and the results should be interpreted with caution. However, the small

sample sizes resulting from low response rates across several training sessions substantially limit the statistical power and the stability of estimates

4. Discussion

The present study aimed to evaluate the effectiveness of an online certificate course of 8-weeks duration in improving the knowledge and self-efficacy regarding plasma exchange for rodenticidal hepatotoxicity. The findings demonstrate a statistically significant improvement in overall knowledge scores following the intervention, indicating that structured online educational programs can effectively enhance the clinical understanding in specialized areas¹³.

Rodenticide poisoning continues to be a major public health issue, particularly in developing countries, due to the widespread availability and toxicity of these compounds ^{1,2}. Many rodenticides are known to cause severe hepatotoxicity, which may progress to acute liver failure, a condition associated with high mortality ^{4,5}. Plasma exchange has been increasingly recognized as an important supportive therapy in such conditions, as it facilitates the removal of circulating toxins and inflammatory mediators ^{7,8}. Evidence from the previous studies suggests that high-volume plasma exchange significantly improves survival outcomes in patients with acute liver failure ^{9,17,19}. Therefore, improving awareness and knowledge of this therapeutic modality among healthcare professionals is of considerable clinical importance²⁰.

In this study, the overall improvement in knowledge scores was statistically significant ($p < 0.05$), suggesting that the educational intervention was effective. However, only three modules (Modules 1, 3, and 7) demonstrated statistically significant improvement individually. This variation in module-wise outcomes may be attributed to differences in baseline knowledge, variability in participant engagement, and the complexity of the content delivered. Modules that showed significant improvement may have included more clinically relevant or practically oriented topics, making them easier to comprehend and retain.

The findings of this study are consistent with existing literature on the effectiveness of online learning models, particularly the Extension for Community Healthcare Outcomes (ECHO) model. Previous studies have demonstrated that ECHO-based programs significantly improve the knowledge, confidence, and clinical practice among healthcare providers ^{10–12}. These programs are especially beneficial in resource-limited settings, where access to specialized training is often restricted. The current study reinforces the role of such digital platforms in bridging knowledge gaps in emerging and specialized areas, such as plasma exchange in toxicology¹⁶.

Another important finding of the study was the substantial improvement in participants' self-reported knowledge and self-efficacy. The proportion of participants reporting higher levels of knowledge increased considerably after the intervention, and 97% expressed their confidence in applying the knowledge gained. This is a critical outcome, as self-efficacy is strongly associated with the successful translation of knowledge into clinical practice. According to adult learning theory, confidence and perceived competence are essential indicators of effective learning ¹⁴. The high levels of satisfaction and confidence observed in this study suggest that the course was well-structured and relevant to the participants' professional needs¹⁵.

Despite these positive findings, the study has certain limitations. The absence of data regarding professional designation and experience limits the ability to perform subgroup analyses and understand variations in learning outcomes across different participant groups. Additionally, the relatively small sample size reduces the study's statistical power and may have contributed to the lack of significant findings across several modules. The reliance on self-reported measures for knowledge and confidence also introduces the possibility of response bias.

Nevertheless, the study has an important implication for medical education and clinical practice. It highlights the potential of structured online certificate programs in improving the knowledge and capacity building among healthcare professionals, particularly in specialized areas such as Toxicology and Hepatology. The ECHO model provides an effective framework for delivering such online training programs at scale¹⁸.

Recommendation

Future research should focus on including larger and more diverse participant populations, incorporating demographic variables and evaluating long-term knowledge retention and clinical outcomes. Additionally, integrating objective performance-based assessments could further strengthen the evaluation of educational interventions.

5. Conclusion

The online certificate course of 8-weeks duration has significantly improved the overall knowledge and self-efficacy regarding plasma exchange for rodenticidal hepatotoxicity. These findings support the growing role of digital learning platforms in enhancing clinical education and addressing the knowledge gaps in specialized medical fields.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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