

# Pediatric Simulation Training for Emergency Pre-Hospital Providers in Hawai'i: An Inter-Professional Curriculum Collaboration and Update

Jannet J. Lee-Jayaram MD; Mark Kunimune EMT-P; Kristine M. Hara BAS, RRT; Leageay C. Barnes MS, NRP; and Benjamin W. Berg MD

## Abstract

*Experience with pediatric transport and pediatric-specific training for paramedic students and practicing paramedics is lacking nationally. Kapi'olani Community College (KCC) conducts the only paramedic training program in the state and has recently expanded its pediatric training section. KCC and the John A. Burns School of Medicine (JABSOM) collaborated on a simulation-based pediatric pre-hospital provider training course titled PediSTEPPs-H (Pediatric Simulation Training for Emergency Pre-hospital Providers in Hawai'i), which was developed and piloted in 2019, to supplement the students' didactic and clinical experiences. The program was developed using Kern's 6-step approach to curriculum development in medical education. The PediSTEPPs-H pilot course was co-facilitated by faculty from both campuses and enrolled 12 students in the first cohort. Program evaluation demonstrated high student satisfaction and included feedback regarding curriculum elements for further refinement. The PediSTEPPs-H pilot program evaluation provided direction that the course be offered annually for all KCC paramedic students and as continuing professional development program for practicing paramedics in Hawai'i.*

## Keywords

*Simulation, Inter-professional education, Pediatrics, Pre-hospital providers, Paramedics, Emergency medical services*

## Abbreviations

CE = Continuing education  
EMS = Emergency medical services  
JABSOM = John A Burns School of Medicine  
KCC = Kapi'olani Community College  
MICT = Mobile Intensive Care Technician  
PALS = Pediatric Advanced Life Support  
KMCWC = Kapi'olani Medical Center for Women and Children  
NREMT = National Registry of Emergency Medical Technicians

## Introduction

The Kapi'olani Community College (KCC) Mobile Intensive Care Technician (MICT) or Paramedic Program was started in 1988. Prior to that, a state agency at The Queens Hospital conducted the certification program. Currently, there are 3 teaching sites for the KCC MICT Program – O'ahu, Maui, and Hawai'i Island. Students are employed prior to joining the program and continue their employment with their respective agencies upon graduation. These agencies include the City and County of Honolulu, Hawai'i County Fire Department and a private ambulance service. Each agency follows Hawai'i state

standing orders to guide actions and define the paramedic scope of practice. These orders are age- and condition-specific and include drug dosages, indications for procedures, and guidance on communication with medical command. The KCC MICT Program consists of 16 courses, 2 of which focus on pediatrics and other special populations. The pediatric curriculum didactic portion includes the American Heart Association Pediatric Advanced Life Support (PALS) and the Emergency Pediatric Care courses. The recently expanded clinical component includes rotations at the Kapi'olani Medical Center for Women and Children (KMCWC) in the emergency department, pediatric intensive care unit, the pediatric outpatient clinic, and operating room. During clinical experiences, the KCC MICT students learn alongside other trainees, including residents, medical, and nursing students. Paramedic trainees report being less directly involved during their training in the care of pediatric patients, even during pediatric-specific rotations, compared to other clinical training experiences.<sup>1</sup> In these rotations, students perceived that priority for direct patient care, procedures, and decision-making was given to other trainees including nursing, medical students, and residents. KCC MICT students likely face similar barriers at KMCWC, which is a teaching site for the University of Hawai'i at Mānoa Nursing School, John A Burns School of Medicine (JABSOM), and Hawai'i Residency Programs for Pediatrics and Family Medicine.

## Curriculum Development and Program Evaluation

The KCC MICT faculty, while expanding their pediatric curricula, collaborated with the directors of the JABSOM SimTiki Simulation Center, which included a pediatric emergency medicine physician from KMCWC. To apply Kern's 6-step approach to curriculum development for medical education, the first step was problem identification by the KCC MICT faculty when they approached the pediatric emergency medicine physician about improving and expanding pediatric education for the KCC MICT Program.<sup>2</sup>

The second step was performing a curriculum needs assessment, including literature search, local data analysis, and local expert consensus. Nationally, emergency medical services (EMS) responses to pediatric patients most often include traumatic injuries and respiratory complaints; therefore these topics were

included in the course.<sup>3-9</sup> In 2018, in keeping with national data, trauma-related calls made up 27.5% of pediatric transports by the City and County of Honolulu EMS (personal communication with Assistant Chief of Professional Standards City and County of Honolulu EMS Division). Drowning was identified as the trauma topic most relevant to local EMS providers given the unique local conditions of beach environments, large tourist population, and year-round warm weather allowing for swimming pool activities. While EMS providers are in a distinct position to observe and report suspicions for child abuse, a lack of training, resources, and knowledge about child abuse have been identified as barriers to recognition and reporting.<sup>10</sup> A child abuse module was therefore included in the curriculum. Communication challenges between providers, especially at transitions of care and with the child/family, have been identified to be threats to patient safety in the pre-hospital setting; therefore, elements addressing these topics were included.<sup>11</sup> The KCC MICT faculty identified the commonly encountered problem of pediatric seizure and the low frequency, high-risk event of pediatric shock as important topics for the course. Finally, pediatric drug dosing was included, as it is notoriously challenging; practicing EMS providers identify medication errors as a threat to patient safety and medication errors are a frequent root cause of errors in pre-hospital simulations.<sup>11,11-14</sup>

The third step of developing curricular goals and objectives was conducted collaboratively by KCC MICT faculty and the SimTiki directors. The course had the following goals: (1) increased awareness and confidence with pediatric evaluation and assessment, and (2) improved communication and teamwork when dealing with pediatric patients. Objectives identified to support the achievement of the goals included the following learner behaviors: (1) to prioritize assessment and interventions in pediatric emergencies, (2) to develop a broadened differential diagnosis for pediatric chief complaints, (3) to calculate correct drug dosages for pediatric patients, (4) to anticipate and prepare for patient care at the receiving facility, and (5) to verbally communicate with inter-professionals over medical command radio and at handoff.

The fourth step in curriculum development was to select an educational strategy to accomplish the goals and objectives. The KCC MICT faculty and the SimTiki directors elected to design a 1-day simulation-based educational course, with interactive debriefing and short lecture to supplement the didactic and clinical portions of the existing pediatric curriculum. Simulation is a well-matched educational strategy for pre-hospital medicine topics and has been used to identify specific cognitive, knowledge, and psychomotor skill deficiencies in practicing paramedics.<sup>15</sup> Cognitive, procedural, systems, and teamwork errors have been identified using simulation-based pediatric training with debriefing, yielding opportunity for enhanced education and training outcomes.<sup>12,13</sup> Realistic, simulation-based training that is locally-provided and primarily hands-on has been identified by practicing pre-hospital providers as the

most effective method of continuity training.<sup>11,16</sup> The structure and content of our course were based on a previously published simulation course for pre-hospital providers from Texas Children's Hospital titled *PediSTEPPs Pediatric Simulation Training for Emergency Pre-hospital Providers*.<sup>17</sup> Interactive lecture with image identification and discussion were selected as the most efficient educational strategy for the child abuse content of our course. Four simulations were developed to address the objectives, using the medical problems of asthma, seizure, drowning, and septic shock. Participants were paired in 2-person teams to manage simulation cases, mimicking real-world pre-hospital conditions; equipment, medication, and supplies were limited to that which are routinely available in EMS packs and ambulances. Participants completed a pre-training quiz consisting of 12 multiple-choice questions that were based on Hawai'i State Standing Orders for pediatric patients and on published PALS guidelines. This served to establish the participants' perceptions of relevance and need for the training.

The fifth step of curricular implementation took place in April of 2019, with a cohort of 12 KCC MICT students. See Figure 1 for the course outline. All participants were simultaneously enrolled in the KCC MICT Program and employed as emergency medical technicians (EMT); 11 by the City and County of Honolulu EMS and 1 by a private ambulance service. At the time of the course, they had completed the didactic and clinical portions of the program's standard pediatric rotation. Participants were instructed to review and reference the Hawai'i State Standing Orders for pediatric patients before and during the course. All participants completed the pre-course quiz; the average score was 66%. In a 3-hour morning session, learners sequentially completed 2 simulation exercises, each followed by a debriefing and engaged in the child abuse lecture and discussion. In a 3-hour afternoon session, learners participated in 2 additional simulation cases followed by debriefings. Between simulations, participants participated in a round table discussion of difficult topics led by the KCC MICT faculty.

The final step of Kern's approach to curriculum development, feedback and evaluation, was accomplished by administering an anonymous online post-course survey for all participants. The participants reported low frequency contact with pediatric patients in their regular practice, with 100% caring for 0-3 pediatric patients per month, consistent with national provider self-reports of pediatric patient encounter rates.<sup>16,18,19</sup> See Figure 2 for learner responses on level of course. Participants unanimously agreed that practicing paramedics would benefit from the course, but they differed in how frequently the course should be offered; answers ranged from once a month to once a year. Participants valued the in-course physician interactions, both during the communication exercises and while receiving external feedback on assessment and management during scenarios and debriefing. Inter-professional interaction with physicians was specifically referenced by 75% of participants as the most valuable part of the training.

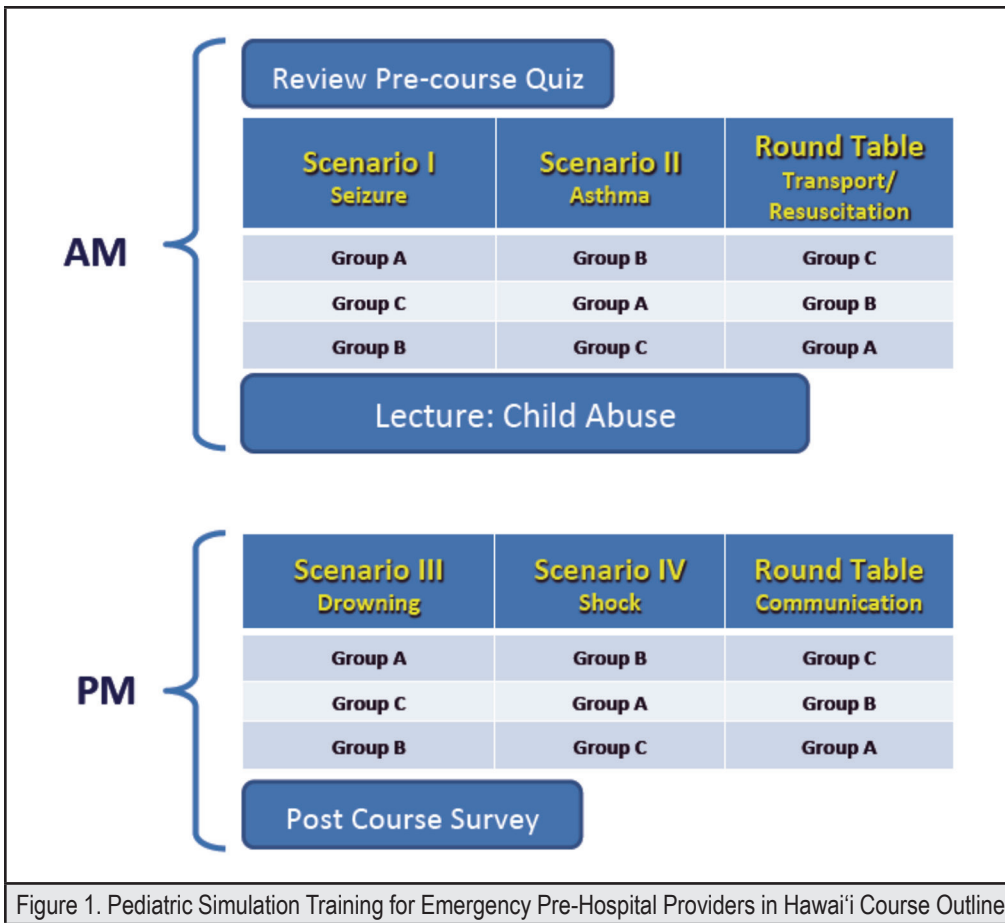


Figure 1. Pediatric Simulation Training for Emergency Pre-Hospital Providers in Hawai'i Course Outline

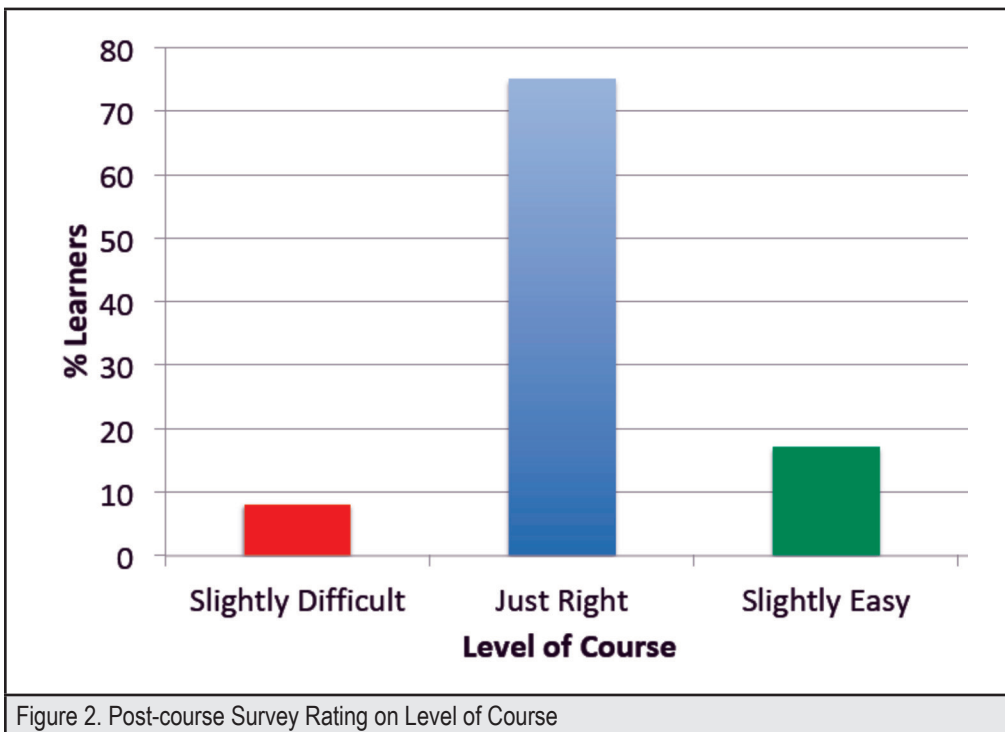


Figure 2. Post-course Survey Rating on Level of Course

## Discussion

KCC MICT faculty speculated that the inter-professional interaction would be a highly-valued component of the PediSTEPPs-H training. The KCC MICT faculty had observed that real-time feedback and follow-up from emergency department providers to the pre-hospital providers had become non-existent in the local community. This was attributed to the nature of emergency department operations, pre-hospital provider requirements to transition patient care quickly, and to resume work by getting ambulance crews back on the road. Pre-hospital providers have identified deficits in communication as a threat to patient safety and suggested development of opportunities for interaction with emergency department staff as a method to address these deficits.<sup>11,20</sup> This curriculum directly addressed the inter-professional communication deficit and was identified by the participants in open-ended comments as the most highly-regarded element of the course.

Participant learners in this cohort were KCC MICT students, in the process of achieving paramedic certification, and will continue to work for their current agencies following paramedic certification. Paramedic recertification is required every 2 years, achieved by maintaining National Registry of Emergency Medical Technicians (NREMT) certification or by submitting evidence of continuing education (CE) at the state level. Currently, the NREMT 2016 National Continued Competency Program requires 3.5 hours of pediatric-specific CE every 2 years to re-certify and the state of Hawai'i does not have a pediatric-specific CE requirement.<sup>21,22</sup> National surveys of EMS for Children State Partnership grantee program managers have identified that limitations in funding, time, instructors, and accessibility are all barriers to engagement in pediatric education for pre-hospital providers.<sup>23</sup> Gaps or inadequacies in continuing pediatric education have been identified by practicing pre-hospital providers as threats to patient safety.<sup>11,20</sup>

There are 145 paramedics who staff the 21 advanced life support ambulances operated by the City and County of Honolulu EMS division. In 2018, there were 1796 pediatric transports by the City and County of Honolulu EMS, comprising only 3% of total transports (personal communication with Assistant Chief of Professional Standards City and County of Honolulu EMS Division). Of these pediatric transports, 77% were categorized as advanced life support transports. Pediatric patients, as defined by the City and County of Honolulu EMS, are those who are 14 years or below. This level of pediatric experience averages approximately 1 pediatric patient per month per provider, similar to the self-reported contact with pediatric patients reported by the KCC MICT student cohort in our course, and as reported in national surveys of practicing pre-hospital providers. Analyses of large EMS databases nationally demonstrate that children comprise between 4%-13% of pre-hospital responses.<sup>5,6,24,25</sup> The age criteria for children in these databases were typically ages 19 years and below, which likely explains the comparatively lower percentage of pediatric patients in the Honolulu EMS report. Advanced life support skills and critical care procedures are employed infrequently during pediatric transports.<sup>3,6</sup> Skills such as intravenous medication administration, defibrillation, cardioversion, cardiac pacing, cardiopulmonary resuscitation, endotracheal intubation, cricothyroidotomy, needle decompression, pericardiocentesis, intraosseous, or central venous catheter placement are reported between 1-14% of pediatric transports.<sup>3,6-8</sup> Of these advanced skills and procedures, intubation is one

	Honolulu EMS	National EMS
Pediatric prehospital response rate	3%	4%-13%
Pediatric intubation attempt rate	1.1%	0.33%-0.67%
Pediatric intubation success rate	70%	76.2%-81.1%

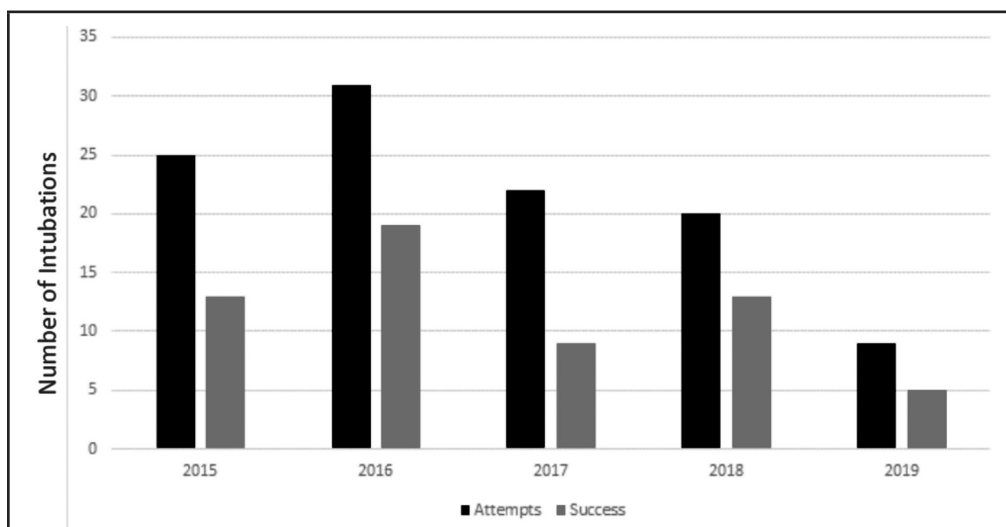


Figure 3. City & County of Honolulu EMS Pediatric Intubations

of the more frequently reported, occurring in 0.33-0.67% of pediatric transports, with a success rate between 76.2% [95% CI=74.7–77.7] to 81.1% (95%CI=79.7–82.6).<sup>3,26</sup> City and County of Honolulu EMS intubation attempts occurred at a rate of 1.1% in 2018, with a success rate of 70%; again, noting that these were in patients aged 14 years or younger. See Table 1 for a comparison of Honolulu EMS pediatric transports to national data on intubation.<sup>3,26</sup> However, best current evidence suggests that out-of-hospital endotracheal intubation is not associated with more favorable neurologic outcomes compared to bag-mask ventilation and intubation attempts over the last 3 years have decreased.<sup>27</sup> See Figure 3 for City and County of Honolulu EMS pediatric endotracheal intubation trends provided by the Assistant Chief of Professional Standards City and County of Honolulu EMS Division.

Discrepancies in pre-hospital documentation and assessment between adult and pediatric patients have been described; children are less likely to have complete vital sign assessment and pain score documentation than adults presenting with similar complaints.<sup>9</sup> Perceptions of pediatric calls have been described as “very high risk, very low frequency.” Lack of individual experience to inform and guide emergent and urgent pre-hospital management leads providers to associate concomitant anxiety and complexity as contributors to patient safety threats.<sup>11</sup> Self-described discomfort and anxiety with pediatric patients, combined with a lack of experience and training, have been consistently identified as contributors to patient care errors.<sup>1,28,29</sup> Integration of this course as a routine component of the KCC MICT Program to augment existing pediatric didactics and clinical rotations appears to be warranted based on learner and faculty perceptions. Expanding the course and offering CE credits to practicing paramedics is arguably a higher priority since they do not routinely encounter critically ill pediatric transports and are distant in time from exposure to pediatrics during paramedic training. Future iterations of this course, with larger numbers of learners, will allow assessment of more advanced educational outcomes including self-efficacy, specific skill performance, and broader knowledge assessments.

Qualitative studies surveying practicing pre-hospital providers on barriers to and resources for improving the care of pediatric patients identify the need for more frequent pediatric training, including opportunities for external feedback, and for improved interactions with emergency department staff.<sup>20,30,31</sup> The quality of available pediatric training has been identified as the foremost barrier to additional training and PALS was identified as the most commonly reported pediatric-specific ongoing training for practicing pre-hospital provider.<sup>16</sup> PALS content provides an important knowledge base in an educational format of lectures and basic simulation, which are not identified by providers as their most effective method of training. Currently, PALS is the most common pediatric-specific CE activity completed by City and County of Honolulu EMS practicing paramedics. Providers are in favor of mandated pediatric CE; however, cost, avail-

ability, and travel distance have also been identified as barriers to obtaining this training.<sup>19</sup>

## Conclusion

This KCC and JABSOM collaborative pilot program has demonstrated proof of concept, high learner satisfaction, and is aligned with the pediatric-specific goals and objectives of the State of Hawai‘i Department of Health Emergency Medical Services Division. Integrating PediSTEPPs-H in the regular pediatric curriculum for the KCC MICT Program and expanding the offering annually with CE credits for practicing paramedics annually are priorities that depend on adequate funding and leadership support. Future directions for investigation may include paramedic program feedback and evaluation, self-efficacy surveys for participants, performance outcome measures, and expansion of needs assessment for additional training.

## Conflict of Interest

None of the authors identify a conflict of interest.

## Disclosure Statement

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### Authors' Affiliations:

- SimTiki Simulation Center at the John A. Burns School of Medicine University of Hawai‘i at Mānoa and Kapi‘olani Community College University of Hawai‘i, Honolulu, HI

### Correspondence to:

Jannet Lee-Jayaram MD; 651 Ilalo Street, MEN 212, Honolulu, HI 96813; Email: jannet98@hawaii.edu

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