Article

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Pediatric Life Support in Prehospital Emergency Medicine: An Empirical Investigation in the Context of Taiwan's Critical Shortage of Pediatric Emergency Specialists

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Background: This study aims to facilitate parental identification of designated emergency facilities for expeditious pediatric care within the framework of Taiwan's newly implemented "regional joint defense" approach to pediatric emergency services. The research seeks to elucidate the mechanisms by which this novel system can enhance timely access to appropriate emergency care for children, potentially improving health outcomes and resource utilization in acute pediatric situations.

Methods: Factor analysis (FA) and triangular entropy matrix (TEM) analyzed the appearance, breathing and skin of pediatric assessment triangle (ABC of PAT), three types of prehospital pediatric emergence condition (PPEC), five levels of Taiwan's pediatric emergency triage (TPET), and applied the social learning theory (SLT) in educational doctrine, using experts' weighted questionnaires.

Results: Firstly, to address deficiencies in Taiwan's pediatric prehospital emergency medicine (PEM) system, integrating emergency medical knowledge (EMK) and pediatric life support (PLS) into medical education, staff training, and the national handbook for new parents is crucial. This equips parents to manage children's illnesses and prevent emergencies. Then, in life-threatening situations, immediate emergency room (ER) transport is vital for symptoms like whitish or purple lips, cold limbs, mottled skin, cold sweat, convulsions, dyspnea, chest dimples, weak consciousness, and oxygen saturation below 94%. Finally, for non-life-threatening emergencies, seek medical evaluation if symptoms include wheezing, chest tightness, chest pain, persistent high fever over 39 degrees with convulsions, chills, cold sweats, not eating or urinating for over 12 hours, or fever lasting more than 48 hours.

Conclusion: Parents must remain calm and provide their baby with a sense of security while observing the development of physical symptoms. This approach enables them to effectively determine the most appropriate time to take their children to the emergency room, thereby avoiding life-threatening emergencies. Prompt and proper measures and treatments not only alleviate various discomforts caused by illness or medical emergencies but also reduce systemic distress, life-threatening situations, and unfortunate incidents before hospitalization.

Keywords: prehospital emergency medicine; emergency medical knowledge; pediatric life support; social learning theory

Introduction

Nowadays, it is common for parents to rush their child to the emergency room in the middle of the night when their child has a fever because they are often inexplicably worried about "baby fever" [1]. Parents expect their child to be immediately attended to by the emergency room (ER) medical staff, receive a thorough medical evaluation, and be given the proper treatment. However, long wait times often occur in emergency rooms, even for pediatric cases, and in many instances, the emergency room physician recommends that parents follow up on their child's non-life-threatening medical issues through an outpatient medical clinic. This is because prehospital pediatric emergency medicine (PPEM) focuses on urgent medical care for patients with diseases or injuries requiring immediate treatment. The primary duties of emergency physicians include stabilizing patients, initiating investigations and treatment, diagnosing illnesses during the acute phase, coordinating with medical specialists, and determining whether patients need to be admitted, observed, or discharged. Emergency medical services must adhere to the five levels of Taiwan emergency triage principles (TETP) [2], which are: first level of resuscitation first aid (FL-FD)—immediate treat-

ment by medical staff after seeing a doctor [3]; Second level (SL-10)—critical cases must be addressed within 10 minutes [4]; Third level (TL-30)—urgent cases should be managed within 30 minutes [5]; Fourth level (FL-60)—less urgent cases can be treated within 60 minutes [6]; Fifth level (FIL-120)—non-emergency cases can be treated within 120 minutes [7]. Therefore, parents should be reminded that going to the emergency room does not necessarily solve their child's problems immediately.

The current fatigue level of emergency departments in Taiwan has increased five to ten times compared to pre-Coronavirus disease (COVID-19) levels since the number of confirmed COVID-19 cases exceeded 10,000 per day at the end of 2021. The high infectivity of the COVID-19 virus and the risk of epidemic spread have resulted in more patients and more cumbersome procedures. To effectively control the outbreak, Taiwanese emergency room practices have been divided into "emergency department for epidemic prevention" and "emergency department for general epidemic prevention". However, emergency patients under the age of 12 have not been separately categorized, meaning there is no "emergency department for pediatric emergency prevention". Consequently, these children may not be treated by professional pediatric emergency physicians or medical staff, as prehospital emergency medicine (PEM) has not been established as a medical specialty in Taiwan. Most professional emergency physicians and medical staff in emergency departments focus on first-level triage cases, which can take 30 minutes to an hour to manage. This makes it very difficult to care for children waiting for treatment, especially given the current severe shortage of pediatricians and even fewer full-time to find the pediatric emergency physicians (PEPs). Parents often complain, "When will it be my child's turn?" and question the definition of "emergency" as they wait for an hour or two for their children to see a doctor. Many middle and regional hospitals can no longer independently provide emergency services for pediatrics and obstetrics and gynecology due to this shortage. As a result, most pediatric emergency services and operations in Taiwan now adopt a "regional joint defense" method. Parents must verify "who will be in charge tonight" at nearby emergency rooms to avoid going to the wrong hospital and missing out on timely care for their child.

According to the 2022 annual report of the pediatric emergency situation survey by the Pediatric Medical Association (PMA) in Taiwan, there are about 1795 pediatric medical institutions in Taiwan. However, over the past three years, the number of pediatric physicians in these medical centers has dropped from 763 to 552, while the number of pediatric practitioners in general clinics has increased from 1597 to 1947. This shift has resulted in 11 out of the 18 counties and cities in Taiwan having inadequate pediatric emergency resources, with only two or fewer hospitals offering 24-hour pediatric emergency services. Most pediatric physicians are reluctant to work in the current ER environment, which is characterized by abnormally busy medical systems and high parental complaint pressure. The survey also found that the number of counties and cities with poor pediatric emergency resources has increased from 6 out of 22 (about 27%) in 2018 to 11 out of 18 (about 61%) in 2022, leading to an overburdened the PEM staff. Currently, only 42% of regional hospitals in Taiwan have pediatricians as first-line physicians for pediatric emergencies. Many pediatric physicians prefer to work in general children's clinics, which have fixed consultation hours and simpler medical treatments, once they obtain attending physician qualifications.

In 2022, the recruitment rate of pediatric residents in Taiwan was only 83%, and this year it has dropped to 70%. Pediatric physicians remain concerned that if the health insurance payment system does not change, and due to the impact of the epidemic, young physicians will become increasingly reluctant to join the field of emergency medicine. The significant shortage of the PEPs on the front line has been a major factor in recent medical correction incidents [8]. Additionally, more than half of pediatric physicians are burdened with heavy and complicated workloads, increasing the risk of urgent care errors for babies and children. Most current PEPs are stretched thin, managing both pediatric and adult patients, and are often preoccupied with a high volume of patients under observation, leaving less time to care for pediatric emergency cases. This is exacerbated by the fact that the PEM is not yet recognized as a medical specialty in Taiwan. As a result, more than half of the counties and cities in Taiwan currently lack sufficient PEPs, leading to prolonged wait times in pediatric ERs, both during the day and at night. General ERs follow the five levels of Taiwan's pediatric emergency triage (TPET) system to manage urgent patients, which often means several hours of waiting followed by a formulaic consultation including a physical examination, diagnosis, health education, prescribing necessary medication, and scheduling a return visit. For babies and children with mild illnesses that require an ER visit, general pediatric clinic treatment remains the primary method. More parents are seeking to find the cause of their child's fever rather than just reducing it. However, general emergency physicians may immediately administer an antipyretic injection to reduce the fever, aiming to quickly resolve the case and discharge the patient. Consequently, patients who are not in immediate danger often spend extended periods waiting in the ER. Therefore, parents must carefully consider and evaluate whether their child's sickness and discomfort truly require an emergency room visit, especially given the limited time and resources available in ERs.

According to the American College of Emergency Physicians and the PMA in Taiwan, the core of children's first aid education is the pediatric assessment triangle (PAT). Initially developed for pediatric education for the

PEPs courses and later revised for pediatric education for prehospital professionals (PEPP) courses, the PAT provides both pediatric emergency medical professionals and general medical staff with a reliable and [9] structured method to quickly assess a child's condition or trauma in an emergency. It is the most commonly used method by the current PEPs for identifying and managing acute and severe diseases in children because it enables timely diagnosis and treatment based on visual and auditory cues. The PAT consists of three brief elements [10]:

Appearance (A): This element focuses on evaluating the child's ability to respond to their environment. Parents should observe the child's state of alertness (awake, drowsy, or comatose), energy levels, responsiveness to stimuli, and whether the child can be comforted or is crying uncontrollably.

Breathing (B): This element evaluates the child's respiratory function. Parents should look for key signs such as abnormal breathing sounds and nasal flaring.

Circulation to Skin (C): This element assesses the perfusion of the child's circulatory system. Parents should observe whether the skin appears mottled, pale, or cyanotic, check for signs of severe dehydration like sunken eyes, and assess the elasticity of the skin and mucous membranes.

Therefore, the appearance, breathing and skin of the pediatric assessment triangle (ABC of PAT) is widely applied in PEM, indicating that a child's physical condition is stable if no problems are identified in these areas. If any element shows a problem, it is critical to seek medical assistance immediately. Empirical working experience and academic research have shown that the ABC of PAT is already integrated into Taiwanese pediatric emergency medicine practice [11]. However, the field of prehospital pediatric emergency medicine (PPEM) is currently absent in Taiwan. To address this gap, the authors have developed an innovative the PPEM system based on their emergency medical knowledge (EMK). This system aims to help parents establish correct emergency medical concepts, understand how to evaluate and care for their children, and determine when to take their children to the emergency room, thereby achieving sustainable pediatric life support (PLS) without cultural myths and misunderstandings [12].

Taking the next sept, regarding the PEM, the essential medical training outlines for children's emergency medicine have been strictly defined in the Emergency Medicine Subspecialty Physician Training Curriculum (EMSPTC) benchmarks in Taiwan. The PEM in the ER is a high-risk, highly challenging specialty that tests both mental and physical strength. The key components of this training include: (1) all emergency physicians, professionals, specialists, and general medical staff must learn baby/pediatric first aid skills and understand the basic concepts of pediatrics, including how to take medical histories and conduct physical examinations, to systematically assess common pediatric emergency patients. These patients may present with issues related to the nervous system, thoracic system, heart and circulatory system, digestive system, general blood diseases, immune system, common systemic infectious diseases, kidney diseases, endocrine and metabolic diseases, skin diseases, bone and soft tissue diseases, and respiratory diseases [13]. (2) All emergency physicians, professionals, specialists, and general medical staff must learn to handle clinical and special problems related to children's emergencies and trauma, including diagnosis and treatment. Furthermore, with respect to PLS education, the Subcommittee on Pediatric Resuscitation (SPR) and the American Heart Association (AHA) in the United States addressed nine symptoms for identifying critical situations and stabilizing treatment in the Pediatric Emergency Medicine Program's Student Handbook of the Pediatric PLS in 1984. These nine symptoms [14] are: (1) physical convulsions (PC), (2) weak consciousness (WC), (3) dyspnea or chest dimples (D-CD), (4) lip color is whitish or purple (LCWP), (5) oxygen saturation below 94% (OSB-94), (6) cold body limbs, mottled skin, cold sweat (CBL-MS-CW), (7) fever for more than 48 hours, or persistent high fever over 39 degrees to convulsions combined with chills, cold sweats, chills, etc. (F-48-39-C), (8) the activity is not good combined with wheezing, chest tightness or chest pain, although the fever has gone, (ANG-FG) and (9) no food or urine for more than 12 hours (NF-U-MT12).

Despite the paramount importance of children's health to all parents, the PEM has yet to be recognized as a distinct medical subspecialty in Taiwan. Consequently, the Taiwanese government has mandated that all ERs establish independent children's emergency rooms equipped with comprehensive facilities and staff separate from adult emergency departments. These specialized ERs are tasked with cultivating highly trained and dedicated medical teams specifically focused on the PEM. Moreover, the ERs are encouraged to foster independent scientific research and development initiatives to advance professional knowledge and treatment strategies in the PEM.

However, despite the specialization of the PEPs in most medical centers in Taiwan, there are several significant challenges that discourage many young physicians from pursuing pediatric emergency medicine as a lifelong career. These challenges include: PEPs must possess extensive knowledge to manage all life-threatening conditions in children, requiring a breadth of expertise unmatched by other subspecialties; PEPs often work demanding 24-hour shifts, necessitating exceptional physical stamina compared to other medical fields; PEPs must exhibit exceptional patience in communicating with and addressing the concerns of anxious parents, adding to the emotional demands of the job. A critical issue facing the PEM in Taiwan is its financial sustainability within the subspecialty medical landscape. Taiwan's declining birth rate has significantly reduced the annual number of newborns, dropping from a peak of 300,000 births per year to less than 160,000,

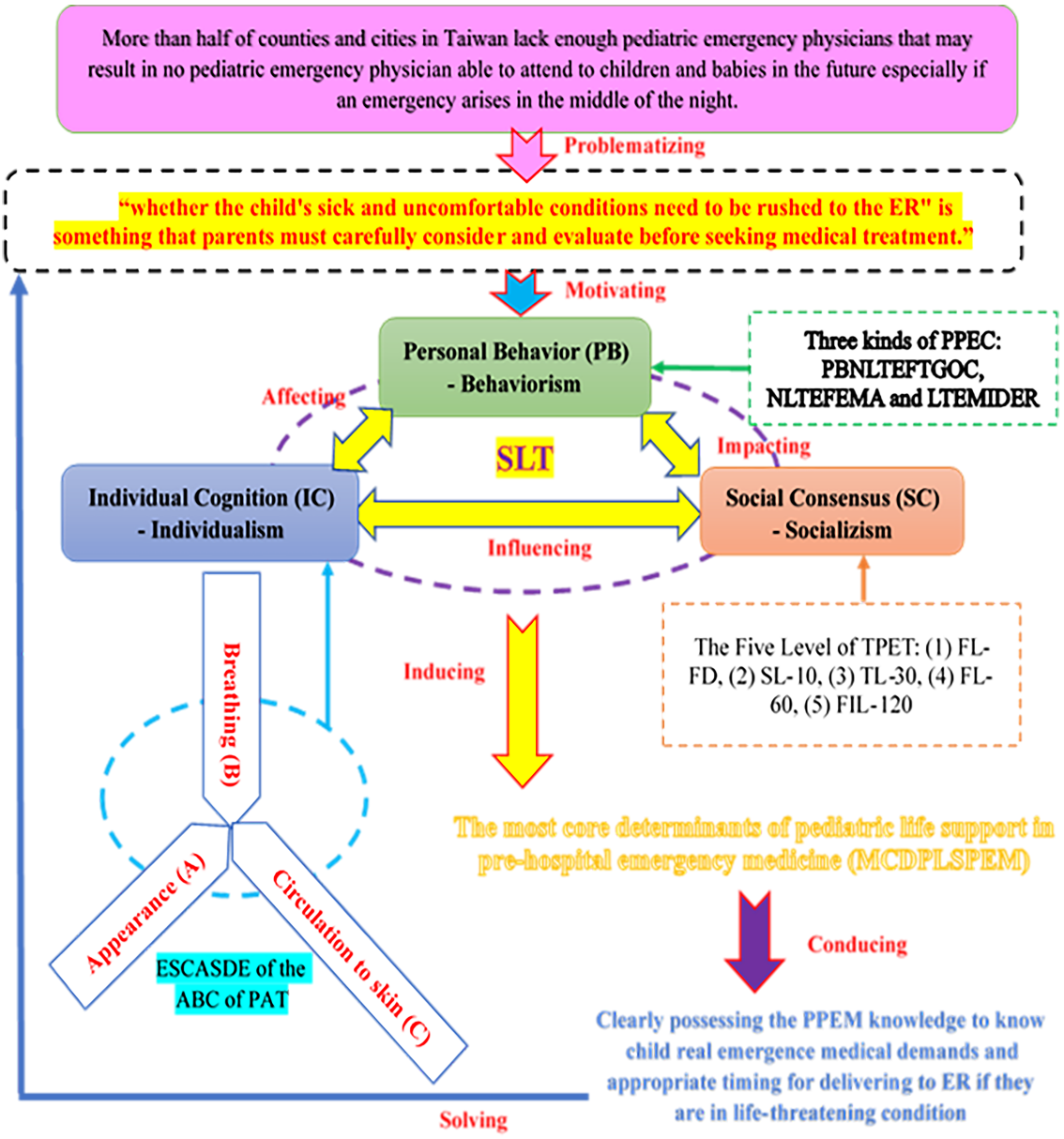

Fig. 1. The core research interdisciplinary analytical concept. Drawn by Microsoft Word. ESCASDE, emergency symptoms of children's acute and severe diseases; ABC of PAT, the appearance, breathing and skin of pediatric assessment triangle; SLT, social learning theory; ER, emergency room; PPEC, prehospital pediatric emergence condition; TPET, Taiwan's pediatric emergency triage; FL-FD, first level of resuscitation first aid; SL-10, critical cases must be addressed within 10 minutes; TL-30, urgent cases should be managed within 30 minutes; FL-60, less urgent cases can be treated within 60 minutes; FIL-120, non-emergency cases can be treated within 120 minutes.

one of the lowest rates globally. This demographic shift has strained the Taiwanese health insurance system, which struggles to adequately support the financial needs of the PEM services in major hospitals. Currently, hospital management teams often subsidize the PEM services using surplus income from other sources, but this practice is not sustainable and has hindered the development of the PEM in major healthcare facilities.

To comprehensively discuss and evaluate the interactions and dependencies among the emergency symptoms of children's acute and severe diseases (ESCASDE) using the ABC of PAT, the three kinds of prehospital pediatric emergence condition (PPEC), and the five levels of the TPET, the social learning theory (SLT) [15] of educational doctrine was employed. This theory considers and analyzes these interactions and dependencies to enhance the application of emergency medical knowledge in pediatric life support through three dimensions [16]: individual cognition (IC)—individualism, personal behavior (PB)—behaviorism, and social consensus (SC)—socialization, as depicted in Fig. 1.

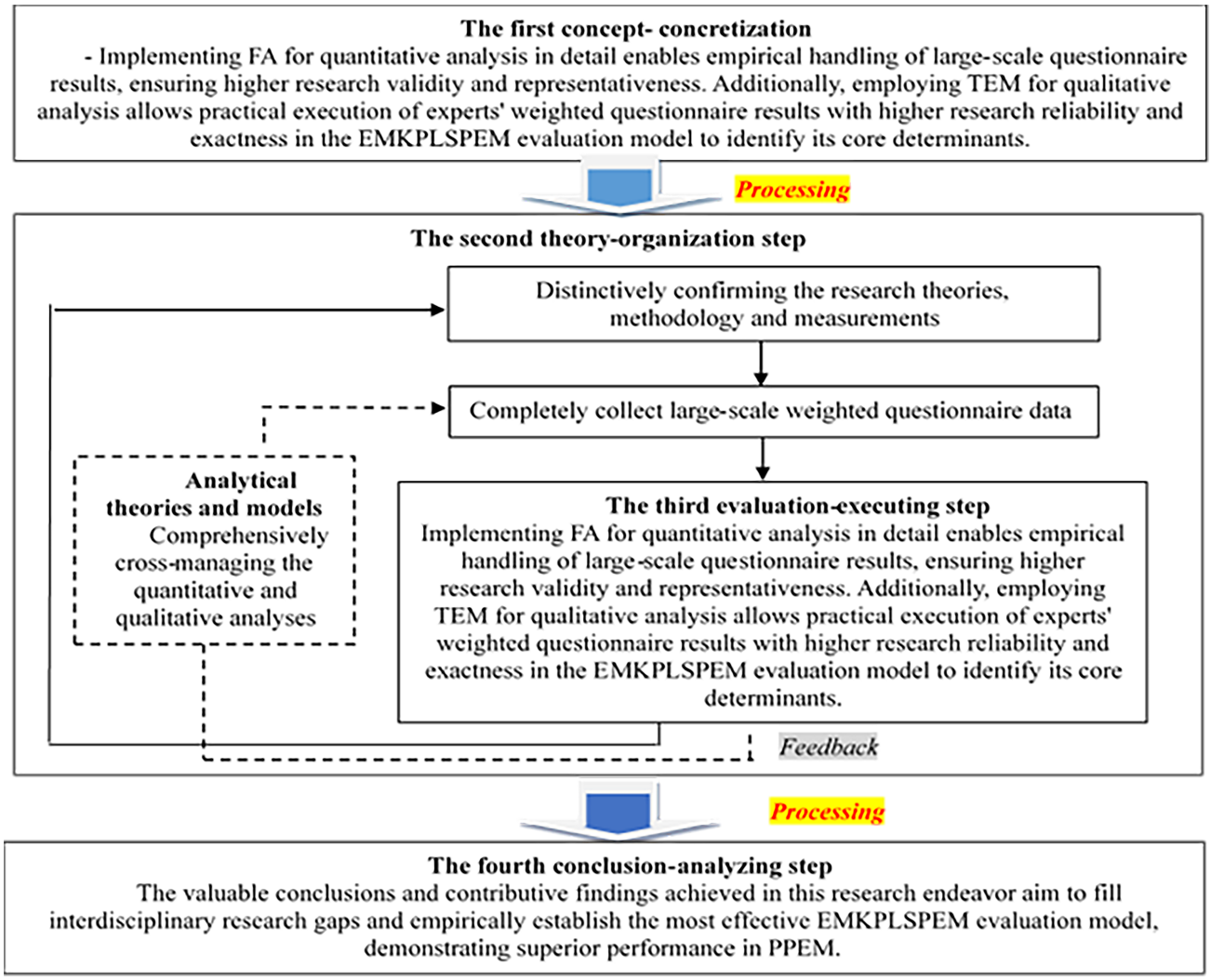

Fig. 2. Research design and steps. Drawn by Microsoft Word. PPEM, prehospital pediatric emergency medicine.

The first reason for using SLT is its focus on IC—individualism, which discusses the impact of human consciousness. This matches the ESCASDE of the ABC of PAT, where the physical function of breathing must be seriously assessed because dysfunction can lead to immediate loss of consciousness. Next, the physical features of the circulatory system must be observed because individuals cannot function properly if their circulatory system is impaired. Lastly, the physical recognition of a healthy appearance must be investigated because people are generally considered unwell if they do not display healthy energy and appearance. Based on empirical observations of medical evaluation and delivery times in the ER, there are three types of the PPEC: firstly, non-life-threatening emergencies that can be followed up in outpatient clinics (PBNLTEFTGOC); secondly, non-life-threatening emergencies that require further emergency medical evaluations and attention (PBNLTENEMEAEMK) and finally, life-threatening emergencies that must be immediately delivered to the ER (LTEMIDER). Together, these methods were used to efficiently construct the most effective EMK model of PLS in PEM, referred to as the EMKPLSPEM evaluated model. This approach successfully identifies the most critical determinants of pediatric life support in pediatric emergency medicine (MCDPLSPEM).

Materials and Methods

Research Steps

This interdisciplinary research not only employed the three dimensions of SLT—IC (individualism), PB (behaviorism), and SC (socializationism)—for a detailed discussion of the interplays and dependencies of the ABC components of the PAT in the PEM, but also utilized the factor analysis (FA) of quantitative analysis and triangular entropy matrix (TEM) of qualitative analysis to comprehensively establish the EMKPLSPEM evaluation model. The goal was to identify the core determinants necessary to address the research objectives effectively. The research was structured into four main steps:

First of all, Concept-Concretization Step: focus on developing sustainable pediatric life support education by applying emergency medical knowledge to provide viable solutions for parents dealing with the current shortage of resources and pediatric emergency medical professionals, including general medical staff.

Successively, Theory-Organization Step: integrate the SLT into educational doctrine to extensively evaluate the interplays and dependencies of the ABC components of the PAT in PEM. This step also involved statistically synthesizing the EMKPLSPEM evaluation model using the FA and TEM methodologies.

Continuously, Evaluation-Execution Step: implement the FA to empirically analyze large-scale questionnaire data for higher research validity and representativeness. Simultaneously, utilize the TEM to practically execute expert-weighted questionnaire results, ensuring higher research reliability and precision in the EMKPLSPEM evaluation model to identify core determinants.

Finally, Conclusion-Analysis Step: based on systematic measurements and assessments of the EMKPLSPEM evaluation model, draw valuable conclusions and findings to achieve research goals and contribute to academic literature. This step aimed to fill interdisciplinary research gaps and empirically establish the most effective EMKPLSPEM evaluation model with superior performance in the PPEM.

Fig. 2 illustrates the systematic progression of these four research steps.

Data Collection

Specifically, the large-scale questionnaire involved interviews with 250 parents in person. Three parents declined to participate due to personal reasons, and their questionnaires were not included in this research. The collection of entire questionnaires adhered to the five principles of the exemption from examination for ethical conduct in social science research, as outlined by Taiwanese National Science and Technology Council and global academic ethical organizations. These principles ensure the confidentiality of participants and the ethical handling of data: (1) all 250 participants were directly interviewed for this research; (2) no personal information or specific participant identification was disclosed; (3) all 250 participants consented to the use of their completed questionnaires for research purposes; (4) all participants were older than 18 years (legal adults) and (5) non-invasive methods were employed in data collection. Thus, no further ethical examination was deemed necessary for the utilization of these large-scale questionnaires. Additionally, regarding the expert-weighted questionnaire results, Dalkey and Helmer [17] suggest that qualitative analysis requires expert input comprising at least ten percent of the data collected in quantitative analysis, ensuring validity and reliability in research using the Delphi method. Consequently, twenty-five experts were interviewed in person for their questionnaires in the qualitative analysis: (1) ten scholars with over ten years of research experience in the field; (2) ten emergency medical specialists with at least ten years of experience in the ER and (3) five government officers with a minimum of five years of experience in the ER system management and planning.

Statistic Methods

To precisely measure the dependencies among the emergency symptoms of the ESCASDE using the ABC of PAT—individual cognition (individualism), PEC—personal behavior (behaviorism), and the five levels of the TPET—social consensus (socializationism), a combination of quantitative and qualitative analyses was employed. First, the FA of quantitative analysis [18] was utilized to process the measurements from large-scale questionnaires. Because, in recent social science research, efficient quantitative analysis methods have become increasingly important. The FA is particularly effective for thoroughly investigating the interactions and dependencies within large-scale questionnaires used to address complex research questions. The FA identifies commonalities among evaluated factors through theoretical concepts and statistical methods embedded in its original design and structure. In the FA of quantitative analysis, each factor has categorized as the dependent variable as ($X = X_1, X_2, \ldots, X_k$) and independent variables as ($Y = Y_1, Y_2, \ldots, Y_k$). Continuously, in terms of explanation of the statistical calculations of the FA of quantitative analysis, the linear combination equation was established as [19].

$$\mathrm{Y}_k = W_{k1}X_1, W_{k2}X_2, \ldots, W_{kk}X_k \tag{1}$$

s.t. 1: K numbers of common potential factors are organized from the L numbers of general influenced factors; 2: the M numbers are more than the K numbers.

Then, the weights constants ($W(W_{ij})$) in the FA of quantitative analysis were defined as the evaluated variable loadings of each evaluated factor and variable-weights of the entire appraised factor under the linear combination Eqn. 2 which resulted from the Eqn. 1 [20]. The linear combination Eqn. 2 of the FA of quantitative analysis processed as:

$$\mathrm{X}_1 = \lambda_{11}Y_1, \lambda_{12}Y_2, \ldots, \lambda_{1k}Y_k$$

s.t. 1: $\mathrm{P}\_ = P^1X\_, X\_ = P^1X\_$,

s.t. 2: standardize intersection of variance to be 1 (Max)

If maximization: $\mathrm{Y}_k - u_k = \lambda_{11}f_1 + \lambda_{12}f_2 + \cdots + \lambda_{km}f_m + e_k$

(s.t. $(X - u)_{-k*1} = \Lambda_{m_{k+m}}f_{m*1} + e_{-k*1}$) the variance-covariance matrix presents as:

$$\Sigma = \Lambda\Phi\Lambda^1 + \Psi, \Psi = \mathrm{diag}\,(\Psi_1, \Psi_2 + \cdots + \Psi_m) \quad (\text{s.t. } \phi = I_{\mathrm{m}*m}) \tag{2}$$

Table 1. The descriptive statistics of 247 valid questionnaires.

Gender	Male: 69 (27.94%)	Female: 178 (72.06%)			
Geography	Northern Taiwan[1]: 41 (16.59%)	Middle Taiwan[2]: 62 (25.1%)	Southern Taiwan[3]: 142 (57.49%)	Eastern Taiwan[4]: 2 (0.82%)	
How long did you ever wait to see the doctor with your child in the ER?	In 30 minutes: 67 (27.13%)	30–60 minutes: 131 (53.03%)	60–90 minutes: 47 (19.02%)	90–120 minutes: 2 (0.82%)	Up to 120 minutes: 0 (0%)
Are you willing to learn the emergency medical knowledge (EMK) of the prehospital emergency medicine (PEM) for your children?	Yes: 233 (94.3%)	No: 14 (5.7%)			
Have you heard about the ABC of the PAT before?	Yes: 18 (7.29%)	No: 229 (92.71%)			
Have you heard about the five levels of TPET before?	Yes: 226 (91.49%)	No: 21 (8.51%)			

[1]: Chilung, Taipei, New Taipei and Taoyuan cities.

[2]: Hsinchu, Miaoli, Taichung and Changhua cities.

[3]: Yunlin, Chiayi, Tainan and Kaohsiung cities.

[4]: Hualien and Taitung counties.

As ($Y = Y_1, Y_2, \ldots, Y_k$), directly unobserved evaluated factors are defined as independent variables as ($X = X_1, X_2, \ldots, X_k$) and the factors' constants are defined as ($W(W_{ij})$) where the factor loading [20].

Then, in order to ensure higher research validity, representativeness, and accuracy. Additionally, the TEM of qualitative analysis [21] was applied to analyze the assessments from experts' weighted questionnaire results.

Following the weighted evaluation and measurements derived from the questionnaire results of 20 experts [17], qualitative analysis using the TEM method was employed. This method was utilized to analyze and assess the experts' weighted questionnaire data, ensuring higher research reliability and precision. The aim was to efficiently construct the EMKPLSPEM evaluation model and effectively determine the MCDPLSPEM through triangular weight pairwise comparison matrices and entropy statistical computations. In the triangular weight pairwise comparisons matrix, the discrete probability connections ($P = P_1, P_2, \ldots, P_k$) was induced from the initial entropy statistic entropy statistic as.

$$\mathrm{E}\left(P_1, P_2, \ldots, P_k\right) = -\phi_k \sum_{i=1}^{k} P_1 \ln\left(P_i\right) \quad (3)$$

s.t. 1: $\Phi_k = 1/I(k)$ was the normal quantity and $0 \leq E\left(P_1, P_2, \ldots, P_k\right) \leq 1$; 2: the number of $0 \leq E\left(P_1, P_2, \ldots, P_k\right) \leq 1$ was reversely related with the interplays and interactive dependences among each assessed criterion.

Finally, the interaction-compared measurements of the the discrete probability connections ($P = P_1, P_2, \ldots, P_k$) were able to be calculated in the entropy measurement-conditional triangular weights ($W(W_{ij})$) deduced as follows:

$$\begin{aligned}
\mathrm{H}\left(\frac{\mathrm{Y}}{\mathrm{X}}\right) &= \sum_{x \in X} p(x) * H\left(\frac{Y}{X} = x\right) \\
&= \sum_{x \in X} p(x) * p\left(\frac{Y}{X}\right) \log p\left(\frac{Y}{X}\right) \\
&= -\sum_{x \in X} \sum_{y \in Y} p(x, y) \log p\left(\frac{Y}{X}\right) \\
&= -\sum_{x \in X, y \in Y} p(x, y) \log p\left(\frac{Y}{X}\right) \\
&= -\sum_{x \in X, y \in Y} p(x, y) \log\left(\frac{p\left(\frac{Y}{X}\right)}{p(x)}\right) \\
&= \sum_{x \in X, y \in Y} p(x, y) \log\left(\frac{p(x)}{p(x, y)}\right)
\end{aligned} \quad (4)$$

Table 2. The Kaiser-Meyer-Olkin measure of FA of quantitative analysis.

Kaiser-Meyer-Olkin measure of sampling adequacy		0.765
Bartlett test of sphericity	Chi-squared test	657.084
	df	171
	Significance	0.000

FA, factor analysis.

Table 3. The commonality of appraised criteria and candidates.

Appraised criteria & candidates	Initial	Extraction
PBNLTEFTGOC (PPEC - Criterion)	1	0.684
PBNLTENEMEAEMK (PPEC - Criterion)	1	0.714
LTEMIDER (PPEC - Criterion)	1	0.763
PC - (C) (BC-(B) - Criterion)	1	0.767
WC - (B) (BC-(C) - Criterion)	1	0.745
D-CD - (B) (BC-(C) - Criterion)	1	0.773
LCWP - (A) (BC-(C) - Criterion)	1	0.761
OSB-94 - (C) (BC-(C) - Criterion)	1	0.753
CBL-MS-CW - (A) (BC-(C) - Criterion)	1	0.718
F-48-39-C - (C) (BC-(C) - Criterion)	1	0.735
ANG-FG - (C) (BC-(C) - Criterion)	1	0.728
NF-U-MT12 - (B) (BC-(C) - Criterion)	1	0.734
FL-FD (TPET-SC - Criterion)	1	0.757
SL-10 (TPET-SC - Criterion)	1	0.737
TL-30 (TPET-SC - Criterion)	1	0.685
FL-60 (TPET-SC - Criterion)	1	0.724
FL-120 (TPET-SC - Criterion)	1	0.733

PBNLTEFTGOC, patents belong non-life-threatening emergencies that just follows up the treatments of the General Outpatient Clinics; PBNLTENEMEAEMK, patents belong non-life-threatening emergencies that needs further emergency medicine evaluations and attentions by Employing the EMK; LTEMIDER, patients belong life-threatening emergencies that must be immediately delivered to the ER; PC, physical convulsions; WC, weak consciousness; D-CD, dyspnea or chest dimples; LCWP, lip color is whitish or purple; OSB-94, Oxygen Saturation Below 94%; CBL-MS-CW, cold body limbs, mottled Skin, cold sweat; F-48-39-C, fever for more than 48 hours, or persistent high fever over 39 degrees to Convulsions combined with chills, cold sweats, chills, etc.; ANG-FG Activity, is not good combined with wheezing, chest tightness or chest pain although the Fever has Gone; NF-U-MT12, no food or urine for more than 12 hours; TPET, Taiwan's pediatric emergency triage; SC, social consensus.

Results

FA Measurements of Quantitative Analysis

In Eqns. 1,2 of the FA for quantitative analysis, large-scale weighted questionnaire results were generated by randomly collecting data. A total of 247 valid questionnaires were collected out of 250, resulting in a valid response rate of 98.8%. These 247 valid questionnaires covered the

Table 4. The evaluated measurement of TEM approach of qualitative analysis.

ESCASDEs of the ABC of PAT -IC									TEM measurements	Five levels of TPET -SC				
PC- (B) (0.767)	WC- (C) (0.745)	D-CD - (B) (0.773)	LCWP - (A) (0.761)	OSB-94 - (C) (0.753)	CBL-MS-CW - (A) (0.718)	F-48-39-C - (C) (0.735)	ANG-FG - (C) (0.728)	NF-U-MT12 - (B) (0.734)	Three kinds of PPEC -PB	FL-FD (0.757)	SL-10 (0.737)	TL-30 (0.685)	FL-60 (0.724)	FL-120 (0.733)
0.0897	0.0706	0.0147	0.0937	0.0977	0.131	0.0898	0.0284	0.1039	PBNLTEFTGOC (0.684)	0.0278	0.0192	0.0887	0.0956	0.059
0.0703	0.0879	0.0779	0.0945	0.0578	0.0937	0.1151	0.1082	0.1274	PBNLTENEMEAEMK (0.714)	0.0382	0.0013	0.0992	0.0967	0.0678
0.1326	0.0881	0.179	0.131	0.1232	0.136	0.0897	0.0703	0.1127	LTEMIDER (0.763)	0.0939	0.1099	0.0651	0.0742	0.0201

TEM, triangular entropy matrix; ESCASDE, emergence symptoms of the children's acute and severe diseases evaluation; IC, individual cognition.

northern region of Taiwan (Chilung, Taipei, New Taipei, and Taoyuan cities), the central region (Hsinchu, Miaoli, Taichung, and Changhua cities), the southern region (Yunlin, Chiayi, Tainan, and Kaohsiung cities), and the eastern region (Yilan, Hualien, and Taitung cities). The descriptive statistics of these 247 valid large-scale questionnaires are presented in Table 1.

Subsequently, the FA of quantitative analysis was deemed appropriate for assessing the results of the 247 valid large-scale questionnaires. The Kaiser-Meyer-Olkin measure of sampling adequacy yielded a score of 0.765, exceeding the threshold of 0.7, and the significance level of the Kaiser-Meyer-Olkin measure and Bartlett's test was 0.000, indicating a value less than 0.05, as detailed in Table 2.

Furthermore, Table 3 lists a total of seventeen commonalities. Significantly, the highest commonality of the three kinds of PPEC were the D-CD - (B) (BC-(C) - Criterion) (0.773), PC - (C) (BC-(B) - Criterion) (0.767) and LTEMIDER (PPEC - Criterion) (0.763). Others' commonalities are listed in Table 3.

In summary, the majority of communalities were above 0.6 and approaching 0.7, clearly indicating significant interdependencies among each criterion measured across the 247 valid large-scale questionnaires in the FA of quantitative analysis.

Measurements of Qualitative Analysis

Following the execution of FA of quantitative analysis, the communalities of each criterion were computed and incorporated into Eqns. 3,4 of qualitative analysis. This process facilitated the analysis of the 25 valid experts' weighted questionnaires using entropy statistics, as detailed in Table 3 and calculated in Table 4.

In Table 4, the highest synthesized weights were observed for the PC-(B) (0.1326), WC-(C) (0.0881), D-CD-(B) (0.179), LCWP-(A) (0.131), OSB-94-(C) (0.1232), and CBL-MS-CW-(A) (0.136) within the ESCASDE of the ABC of PAT, along with FL-FD (0.0939) and SL-10 (0.1099) of the Five levels of the TETP, located in the LTEMIDER of the three types of the PPEC. Subsequently, the second highest synthesized weights were found for F-48-39-C-(C) (0.1151), ANG-FG-(C) (0.1082), and NF-U-MT12-(B) (0.1274) within the ESCASDE of the ABC of PAT, and TL-30 (0.0992), FL-60 (0.967), and FL-120 (0.0678) of the Five levels of the TEPT, situated in the PBNLTENEMEAEMK of the three types of the PPEC.

Discussion

To comprehensively address the severe deficiency in the Taiwan's PPEM system, it is essential to introduce the EMK and PLS practices into essential medical courses, incorporate them into medical staff assessment training, and include them in the national handbook for new parents. This approach aims to effectively educate parents on handling their children's illnesses and preventing pediatric emergencies. Therefore, this research utilized the SLT to cross-evaluate the interactions between PAT and the five levels of the TETP across three types of the PPEC, combining large-scale questionnaires from quantitative analysis and expert-weighted questionnaires from qualitative analysis. Specifically, the interactions and dependencies among the ESCASDE of the ABC of PAT, three types of the PPEC, and five levels of the TETP were analyzed to construct an effective EMKPLSPEM evaluation model. This model aims to identify the MCDPLSPEM [22].

Following the execution of large-scale weighted questionnaires, the two most valuable core determinants of MK-PLSPEM that emerged are pivotal in constructing the innovative PPEM [23]:

Firstly, addressing the severe challenges faced by the Taiwan's PPEM system, the EMK and the PLS must be integrated into essential medical courses and incorporated into training programs for educational medical staff at each institution. It is also crucial to advocate for parental education to effectively manage children's illnesses and prevent pediatric emergencies. Consequently, the two MCDPLSPEM have been identified to significantly enhance the quality of the PEM [24].

Then, it is critical when symptoms such as the LCWP and the CBL-MS-CW from category the A of the ABC of the PAT, PC and D-CD from the B, and WC and OSB-94 from C appear, individuals are at high risk of life-threatening emergencies. Immediate action is necessary, including first-level resuscitation and urgent medical assistance from professional staff in the PPEM, followed by prompt transfer to the ER for urgent treatment [25].

Finally, it is very important that symptoms such as wheezing, chest tightness or pain persisting after fever subsides, not eating or urinating for more than 12 hours, fever lasting more than 48 hours, or persistent high fever above 39 degrees Celsius, accompanied by convulsions, chills, cold sweats, or similar signs, warrant medical evaluation. These symptoms indicate non-life-threatening emergencies that require medical attention. Therefore, parents must remain calm and provide their baby with a sense of security while observing the development of physical symptoms. This approach enables them to effectively determine the most appropriate time to take their children to the emergency room, thereby avoiding life-threatening emergencies. Prompt and proper PPEM measures and treatments not only alleviate various discomforts caused by illness or medical emergencies but also reduce systemic distress, life-threatening situations, and unfortunate incidents before hospitalization [26].

Conclusion

Specifically, life is precious and fraught with risks. Therefore, most of the limitations in this research pertain to its findings and conclusions, which primarily serve as

recommendations. This is largely because pediatric emergency physicians or medical staff often advise parents to bring their child to the ER for onsite evaluation if they have any doubts or concerns, as they can only provide basic advice without personally examining the child. In addition to the measured results, analytical outcomes, and valuable conclusions of this research, there exist more effective theories and methods that can be interdisciplinary applied across related research fields. This approach aims to develop more specific studies on EMK and PLS in innovative PPEM, enhancing the care and health outcomes for children in the future.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding authors on reasonable request.

Author Contributions

Conceptualization, WFC and WHC; methodology, YKC and MYH; validation, WHC and YKC; formal analysis, MYH; investigation, WHC and YKC; resources, YKC; data curation, MYH and YKC; writing—original draft preparation, MYH and WHC; writing—review and editing, YKC and MYH; visualization, YKC and WHC; supervision, YKC and WFC; project administration, MYH. All authors contributed significantly to editorial changes of important content. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

In terms of the collected data, the entire interviewees are all over 18 years old and completely agree with the usage-consent for their completed questionnaires in this research. Particularly, the questions did exclude any personal identified information with the only fulfilment of questionnaires. The collection of entire questionnaires adhered to the five principles of the exemption from examination for ethical conduct in social science research, as outlined by Taiwanese National Science and Technology Council and global academic ethical organizations.

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Conflict of Interest

The authors declare no conflict of interest.

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