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ORIGINAL RESEARCH

An in-Depth Examination of the Characteristics of Pre-Hospital Point-of-Care Ultrasound Training Among Emergency Medicine Residents in Laos as Part of an Overseas Elective Rotation

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Introduction: Point of Care Ultrasound (POCUS) training has been offering invaluable guidance in the diagnostic process and treatment strategies, particularly in resource-limited settings. The purpose of this study was to determine participant satisfaction with the structure and scope of POCUS training in overseas elective rotation.

Material and Methods: A retrospective observational analytical study was undertaken. The study focused on EM residents from Laos who participated in the international elective rotation at the Khon Kaen University during the academic years 2020–2021 and 2022–2023. The research involved an exploration of training data related to this course, encompassing participant characteristics, the structure and scope of POCUS training, the training assessments, and post completion surveys of participants.

Results: The study involved 24 participants. The course was characterized by its status as an international elective program prehospital POCUS training for post graduate year 3 students. The duration of the rotation ranged from 2 to 4 weeks. Interestingly, in the academic year 2022–2023, the duration of POCUS training was notably extended to 8 hours, accounting for 4.76% of the total time. The training encompassed peer-to-peer didactic lectures, bedside teaching, and observational case studies at the Emergency Department (ED). The results of our survey, boasting a 100% response rate, indicated participants' contentment with the academic performance, the abundance of learning resources, and the knowledge gained from this rotation that would aid their future careers. The overall satisfaction with this course was highly rated, falling into the "satisfy" and "highly satisfy" categories. However, certain challenges were reported, including feelings of isolation due to the distance from relatives, concerns related to interpersonal relationships with colleagues, and a sense of being isolated.

Conclusion: The participants were highly satisfied to the structure and scope of this course. The overseas elective rotation significantly enhanced the knowledge of Laos EM residents' in POCUS and underscored the crucial importance of this course in EM training.

Keywords: ultrasonography, emergency medicine, emergency medical services, education, developing countries

Introduction

With the increasing recognition and affordability of the positive aspects of bedside ultrasound, the utilization of point-of-care ultrasound (POCUS) is experiencing rapid growth across the medical field. Particularly in emergency medicine (EM), POCUS is employed to aid in the assessment and management of various clinical conditions.[1–4] Its implementation has demonstrated a beneficial influence on clinical decision-making, leading to reduced emergency department (ED) and hospital stays.[5–8]

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However, challenges such as inadequate user training, difficulties in maintaining ultrasound proficiency, limitations in equipment availability for optimal imaging, and constraints on quality control impede broader application. These challenges are particularly pronounced in healthcare settings characterized by limited resources and underserved populations.[9,10]

In 2019, a collaborative effort was initiated among the University of Health Science in Laos, the University of Tsukuba in Japan, and the Faculty of Medicine at Khon Kaen University in Thailand. The objective of this collaboration was to design an educational program for emergency medicine physicians in Laos, classified as a lower middle-income country. This initiative followed the principles of the SAFER project (Project for Stopping the Accident Fatality Rise by EMS Development and Road Safety) supported by The Japan International Cooperation Agency (JICA). The overarching aim of this partnership was to cultivate the field of emergency medicine and emergency medical services (EMS) within Laos, an area still in its developmental stages. This program was crafted to equip medical professionals with the knowledge and skills required for effective emergency patient care, both within prehospital and hospital settings.

Since the year 2020, the Department of Emergency Medicine at the Faculty of Medicine, Khon Kaen University, has been orchestrating an international elective rotation tailored for training medical practitioners from Laos in the domain of EM. Of particular focus within this curriculum is a dedicated ultrasound learning segment, specifically aimed at enhancing participants' understanding of ultrasound applications within EMS. This elective program has offered participants both theoretical insights and practical training in the prehospital ultrasound.

The prehospital POCUS training was one of the training components of the international elective rotation. This rotation's POCUS training was adapted from our institution's POCUS training program for first-year emergency medicine residents, which included 1) peer-to-peer didactic lecture focused on POCUS knowledge applicable to use in the EMS setting, such as cardiac, lung, inferior vena cava ultrasound, and POCUS protocols including as EFAST (extended focus assessment of sonography in trauma) and CASA (Cardiac Arrest Sonographic Assessment) and 2) peer-to-peer bedside ultrasound learning with actual patients at emergent care. Our instructor of this course was the emergency ultrasound expert who was certified with the World Interactive Network Focused On Critical UltraSound (WINFOCUS) instructor course and had one year of emergency ultrasound fellowship training.

The international elective program stands as a forefront initiative in international emergency medicine training within Thailand, particularly in the sphere of POCUS knowledge. Crafting an effective POCUS educational program demands a comprehensive strategy, encompassing didactic instruction, hands-on training with standardized patients, and utilization of simulations or task trainers.[11,12] Given the scarcity of research within this domain, our decision was made to delve into the landscape of prehospital POCUS training within international elective rotations tailored for healthcare professionals from Laos. In this endeavor, we provide an overview of these rotations while accentuating pivotal components necessary for fostering a sustainable and high-value educational experience. Our objective is to share our insights with educators who contemplate the implementation of a dedicated POCUS training curriculum within developing countries.

Materials and Methods

This retrospective observational analytical study was conducted between April 2020 and June 2023 at the Department of emergency medicine, Faculty of Medicine, Khon Kaen University. Situated in northeastern Thailand, this faculty boasts one of the most advanced tertiary healthcare services and a cadre of highly skilled professionals in the region. As a prominent medical teaching institution, it plays a pivotal role in shaping the medical landscape of the area.

The primary objective of this study was to investigate how satisfied participants were with the structure and scope of POCUS training in overseas elective rotations.

Data Collection

The study enrolled Laos EM residents who participated in the international elective rotation at the Department of emergency medicine, Khon Kaen University during the academic years 2020–2021 and 2022–2023.

The dataset from our investigation encompassed various aspects, including participants demographics, information about the structure and scope of POCUS training, POCUS workflow, POCUS resources and requirements for each rotation, and POCUS knowledge pretest/posttest assessments. Learner assessment consisted of a set of 20 multiple choice

questions about POCUS knowledge. After completing the rotation, the survey was electronically distributed to all individuals. The survey required 10-question with five-level of satisfaction scale including very dissatisfied, dissatisfied, neutral, satisfied and very satisfied. Participants were informed that their information would be collected anonymously and solely for research purposes.

The pretest/posttest scores and surveys were gathered and reviewed at the end of the rotation. Two independent investigators used Microsoft Excel (Microsoft Windows 10, Khon Kaen University license) to compile data into a research dataset. The data extracted from the survey did not include the identification of custom data with the survey number and survey collection date.

Sample Size

In our study, we employed the Estimated Sample Size for Two Dependent Means formula, considering a two-tailed test. The value of P was determined based on data extracted from a previously published study.[13] To ensure statistical significance, a minimum sample size of eight was deemed appropriate for this particular investigation.

Statistical Analysis

There were two types of variables: categorical variables and ordinal variables. Frequency and percentage distribution were employed to recapitulate categorical variables. Mean and standard deviation were implemented to summarize ordinal variables. Bivariate analyses have been conducted to identify associations or differences between groups of respondents. Cross tables and Pearson's chi-square test assessed the relationship between categorical variables. Paired t-tests were used to determine whether the means of two paired measurements differed pre-test and post-test scores. P-values of 0.05 were considered significant. The data was input into Microsoft Excel and analyzed using IBM SPSS for Windows version 28.0, which is licensed to Khon Kaen University (SPSS Inc., Chicago, IL, USA).

Results

The international elective program was divided into two distinct periods, covering the academic years 2020–2021 and 2022–2023, respectively. For the current study, we recruited a total of 24 Lao emergency medicine (EM) residents, all of whom successfully completed both the examination and the electronic survey. It's important to note that all participants were at the postgraduate year 3 (PGY-3). The average age of these participants was approximately 34 ± 4.30 years for the 2020–2021 academic year and 33 ± 3.60 years for the 2022–2023 academic year.

In terms of the program's duration, the rotation length during the 2022–2023 academic year was extended to 4 weeks, compared to 2 weeks in the 2020–2021 academic year. Similarly, the duration of POCUS training or blocks during the 2022–2023 academic year increased to 8 hours, while it was 6 hours in the 2020–2021 academic year. Furthermore, the number of ultrasound machines available for training was higher during the 2022–2023 academic year.

The number of POCUS cases that learners attended, alongside attending staff or residents, was also notably higher during the 2022–2023 academic year. This aligns with the observation that the post-training scores were higher during the same academic year, as depicted in Table 1.

All participants in the international elective program were surveyed, achieving a 100% response rate. Overall, all EM residents expressed either delight or high satisfaction with the POCUS learning. The level of satisfaction with the number of learners per block rotation was commensurate with the number of learners who rated themselves as satisfied or highly satisfied. However, a portion of learners (18.75%) expressed dissatisfaction, particularly in the aspect of the rotation length during the 2022–2023 academic year. The majority of learners across both academic years conveyed high levels of satisfaction, but there were some exceptions. For instance, in the 2020–2021 academic year, 25% of learners rated their satisfaction level as dissatisfied. Notably, most participants reported high levels of satisfaction in terms of academic performance, as demonstrated in Table 2. Furthermore, in response to an open-ended question, learners cited several obstacles to their training, including issues related to the distance from relatives, interpersonal relationships with colleagues, and feelings of isolation.

Table 1 Characteristics of Learners and POCUS Teaching in the International Elective Program

Characteristics	Academic Year 2020–2021	Academic Year 2022–2023	*P*-value
Total number of learners	8	16	<0.001
Gender, Male (%)	3 (37.50)	10 (62.50)	<0.001
Age, mean (SD), years	34 (4.30)	33 (3.60)	0.560
Post-graduate year of residency, frequency (%)			
PGY-3	8 (100)	16 (100)	0.952
Number of learners/blocks	2	2–4	0.731
Current place of work			
University of health and science	3 (37.50)	8 (50)	0.031
Setthathirath hospital	1 (12.50)	3 (18.75)	0.042
Mahosot hospital	2 (25)	2 (12.50)	0.031
Mittaphab hospital	2 (25)	3 (18.75)	0.042
Length of rotation (weeks)	4	2	<0.001
Length of POCUS training/blocks, hours (%)	6 (1.60)	8 (4.76)	0.005
Duration of POCUS learning activities, hours (%)			
Didactic lecture	3 (50)	4 (50)	0.964
Bedside teaching	3 (50)	4 (50)	0.964
Number of ultrasound machines at department	4	5	0.006
Type of ultrasound machine			
Hand-held device	1	2	<0.001
Cart-based system	3	3	0.642
Estimated number of POCUS cases that learner attended with attending staff or residents.	9–12	16–20	0.023
Assessment of Learners			
Pre-training scores, mean (SD)	11.13 (1.27)	10.51 (1.32)	0.463
Post-training scores, mean (SD)	17.75 (1.30)	18.20 (1.41)	0.425

Abbreviations: SD, Standard deviation; PGY, Post-graduate year of residency; POCUS, Point of Care Ultrasound.

Discussion

The primary aim of this study was to assess the satisfy of the participants to this course. Since the participants were emergency medicine residents from Laos who work in both the ambulance and the emergency department in their country, the prehospital POCUS knowledge will improve diagnostic accuracy, facilitate rapid treatment decisions, and assist their future careers.

Our study assess the current state of POCUS training for prehospital care among healthcare professionals from Laos who participated in international elective rotations. Our investigation delved into the program's structure and underscored key elements essential for cultivating a sustainable and valuable educational experience.

Table 2 POCUS Learning Feedback

Survey Questions, n (%)	Academic Year 2020–2021 (N=8)	Academic Year 2022–2023 (N=16)	*P*-value
Number of learners/blocks			
Satisfied	2 (25)	4 (25)	0.925
Very satisfied	6 (75)	12 (75)	0.925
Length of rotation (weeks)			
Very dissatisfied, Dissatisfied	0 (0)	3 (18.75)	0.031
Neutral	2 (25)	2 (12.50)	0.042
Satisfied	2 (25)	8 (50)	<0.001
Very satisfied	4 (50)	3 (18.75)	<0.001
Length of POCUS training/blocks			
Very dissatisfied, Dissatisfied, or Neutral	2 (25)	0 (0)	<0.001
Neutral	0 (0)	1 (6.25)	0.623
Satisfied	2 (25)	5 (31.25)	0.725
Very satisfied	4 (50)	10 (62.50)	0.741
Peer-to-peer didactic teaching experience			
Satisfied	0 (0)	2 (12.50)	0.039
Very satisfied	8 (100)	14 (87.50)	0.043
Peer-to-peer bedside teaching experience			
Satisfied	2 (25)	1 (6.25)	0.020
Very satisfied	6 (75)	15 (93.75)	0.012
Observation cases at emergency department			
Satisfied	0 (0)	2 (12.50)	0.039
Very satisfied	8 (100)	14 (87.50)	0.043
Number and type of ultrasound machines at department			
Satisfied	2 (25)	1 (6.25)	0.020
Very satisfied	6 (75)	15 (93.75)	0.012
Number of POCUS cases that learners attended with attending staff or residents.			
Satisfied	0 (0)	4 (25)	<0.001
Very satisfied	8 (100)	12 (75)	0.015
POCUS skills learned on this rotation will help my specialty			
Satisfied	0 (0)	2 (12.50)	0.048
Very satisfied	8 (100)	14 (87.50)	0.015
Overall satisfaction with the POCUS learning			
Satisfied	2 (25)	6 (37.50)	0.041
Very satisfied	6 (75)	10 (62.50)	0.043

The participants in our study were exclusively at the PGY-3 level, representing the final year of emergency medicine training in Laos. This setting differs from other international elective programs and global health trainings, which usually involve trainees at various levels.[12,14–16] Despite this, the mean age of participants remained consistent across both academic years.

Regarding the program's structure, the rotation period was shorter in the 2022–2023 academic year due to a higher number of participants. The JICA, responsible for funding the participants' living expenses, divided the rotation accordingly. The duration of our rotation aligned with other studies, typically ranging from 2 to 4 weeks.[12,16,17] Notably, the length of POCUS training in the 2022–2023 academic year was extended based on feedback from prior participants who exhibited heightened interest in POCUS.

This rotation's POCUS training was modified from our institution's program. In terms of standard prehospital POCUS training, which should be produced for 3-year prehospital professionals, our program aimed to deliver essential POCUS knowledge to our participants for using POCUS for handling prehospital and emergency patients in this course.

Our POCUS training program encompassed peer-to-peer didactic lectures and bedside teaching, resembling the structure of many POCUS training programs.[18–20] Participants were assigned to observe in the emergency department, enabling hands-on experience with actual emergency patients, considering foreign doctors cannot practice as physicians due to regulations. Diagnostic exams conducted by participants align with typical POCUS programs, involving an average of 10–20 cases per block.[12] The assessment method utilized multiple-choice questions to gauge changes in pretraining and post-training knowledge scores, akin to previous research.[12,18,19] There are different ways to assess POCUS skills.[21–24] However, our application solely employed multiple-choice questions. This is due to the time constraints and the many responsibilities associated with this course.

In terms of program evaluation, participants expressed satisfaction with the number of learners per block, typically ranging from 2 to 4 individuals, which enhances the educational experience.[25] However, some participants were dissatisfied with the rotation's duration. Consistent with reported obstacles, participants cited challenges related to being distanced from relatives and feelings of isolation. This outcome would result from some participants taking this course during the Laos Songkran traditional festival, which is similar to a national holiday during which Laos people always stay with their families. This would dissatisfy the participants. To enhance the international elective, the balance between acclimatization to the hosting site and organizational restrictions should be addressed. The program's peer-to-peer academic approach was positively received, aligning with the widely accepted use of peer and near-peer tutoring for healthcare curricula.[26–28]

In terms of learning resources, participants reported contentment with the availability of an adequate number of ultrasound machines and cases. POCUS training is difficult, time-consuming, and demands a significant amount of resources.[29,30] Acknowledging the resource-intensive nature of POCUS training, our faculty ensured learners had access to various machines and modern technologies, including handheld devices. Our ultrasound machines provided the essential ultrasound transducer included linear, phased array, and curvilinear transducers. The ultrasound machines used at our emergency department mainly were three cabinet ultrasound and hand-held ultrasound device. The function of ultrasound machine included B-mode, M-mode, colored Doppler mode, and power Doppler mode.

Areas for improvement include the lack of program access to hospital-based archives for systematic ultrasound image evaluation. Furthermore, the program's uniqueness, targeting final year emergency medicine residents and fostering international collaboration, should be capitalized on. POCUS abilities should be evaluated through diverse methods, and the program should consider expanding to include hometown visits to assess long-term learning.

The study's limitations encompass its retrospective nature and reliance on self-administered questionnaires, potentially introducing self-reporting bias. However, our study main to explore how satisfy of the participants to this course. Thus, we used the electronic self-reporting survey which performed after finished the course to reduce recall bias and make the participant to confident to report themselves. This study was not designed to assess participants' POCUS competency, including image acquisition, image interpretation, and clinical decision-making ability; instead, we used multiple-choice questions to assess POCUS knowledge, which may not guarantee that participants gained adequate POCUS skills from this course.

Conclusion

This study delves into the highly satisfy level of participants to our international medical elective program conducted under the SAFER project which offered a unique insight into the Thai – Laos training experience. Our investigation sheds light on both the shared characteristics and the challenges encountered throughout the program. Central to our efforts was the provision of Point-of-Care Ultrasound (POCUS) training, which allowed participants to engage with a diverse range of patients they may encounter in their future medical careers.

Notably, the success of the program hinged on the active involvement of preceptors who provided didactic teaching, hands-on guidance, and assessment review. Additionally, we found that the establishment of a hospital-based archiving system was imperative for systematic image review, significantly enhancing the effectiveness of POCUS training. As we look ahead, further research is warranted to explore the impact of these rotations on learners' proficiency and the integration of POCUS into clinical practice, including its long-term implications.

Abbreviations

POCUS, point of care ultrasound; EM, emergency medicine; ED, emergency department; SAFER project, Project for Stopping the Accident Fatality Rise by EMS Development and Road Safety; JICA, The Japan International Cooperation Agency; EMS, emergency medical service; PGY, postgraduate year.

Data Sharing Statement

The corresponding author will disclose the data sets utilized and/or analyzed during the current work upon reasonable request.

Ethics Approval and Informed Consent

The Helsinki Declaration's principles and Good Clinical Practice recommendations were implemented in this study. The Khon Kaen University Ethics Committee approved the study for Human Research. To maintain anonymity, all identifiers from the data gathered were removed. (HE661297).

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Author Contributions

All authors have significantly contributed to the reported work, spanning conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas. They have participated in drafting, revising, and critically reviewing the article, granting their final approval of the version to be published. Agreement has been reached on the journal to which the article has been submitted, and all authors collectively assume for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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