What are the educational and curriculum needs for emergency medical technicians in Taiwan? A scoping review

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Purpose: The development of emergency medical services (EMS) training in Taiwan is in a transitional phase because of increasing demand for, and advancements in, clinical skill sets. The aim of this study is to review the current literature to compare the key factors of EMS training and education development in different countries in order to provide a new curricula blueprint for the Taiwanese EMS training system.

Method: The method follows Arksey and O'Malley's six stages of scoping review.

Results: Five databases were searched for relevant articles: MEDLINE, EMBASE, Allied and Complementary Medicine Database; Education Resources Information Center, and Google Scholar. The initial search of five databases produced 1,230 articles, of which title and abstract screening excluded 1,156 articles. The 74 remaining articles underwent a full-text screening process, which further reduced the number of articles to 22. Researching references and citations produced an additional 23 articles, national curriculum standards produced a further six documents, and one article derived from emergency medical technician (EMT) regulation in Taiwan. In total, 52 articles were included in the study, categorized by competency and standards, EMT education and learning environment, curriculum design, and teaching and learning method.

Conclusion: This study reviewed international EMS training and education literature and documents to summarize the essential elements for developing an EMS education system: for example, core competencies and standards, education environment, curriculum design, and teaching and learning method. By connecting the essential elements for developing an EMS education system, a blueprint for the Taiwanese EMS education system can be identified. Analysis and study of the essential elements will provide educators with clear direction in developing the EMS education system in Taiwan.

Keywords: EMT, EMS, curriculum, education standards, teaching methods

Introduction

The primary cause of death in Taiwan is due to chronic diseases such as cancer, cardio- and cerebrovascular disease, pneumonia, and diabetes which places a considerable burden on the Taiwanese health care system.[1] Combined with the epidemiology of health issues and an affordable public health care and welfare system, the increasing demand on the health care system, including the emergency medical services (EMS), is considerable.[1,2] The EMS in Taiwan have served over 23 million people and covered an area of 36,000 km^2 for more than 20 years.[3] In 1995, the first EMS Act was legislated and became the stepping stone for the development of an EMS system in Taiwan. The EMS Act designated the EMS as one of the essential missions for Fire Departments which are overseen by the National Fire Agency (NFA) and the Health Department.

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The current annual EMS workload is one million cases, projected to increase by an average of two percent each year.[2,4]

In 2015, there were 12,555 firefighter-emergency medical technicians (EMTs) in the Fire Departments across Taiwan, responsible for Fire Rescue and EMS duties in their designated jurisdictions.[4] There are three levels of EMT in Taiwan: EMT-1, EMT-2, and EMT-Paramedic. Eleven percent of all firefighter-EMTs are at EMT-1 which is the basic level of EMT, while the majority (over 80 percent) of firefighter-EMTs are at EMT-2 level. The highest level is EMT-Paramedic which accounts for less than 10 percent of all firefighter-EMTs.[4,5] Figure 1 illustrates the hierarchy of EMT levels and their scope of practice as listed in the EMT Administration Regulation.[5] The EMT Administration Regulation stipulates that to be eligible to teach on the EMT-Paramedic training course, instructors must be a doctor, a registered nurse, an EMT-Paramedic, or an EMT-2 with at least three years' experience in EMS.[5]

The EMS Act and the EMT Administration Regulation shape the Taiwanese EMT training system through license-based vocational training. Qualified organizations in Taiwan are eligible to provide training courses from EMT-1 level to EMT-Paramedic level, overseen by the Health Department. These EMT training organizations provide a license to practice to students who successfully pass all examinations. EMT-Paramedic courses and exams are provided by third-party organizations (e.g. the Taiwan Emergency Medicine Association), and the EMT-Paramedic license is authorized by the Health Department.[5]

Internationally, EMS training and education systems have evolved in different ways influenced by the operational needs of individual EMS systems.[5–10] A review of the literature highlighted three predominant EMS education and training systems: vocational licensure, graduated certification, and a combination of both. Vocational systems, such as the Taiwanese EMS, rely on training organizations to issue licenses to practice at a nonuniversity level. University or college EMT-Paramedic courses, for example in Australia, provide graduated certification (such as a bachelor degree) for graduate students. The two-tier system, for example in the United States, operates vocational licensure and graduated certification for both private and public EMS needs.

The review of EMS training and education literature suggests there are a number of factors that might affect the
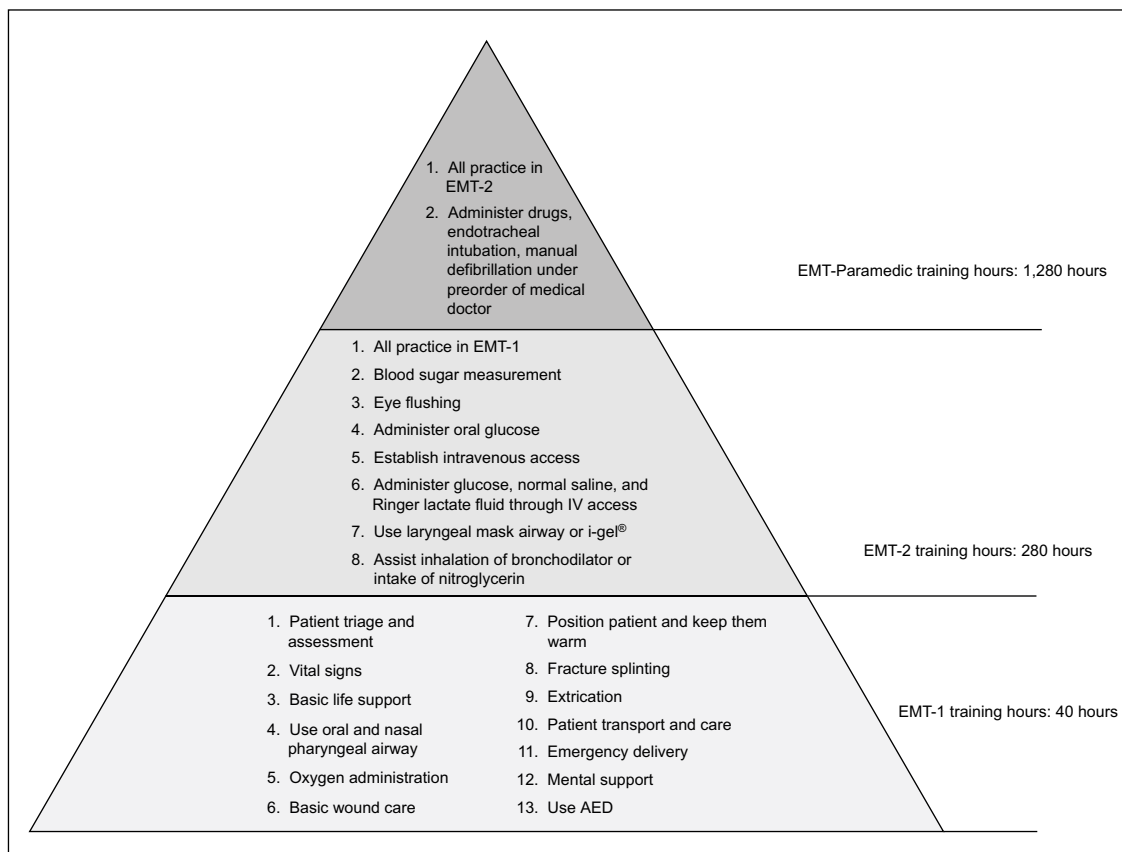

Figure 1 The hierarchy of EMTs' scope of practice in Taiwan.
Note: i-gel®, Intersurgical Ltd, Wokingham, UK.
Abbreviations: AED, automated external defibrillator; EMT, emergency medical technician.

development of training and education: national standards and curriculum; teaching method and learning environment; research development; and Acts and Regulations.[11–20] For example, the EMT Administration Regulation as part of the EMS Act in Taiwan sets the number of training hours and curricula topics for the three levels of EMT and leads training course structure and operation within the vocational licensure system.

Taiwanese EMS training development is currently in a transitional phase due to increasing demand and advancements in clinical skill sets.[4] The findings of a study by Kuo et al which investigated EMT-2s' requirement for in-service education revealed a gap between curricula standards in EMT Administration Regulation and clinical practice needs for first-line EMS workers in Taiwan.[21] In order to remedy this disconnect, there is a clear need to review and modify training and education content in Taiwan across all levels of EMT training. Therefore, the aim of this study was to review the current literature to compare the key factors of EMS training and education development in different countries. The findings offer educators in Taiwan opportunities for developing a new curricula blueprint for the national EMS training system.

Methods

The scope of the literature review was restricted to searches on the subject of EMS training and education, with findings from the key studies summarized to assist identification of the primary needs of the EMT educational curriculum in Taiwan. The method follows the six stages of scoping review structure as outlined by Arksey and O'Malley's.[22]

Identify the research question

The following research question was developed to inform the review: "What factors can meet the educational and curriculum needs for EMTs in Taiwan?"

Identify relevant studies

Five databases were searched for relevant articles in this study: MEDLINE, EMBASE, Allied and Complementary Medicine Database; Education Resources Information Center, and Google Scholar. The gray literature sites https://www.phecit.ie/, http://www.caa.net.au/, https://www.nremt.org/, http://www.paramedic.ca/, and http://www.hpcsa.co.za/PBEmergencyCare/Registration were searched for non-peer-reviewed articles and national EMS educational/curricula standards. Hand-searching and backward and forward reference searching of articles and documents were

also conducted. The year of searched articles was limited from 2000 to 2016. The search terms used in the strategy combined with two research concepts: EMT/EMS and curriculum/education-related MeSH and keywords. The EMT/EMS group of terms were: "EMT", "EMS", "ambulance", "paramedic*", "emergency medical technician", and "emergency medical services". The curriculum/education terms were: "curriculum", "education", "standards", and "teaching methods". The search strategies for each database are listed in the Supplementary material.

Study selection

The initial search of five databases produced 1,230 articles after elimination of duplicates. The process of title and abstract screening excluded 1,158 articles which were not relevant to the aim of this study. The remaining 72 articles underwent a full-text screening process by two independent reviewers. Of these, 25 pre-2000 articles were excluded due to curriculum and/or standards being too old; a further 25 articles had no supportive data or, ultimately, failed to address the research question. Twenty-two articles remained after full-text review. There were 23 additional articles produced by reference and citation research and consultation with international EMS education experts, six documents from national EMT curricula standards, and one from EMT Administration Regulation in Taiwan. The final yield for the literature review was 52 articles (Figure 2).

Charting the data

Charting data is a valid descriptive analytical method and uses a standardized form to collect and organize information from literature searches.[22] Table 1 displays the summary of charting data through categorization of year, author, location, study type, population, and main findings.

Collating, summarizing, and reporting results

Of the 45 peer-reviewed articles, 18 were qualitative studies, 24 were quantitative studies, and three were mixed method. Sixteen studies from the 45 articles collected data from questionnaires. Of these, 28 were from Australia, nine from the US, four from the UK, and four from Finland, Sweden, the Kingdom of Saudi Arabia, and Taiwan. Five main topics or themes were identified from the 45 articles: EMT competency; EMT education; curriculum design; training standards; and teaching and learning methods. The following discussion will be based on the findings of articles on each topic.
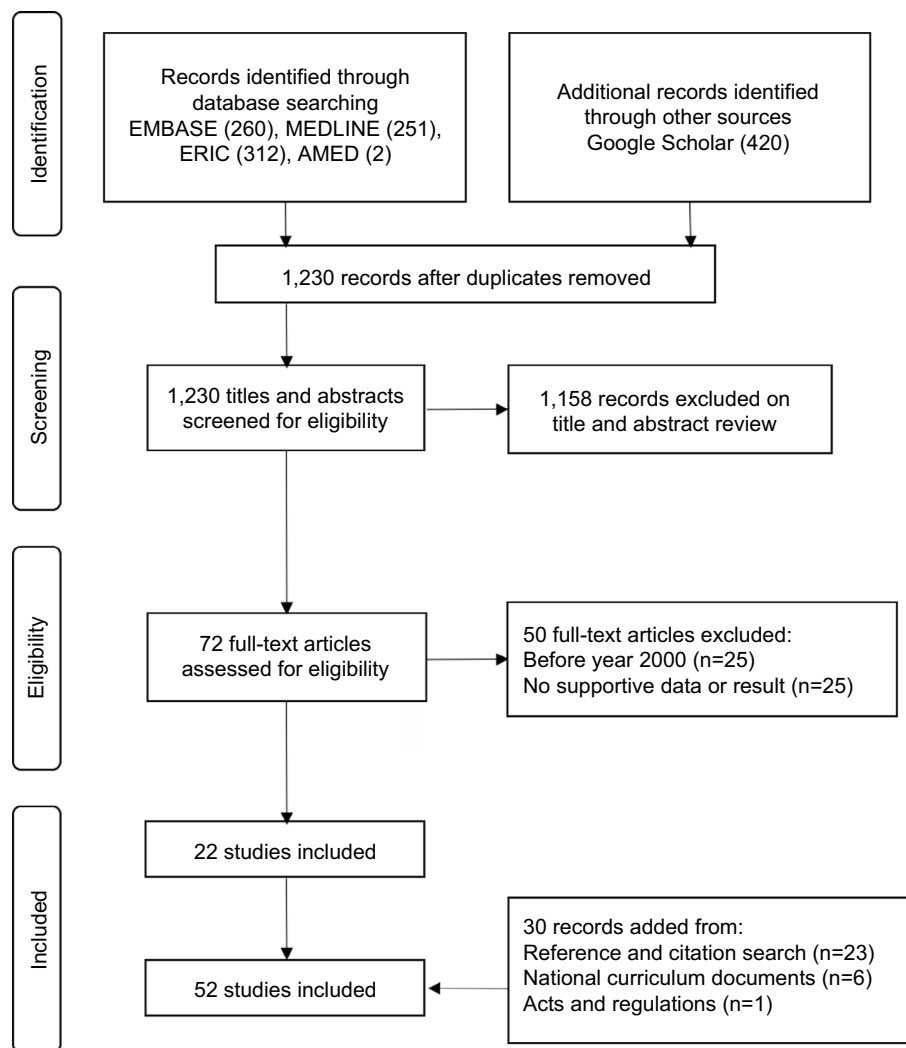
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│                 │  │ Records identified through │  │ Additional records identified │
│ Identification  │  │ database searching         │  │ through other sources         │
│                 │  │ EMBASE (260), MEDLINE (251),│  │ Google Scholar (420)         │
│                 │  │ ERIC (312), AMED (2)        │  │                               │
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Figure 2 Study selection process and result.
Abbreviations: AMED, Allied and Complementary Medicine Database; ERIC, Education Resources Information Center.

Expert consultation

Several international EMS education experts were consulted which resulted in the addition of further papers.

Discussion

The findings from the studies included in the literature review indicated that EMS training and education in many countries is in a transitional stage.[4,13] Searching and reviewing the available literature identified several factors that can be considered essential in relation to EMS education. These include competency and standards, curriculum design, registration and accreditation, teaching and learning methods, acts and regulations, research in EMS, and training organization administration. No available literature was found on Taiwanese EMS curriculum and education system design. This discussion therefore focuses on the themes suggested by the literature review which offer opportunities for informing,

updating, and improving the current EMS training and education system in Taiwan.

EMT-Paramedic competencies and standards

Core competencies and standards for paramedics are essential for educational quality assurance, accreditation, benchmarking, and informed and improved clinical practice.[12,15,16,23–27] In order to compare the international EMT-Paramedic competencies and standards to the current situation in Taiwan, Table 2 summarizes EMT-Paramedic competencies and standards in Taiwan, Australia, the US, the UK, Ireland, Canada, and South Africa.[5–10,28] These countries were chosen as they all have well-established EMS systems and are likely to offer international consensus for comparison with Taiwan. The competencies and standards documents from the EMS or ambulance services, education accreditation councils,

Table 1 Overview of included articles

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2000	Melby[49]	UK	Qualitative	Are nursing students on ambulance placement both educational and valuable?	To explore the effects of experiential learning in prehospital emergency care by nursing students on placement	191 nursing students from University of Ulster who undertook trauma placement between 1992 and 1999	Experiential learning has great potential for expanding and understanding knowledge and skills. The study recommends that experiential learning placement in prehospital emergency care is made a compulsory part of preregistration education for nurses
2004	Kilner[16]	UK	Mixed method	What are the desirable attributes of the ambulance technician, paramedic, and clinical supervisor?	To identify those attributes experts regard as desirable qualities in the ambulance technician, paramedic, and clinical supervisor	Expert panel: 93 people in the first round and 42 in the second round	This study identified some of the desirable attributes in three occupational groups within contemporary ambulance services in the UK. The curriculum has become the driving force for defining the occupational groups
2004	Kilner[24]	UK	Quantitative method (factor analysis)	Can desirable attributes inform future curriculum development?	To use information about the desirable attributes of the ambulance technician, paramedic, and clinical supervisor to inform future curriculum development	Expert panel: 93 people in the first round and 42 in the second round	The profile of desirable attributes emerging from this study is remarkably similar to the generic benchmark statements for health care programs outlined by the Quality Assurance Agency for Higher Education
2005	Russ-Eft et al[36]	US	Quantitative	The major questions revolved around issues related to the quality and costs of the instruction	This study aimed to identify the needed literature on the role of training and instructional quality, particularly as perceived by trainees on EMT preparedness	185,000 EMTs in NREMT database	Results showed significant differences based on instructor quality in the ratings on different dimensions of EMT preparedness for both EMT Basic and EMT-Paramedic
2005	Williams[38]	Australia	Literature review	Is there scope for this educational paradigm in prehospital education?	This paper discusses the findings of a literature review of CBL from a multidisciplinary health science education perspective, and attempts to draw comparisons with the available literature relating to prehospital education and CBL	Available literature relating to prehospital education and CBL	The majority of the evidence revealed that CBL was enjoyed by both students and tutors

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Table I (*Continued*)

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2005	Brown et al[42]	US	Quantitative	How to quantify EMTs' professional behavior by their peers?	Uses peer evaluation methodology to assess the effective competencies of practicing EMS providers	2,443 randomly selected EMTs	Overall, EMTs' peer evaluation of professional behavior was "good". Different levels of EMT, as a peer, considered different professional behavior as important to their partners
2005	Cooper[13]	UK	Qualitative	What are the perspectives of training course stakeholders of contemporary UK paramedic training and education?	To develop an understanding of the current system and future development of training and education within a large UK ambulance trust, based upon the experiences, beliefs, and opinions of stakeholders	44 interviews with a range of ambulance staff	This study indicated that the ambulance service in the UK is in a transition stage with organizational, professional, and cultural challenges
2006	Williams[19]	Australia	Qualitative	N/A	Introduction of web-based innovative teaching and learning landscape for BEH-P	N/A	This innovative CBL approach supports students in a paramedic bachelor program
2006	Williams[39]	Australia	Qualitative	What are student paramedic perceptions of CBL in the clinical curriculum of the BEH degree at Monash University?	To identify student paramedic perceptions of CBL in the clinical curriculum of the BEH degree at Monash University	69 second- and third-year students participated	CBL appears to be a useful and enjoyable teaching and learning approach.
2007	Salzman et al[32]	US	Retrospective quantitative study	Can paramedic students complete the NSC-P internship recommendation?	To examine the completion of the NSC-P internship recommendation by paramedic students	1,817 students from 98 paramedic programs in 38 states	Most paramedic students did not complete the requirements for NSC-P. It is necessary for educators to create new approaches to prepare paramedic students to complete NSC-P recommendations
2007	Boyle et al[51]	Australia	Qualitative	How can a paramedic clinical simulation center meet needs in Victoria?	To describe how the indoor simulation center and the outdoor road trauma simulation center provide a more realistic experience for undergraduate paramedic students in Victoria	N/A	Clinical simulation can improve prehospital care
2007	Hallikainen et al[14]	Finland	Quantitative (questionnaire)	What are the levels of satisfaction for an interprofessional education program in paramedic and medical students?	To describe the concept of interprofessional education in medical students and paramedics in emergency medicine	47 students completed the program in 2001 and 2005	Coeducation in emergency medicine of paramedics and medical students has worked well to the satisfaction of both students and teachers

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Table 1 (*Continued*)

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2008	Hamilton[55]	Australia	Qualitative	Does the teaching and learning model improve the quality of the first-year student learning experience?	To present a teaching and learning model applied within a first-year core subject taught within the Prehospital Care course at Charles Sturt University	N/A	Information literacy can develop graduate attributes and improve learning outcomes
2008	Reeve et al[23]	Australia	Quantitative (questionnaire)	What are the perceptions of paramedics after finishing a Rural and Remote Paramedic Practice course?	To describe the experiences of paramedics doing the population health component of the Graduate Certificate in Rural and Remote Paramedic Practice	29 students based in 27 rural and remote Queensland locations	The findings suggest that the culture of rural and remote paramedics within the Queensland Ambulance Service is changing to incorporate a longitudinal perspective in the form of primary health care
2008	Boyle et al[47]	Australia	Quantitative (questionnaire)	What are the perceptions of paramedic students of clinical placement?	To identify students' experiences during ambulance clinical placement and to provide feedback to the ambulance services	77 students participated in the survey	This study demonstrated that students' experiences on clinical placement were not positive due to self-doubt in their performance in the working environment
2009	Williams[40]	Australia	Quantitative (questionnaire)	What are the perceptions and attitudes of paramedic students to the CBL process?	To assess BEH students' perceptions and attitudes as participants in a CBL process	247 paramedic students	CBL appears to be a useful and enjoyable teaching and learning tool for students enrolled in a paramedic bachelor program
2009	Hryciw[37]	Australia	Quantitative	What are the perceptions of paramedic students to the health fact sheet assessment task?	The aims of the assessment task were to improve their understanding of basic anatomy and physiology, and to enhance essential workplace skills such as communicating scientific concepts to members of the general public	166 students completed the task	The health fact sheet assessment task was a valuable tool in an undergraduate paramedic curriculum, reinforcing skills that are relevant to an allied health career
2009	Margolis et al[17]	US	Quantitative	What are the educational strategies that can be used by paramedic educational programs?	To identify the specific educational strategies used by paramedic educational programs that have attained consistently high success rates on the NREMT examination	12 programs were invited to participate	12 specific strategies were identified by high-performing paramedic education programs

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Table 1 (*Continued*)

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2009	Michau et al[56]	Australia	Quantitative (questionnaire)	What is the theory–practice gap in undergraduate paramedic education?	To investigate the theory–practice gap for paramedic students by linking education and skill level to case exposure and skills praxis during clinical placements	84 paramedic students	This study highlighted the need for additional support in clinical placements to enhance students' experience in clinical skill practice and applied knowledge in the field
2009	Williams et al[50]	Australia	Mixed method	Can DVD simulations provide an effective alternative for paramedic clinical placement education?	To evaluate the usability of DVD simulations, their impact on student learning satisfaction, and the potential for using DVD simulations to reduce the clinical placement burden on the current health care system	97 paramedic students from Monash University	Paramedic students reported the simulations as being educationally, professionally, and clinically relevant. The students also identified some aspects of current clinical placements that may be replaced by using DVD simulations
2009	Wray and McCall[18]	Australia	Qualitative	What are the perceptions of undergraduate midwifery, paramedic, and medical students' experiences of educational reform in the clinical teaching environment?	This paper reports on medical, midwifery, and paramedic students' perception of the impact of education reform that they experienced in the clinical setting	130 undergraduate and graduate students	Curriculum developers and academics involved in developing new programs or modifying existing programs need to engage with change management models and draw on the experiences of the professions who have demonstrated managing education reforms successfully
2010	Willis et al[20]	Australia	Qualitative	What are the perceptions of an interview and focus group of the gap between university- and industrial-based paramedics?	To identify the gap between university- and industrial-based paramedics	Seven focus groups were interviewed, with 12 people in each group	Lack of graduate maturity and road-readiness is a major gap in university-based education
2010	Williams et al[12]	Australia	Quantitative (questionnaire)	Which graduate attributes best meet the current and future needs of the Australian paramedic discipline?	To establish which graduate attributes best meet the current and future needs of the Australian paramedic discipline	63 expert participants	It is critical that empirically based paramedic graduate attributes are developed and agreed upon by both industry and teaching institutions. Until this occurs, national standardization, accreditation, and benchmarking of Australian paramedic education programs will not be possible

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Table 1 (*Continued*)

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2011	Brown et al[48]	Australia	Quantitative (questionnaire)	What is the mismatch between perceived and preferred expectations of undergraduate health science students?	To investigate how undergraduate students enrolled in health-related education programs view their clinical learning environments and, specifically, to compare students' perception of their "actual" clinical learning environment to that of their "preferred/ideal" clinical learning environment	548 undergraduate health science students from Monash University	The study indicated the importance of a supportive clinical learning environment for students and two-way communication between instructors and students to improve the learning environment
2011	Brown et al[29]	Australia	Quantitative (questionnaire)	What are student perceptions of learning environments at a major Australian university?	To investigate student perceptions of learning environments at a major Australian university	548 undergraduate health science students from Monash University	The positive perception held by Monash University health science students towards their education and learning environments is hopefully indicative of similar courses within Australia and internationally
2013	Ross et al[57]	Australia	Quantitative (questionnaire)	What are students' views of teachers using the Clinical Teaching Effectiveness Inventory?	To examine undergraduate students' views of paramedic clinical teachers from a large Australian university	57 Monash University Emergency Health undergraduate students	The results of this study indicated that the clinical teachers involved are able to assist graduates with the integration of theory into practice by providing a positive learning environment that promotes great depth of understanding and autonomy
2012	Alanazi[11]	Kingdom of Saudi Arabia	Qualitative	How to design an EMS curriculum in a logical approach?	To discuss the major adaptations required for adoption of the fully fledged PBL curriculum, use of sequential blocks, and multilayer alignment of the curriculum	An expert panel	There is a need to "localize/adopt" curriculums to specific regions (taking into account health priority areas and cultural norms and practices), and not just to implement existing curriculums from other universities
2012	Williams et al[25]	Australia	Quantitative method (factor analysis)	Can Rasch analysis and factor analysis be used to perform construct validity of the PGAS?	To examine the construct validity of the PGAS using factor analysis and Rasch analysis	872 participants	The seven-factor PGAS produced a good fit to the Rasch model and exhibited good reliability and unidimensionality, offering the Australian paramedic discipline a set of empirically based graduate attributes

Table 1 (*Continued*)

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2012	Kuo et al[21]	Taiwan	Quantitative (questionnaire)	What are the in-service education needs for EMTs in New Taipei City?	To explore EMT in-service education needs in New Taipei City	1,127 participants	This study suggested that it is necessary to consider the contents of an in-service education program for EMTs in different EMS units to meet their professional development requirements
2013	Williams et al[53]	Australia	Quantitative (questionnaire)	Are paramedic students ready for self-directed learning?	To determine undergraduate paramedic students' attitudes and readiness towards self-directed learning at four Australian universities	259 student participants	This study suggested undergraduate paramedic students from four different Australian universities possess an adequate level of self-directed learning readiness. As paramedic-orientated degree programs continue to emerge and develop, establishing SDL needs will assist paramedic educators in diagnosing student learning needs, and assist in shaping contemporary and student-centered curricula
2013	Williams et al[41]	Australia	Quantitative (questionnaire)	Are paramedic students ready for interprofessional learning?	To assess the attitudes of paramedic students to interprofessional learning across five Australian universities	303 paramedic students from five universities	This study discussed students' readiness for interprofessional cooperation and found that tertiary institutions produced different levels of interprofessional education
2014	Williams et al[43]	Australia	Quantitative (questionnaire)	How is peer-teaching perceived by first-year paramedic students?	To examine the perceptions of first-year paramedic peer learners being taught by peer teachers over a three-year period	361 peer learners participated	Results suggest that peer learners believe teaching is an important role for paramedics, and communication between peer learners and teachers was slightly better compared with their tutors
2014	Ross and Williams[35]	Australia	Quantitative (questionnaire)	Would paramedic students' active engagement with elderly patients enhance their ability to develop rapport with elderly patients?	To investigate whether paramedic students' active engagement with elderly patients would enhance their ability to develop rapport with elderly patients, and what impact guided self-reflection would have on this	11 undergraduate students	Students recorded improved confidence, empathy, and overall ability to build rapport with the elderly through this engagement activity

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Table 1 (*Continued*)

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2014	Williams and Fowler[46]	Australia	Quantitative	Can near-peer teaching improve academic performance?	To examine whether a near-peer teaching program improved the overall clinical unit scores of undergraduate paramedic near-peer teachers	74 students participated	This study demonstrated that participation in a near-peer teaching program can result in improved overall clinical unit grades for undergraduate paramedic near-peer teachers
2014	Brice et al[34]	US	Qualitative	How to develop an EMS curriculum for emergency medicine fellows?	To describe a curriculum that is congruent with current EMS core content, as well as providing a 12-month format to deploy the curriculum in an EMS fellowship program	N/A	This study indicated elements and factors for the development of an EMS curriculum in each step
2014	O'Meara et al[30]	Australia	Qualitative	What can the paramedic curriculum change to extend their community role?	To describe one rural community paramedic model and identify enablers related to the implementation of the model	40 participants from different focus groups	Educational programs hoping to include a wider range of topics face the twin challenges of an already crowded curriculum and predominately young students who fail to see the relevance of community primary care content
2014	Abelsson et al[52]	Sweden	Qualitative	How does simulation affect the paramedic learning process?	To provide an overview of the development and foci of research on simulation in prehospital care practice	N/A	Simulation was described as a positive training and education method for prehospital medical staff. It provides opportunities to train in assessment, treatment, and the implementation of procedures and devices under realistic conditions
2015	Brooks et al[31]	Australia/US	Qualitative	What is the changing process of the US EMS education system and its current status?	To describe US EMS education milestones and identify themes that provide context to readers outside the US	N/A	Implementation and evaluation of the national US EMS system would be a valuable addition to the US EMS literature
2015	Williams et al[45]	Australia	Quantitative (questionnaire)	What are the learning and teaching experiences of peer teachers on a paramedic course?	To examine the effects of an educational intervention on students' PAL experiences as peer teachers	38 peers participated in this study	This PAL project yielded important information for the continual development of paramedic education. Although PAL increases students' confidence, the full role of PAL in education remains unexplored

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Table 1 (*Continued*)

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2015	Williams et al[44]	Australia	Quantitative (questionnaire)	What are the experiences of near-peer teaching program in third-year paramedic students in Monash University?	To examine the perceptions and satisfaction levels of students participating in NPT over a 3-year period at a large Australian university	74 peer teachers involved in this study	The near-peer teaching program has been effective in the education of the paramedic students who participated, developing teaching, mentoring, and learning skills to adopt during their graduate year and future career in the paramedic discipline
2015	Renkiewicz and Hubble[54]	US	Mixed method	Does the preparatory program positively affect the attrition rate in EMS students?	To measure the impact of a preparatory course designed to address academic and psychosocial skills affecting EMT course completion	200 EMTs participated	Students who participated in an EMS preparatory course were five times more likely to achieve course completion and the proportion that enrolled but never attended an EMT course was reduced
2015	Thompson et al[15]	Australia	Qualitative	Paramedic capstone education model: How to build work-ready graduates by applying the paramedic capstone education model?	Capstone subjects target the final preparation of the graduating student, with a strong emphasis on articulating them successfully with their chosen industrial settings	N/A	It is clear from the research that no single teaching approach or assessment method offers the panacea of paramedic education, but what is clear is a need to recognize the different ways students learn and to be adaptable in embracing new methods and generational technologies
2009	Pullum et al[58]	US	Qualitative	What is the effect and experience of prehospital providers in rural areas?	To provide a retrospective analysis of training methods used by rural Montana's prehospital care providers	N/A	Emergency medical services administrators, educators, instructors, trainers, and providers must all challenge themselves to look for creative solutions to meet the educational demands and needs of the 21st century
2012	Ministry of the Interior; Republic of China (Taiwan)[59]	Taiwan	Legislation document	N/A	N/A	N/A	This regulation falls under the EMS Act that lists the EMT and EMT training organization's administration rules, including the standard curricula topics for all levels of EMT
2011	Paramedic Association of Canada[10]	Canada	Competency and standards document	N/A	N/A	N/A	This document includes the competencies and the performance environment for all levels of paramedics in Canada

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Table 1 (*Continued*)

Year	Reference	Location	Study type	Study question	Aim(s)	Population	Main findings
2010	Council of Ambulance Authorities Inc[28]	Australia	Competency and standards document	N/A	N/A	N/A	This document lists the graduate competencies for Australian paramedics
2014	College of Paramedics[9]	UK	Competency and standards document	N/A	N/A	N/A	This is curriculum guidance includes paramedic curriculum standards, and outlines the content of each curricula topic
2014	Prehospital Emergency Care Council[7]	Ireland	Competency and standards document	N/A	N/A	N/A	This document lists the scope of practice and the description of each practice
2007	National Highway Traffic Safety Administration[8]	US	Competency and standards document	N/A	N/A	N/A	This document provides a national scope of practice for all levels of EMT in the US. It also describes the training and accreditation system for EMS professionals
2009	Health Professional Council of South Africa[6]	South Africa	Competency and standards document	N/A	N/A	N/A	This document provides detailed information about the education system and curriculum design in South Africa. It also includes the requirements of education institutions and student enrollment

Abbreviations: DVD, digital video disk; EMT, emergency medical technician; NREMT, National Registry of Emergency Medical Technicians; CBL, case-based learning; EMS, emergency medical services; BEH-P, Bachelor of Emergency Health Paramedic; BEH, Bachelor of Emergency Health; NSC-P, National Standard of Curriculum Paramedic; PBL, problem-based learning; PGAS, Paramedic Graduate Attribute Scale; SDL, self-directed learning; PAL, peer-assisted learning; N/A, not available; NPT, near-peer teaching.

Table 2 Overview of global EMT-Paramedic competencies and standards

Items/countries	Taiwan	Australia	US	UK	Ireland	Canada	South Africa
Education/training system (vocational and/or university)	Vocational	University	Both	Both	Both	Vocational	Both
Professionalism	X	X	X	X	X	X	X
Clinical decision making		X	X	X	X	X	X
Ethics and law	X	X	X	X	X	X	X
Communication	X	X	X	X	X	X	X
Demonstration of knowledge	X	X	X	X	X	X	X
Occupational safety		X	X	X	X	X	X
Identifying and assessing social care		X	X	X	X	X	X
Identifying and assessing mental care	X	X	X	X	X	X	X
Identifying and assessing health care	X	X	X	X	X	X	X
Formulating and delivering clinical practice	X	X	X	X	X	X	X
Clinical skills	X	X	X	X	X	X	X
Criticality assessment	X	X	X	X	X	X	X
Academic skills		X		X			X
Interprofessional skills		X					X

Notes: X = the general competency item is included in the competencies and standards document. Data from references 5–10 and 28.
Abbreviation: EMT, emergency medical technician.

or national legislation in each country were searched and screened.

Table 2 lists the type of training and education system in each country (vocational training, university degree, or both) and extracts of general items from each competency document across each of the selected countries. Each competency document listed or described the competencies and standards of EMT-Paramedic in the respective country. The

general competency items in Table 2 are derived from similar descriptions of competencies and standards in the documents from each country: professionalism; clinical decision making; ethics and law, and communication; demonstration of knowledge; occupational safety; identifying and assessing social care; identifying and assessing mental care; identifying and assessing health care; formulating and delivering clinical practice; clinical skills; criticality assessment; academic skills; and interprofessional skills.

The findings indicate that Australia is the only country that trains paramedics completely at university level with other countries adopting a combination of university and vocational-based training systems. Of the countries reviewed, Taiwan and Canada use the vocational training system solely for training EMTs and paramedics. The only countries that contain all the general competency items in their competency documents are Australia and South Africa. In the UK, paramedic competency includes 13 of the 14 general items, the only exception being interprofessional skills. Although the US paramedic education system includes university-based education, academic and interprofessional skills are not mentioned in the relevant competency documents. In the Taiwanese context, EMT-Paramedic competencies cover fewer items than in the other six countries.

Compared to other countries, the approach in Taiwan to setting EMT-Paramedic competencies and standards is unique. The EMT Administration Regulation is a legal document that contains regulations for EMT-Paramedic in Taiwan including the administration of training organizations, the competencies expected of EMTs, and course structure for all levels of EMT.[5] In reviewing the 20-year history of the Taiwanese EMS, it is clear that the populace's demand for ambulance services has exceeded stakeholders' expectations, including those of EMTs and paramedics themselves. Hence, there is a need for the role and mission of EMT-Paramedic to be reviewed by the EMS governance agencies.[4] However, the ability to monitor the quality of EMT services in Taiwan is restricted by issues concerning total training hours, course content, the qualification criteria of EMT instructors, and the lack of national evaluation standards within training organizations.[5]

For example, the skill-based vocational training of EMTs in Taiwan offers limited training hours, and courses therefore may not be able to cover nontechnical skills such as clinical decision making, identifying and assessing social care, and academic and interprofessional skills – items recognized as essential competencies for EMT-Paramedic in other countries. With Taiwanese EMT training in transition, it is necessary to reconsider what constitutes core competencies and to ensure they are consistent with modern EMS requirements and international standards, and societal expectations in Taiwan.

EMT education and learning environment

Internationally, universities and vocational training organizations offer different course content weighting on EMT-Paramedic training. Willis et al conducted a qualitative study in 2011 using interview focus groups in both university education and industry training to address graduate maturity and road-readiness.[20] The study revealed that conflict existed between paramedic university education and the industry environment where results indicated that the university arena provided students with longer teaching and learning hours compared with vocational training. University EMT-Paramedic training also offered more comprehensive and in-depth knowledge of prehospital care, academic resources, and supportive sciences such as psychological and sociological management to enhance graduate maturity, develop students' interpersonal skills and ability to apply knowledge.[20] Moreover, Brown et al's study in 2011 showed that health science students (including paramedics) in universities had positive perceptions of a learning environment in which they were exposed to a combination of traditional classroom-based teaching, practical skills workshops, and clinical fieldwork or practice education placements.[29] Although students in universities have less exposure to clinical practice in the field than industry-trained paramedics, the comprehensive medical and health science knowledge taught in universities has been shown to provide students with the necessary theoretical and practical skills required to become a health care practitioner.[20,30]

The evaluation of EMS/Paramedic education is an essential component in the quality control of EMTs and paramedics. In 2015, Brooks et al reviewed the EMS education system in the US and observed an inconsistency in EMT-Paramedic registration between individual states which acted as a barrier to attempts by education providers to implement national EMS education standards.[31] The same authors contrasted the situation in Australia where ambulance services determine paramedics' scope of practice in their respective jurisdictions, and tertiary qualification provides employers with comparable levels of skill and knowledge, thereby enabling portability of qualifications across states.[31] Based on such findings, the EMS education environment, education agenda and standards, and the scope of ambulance services' practice are interrelated and influence the quality of EMS education.

In Taiwan, one single document, the EMT Administration Regulation, indicates the scope of practice and curriculum standards for all levels of EMT, but no national EMT-related training and education standards exist for EMT instructors as guidance for training and curriculum design.

Curriculum design

A review of UK paramedic training, with the aim of better understanding education issues and determining future recommendations, identified four issues concerning curricula: entry level (accrediting prior learning); program issues (content and time); assessment and competency; and moving towards a graduate profession.[13] In essence, the authors concluded that for EMS in transition, in working towards a graduate profession, stakeholders should review current societal needs and the demands placed on the health care system, and modify curricula accordingly to ensure better prehospital care services. Salzman et al indicated that paramedic students' completion rate of the National Standard of Curriculum Paramedic was low and recommended that curriculum design and national standards be made available and adapted at the local level.[32]

Other studies have suggested additional solutions for developing an improved EMT-Paramedic curriculum including that of Margolis which identified 12 strategies to provide a general concept of curriculum design.[33] In exploring concepts to design more effective curricula for paramedic courses at university level, several authors have demonstrated that courses, curricula, and standards from one national setting can be successfully adapted for EMS training and education in other countries.[11,34] Such studies provide guidance for Taiwanese EMS training instructors in redesigning current curricula standards and content.

EMT-Paramedic training institutes in Taiwan follow the training curriculum standards in the EMT Administration Regulation where the training hours that are set for each course subject in the curriculum reflect the skills-centered context and skills-based training culture. For example, Kuo et al in surveying the continuous professional development (CPD) needs of EMT-2 in the New Taipei City Fire Department recommended the redesign of the Fire Department's in-service education program.[21] Their study identified that the CPD needs of EMT-2s vary according to the type of response unit, for example advanced life support or basic life support units. However, the findings of this study were at odds with the compulsory CPD program requirements as outlined in the EMT Administration Regulation. The education needs identi-

fied, such as communication skills and emotional management, were not included in the compulsory CPD course for all levels of EMT in Taiwan. This highlights the importance of providing clear direction to the Taiwanese EMS training and education system in establishing core EMT competencies and leading the design of curriculum for EMTs.

Teaching and learning methods

It has been documented that teaching and learning approaches can influence the efficiency of education and affect student performance.[35–37] In the Taiwanese context, where EMT training organizations and the learning environment are still based on traditional T&L approaches, there are no studies that have reviewed or discussed T&L methods in EMT-Paramedic training. The EMT training curriculum in Taiwan determines the training hours for each subject,[5] which forces instructors to reduce course content, leading to situations where they struggle to teach the necessary knowledge and skills in some subjects. The implementation of novel T&L methods, as identified in the literature review, in EMT curricula in Taiwan might increase the efficiency of teaching for instructors. A number of specific methods are discussed later in this paper.

Case-based learning

Case-based learning (CBL) is derived from problem-based learning and is applied widely in health care education across the globe.[38] Williams conducted a series of studies investigating the implementation of CBL in paramedic education curricula in Australia between 2005 and 2009.[19,38–40] The results demonstrated that CBL not only provided enjoyable learning experiences for students but also improved their interaction with peers and teachers.[19,39] Williams also expanded the experience of using CBL to an online education platform that allowed students to reduce the amount of time spent in the classroom whilst maintaining a similar learning environment and participation in activities.[38,39] In this research, cases are based on authentic clinical situations where students explore real scenarios in depth and respond to them by applying the knowledge they have learnt. Within the short timeframes of EMT training in Taiwan, students have far fewer opportunities for CBL and exposure to real clinical scenarios and patients (there are no placements for EMT-1; 96 hours for EMT-2; and, 240 hours for EMT-Paramedic). CBL therefore offers Taiwanese EMT students opportunities to practice and apply their knowledge to real cases before they start work in the field.

Interprofessional education

Interprofessional work is a common feature of the health care environment in which the various health care disciplines work with each other to ensure continuity of care for patients.[41] Two studies were identified in the literature review that highlight the necessity of implementing interprofessional education (IPE) in paramedic curriculum.[14,41] Williams et al[50] also state that timing introduction of IPE is essential and that it must be viewed as a professional development process. The Taiwanese EMT Administration Regulation does not currently include IPE in either the EMT competencies or standard curriculum sections. As demand for EMS in Taiwan increases, IPE is an essential requirement for EMTs to ensure the Taiwanese health care system works in an effective and efficient manner.

Peer teaching

Peer-assisted learning (PAL) has been used in health care education for several decades, and has a proven track record in benefitting paramedic students' performance in both the clinical and academic arenas.[42–46] In Taiwan, peers have no teaching role in EMT training courses due to restrictions on time available for training and low numbers of instructors and peers in training organizations. It is recommended that PAL is adopted as a key component in the development of EMT training in Taiwan.

Clinical placements

Clinical placements are an integral part of the learning process in EMT-Paramedic education.[47] For EMT-Paramedic students, clinical placement provides them with a real working environment and patients to manage, and opportunities to apply the knowledge they have learned in the classroom. In addition to prehospital placements, paramedics also undertake ambulance placements, affording students opportunities to work with nursing students and emergency room nurses, thereby increasing their experience and improving their interprofessional skills.[18,47–50] With the exception of EMT-1 level, EMT students in Taiwan are required to complete ambulance and emergency room placement as part of their course. However, the fact that clinical placement occupies more than half of the available training hours on EMT-2 and EMT-Paramedic courses means that in-class and practice training hours are significantly less than in EMT-Paramedic training in other countries.[5] Securing an ideal balance between in-class and placement hours requires further exploration using approaches that measure the number of training hours needed to acquire skills and core competencies.

Other methods

Simulation is recognized internationally as an important component in health care education in universities and hospitals. Several studies have highlighted the value of simulation as a method of learning in paramedic training, with significant benefits in terms of handling medical and trauma emergencies and students' professional development.[51,52] It should be acknowledged, however, that setting up a simulation service can present a challenge to many training organizations, due to the high costs involved and finding available space.

Williams et al purport that establishing self-directed learning (SDL) needs will assist paramedic educators in diagnosing student learning needs, and assist in shaping a contemporary and student-centered curriculum.[53] Preparatory courses for reducing attrition rates in EMT training are another recommendation for improving the delivery of EMT training.[54] Opportunities to introduce SDL and preparatory courses to EMT training and education in Taiwan should therefore be explored.

Limitations

Only articles in English and Chinese were included in the search process, and it is possible that some EMS education-related articles in other languages may have been missed.

Future research

This study compared Taiwanese EMT competencies to international standards, and explored several key factors for improving EMT training and education curricula in Taiwan. According to the findings of this scoping review, current EMT scope of practice and curriculum standards in Taiwan do not provide clear direction and guidance for stakeholders in the EMT training system. There is a clear need to establish EMT core competencies in Taiwan to improve the training system and modify curricula content, with the purpose of meeting societal and the health care system's needs. It is therefore recommended that future research explores all levels of EMT core competencies in Taiwan to establish a clear direction for the development and implementation of an improved Taiwanese EMT education system.

Conclusion

This study reviewed the international EMS training and education literature and documents to summarize the essential elements for developing an EMS education system. These essential elements were identified as core competencies and standards, education environment, curriculum design, and

teaching and learning method. Comparison of Taiwanese EMS training standards and scope of practice with those in other countries demonstrated that EMS training conditions, development, and research in Taiwan are insufficient to meet current demand. Connecting the essential elements for developing an EMS education system and studying and analyzing each element provides educators in Taiwan with guidance and a blueprint for the future development of the Taiwanese EMS education system.

Disclosure

The authors report no conflicts of interest in this work.

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Supplementary materials

MEDLINE/EMBASE/AMED search strategy

1. EMT.tw
2. EMS.tw
3. ambulance.tw
4. paramedic*.tw
5. emergency medical technician.tw
6. emergency medical services.tw
7. *Emergency Medical Technicians/ed [Education]
8. Emergency Medical Technicians/st [Standards]
9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10. Curriculum.tw
11. exp Curriculum/st [Standards]
12. *Curriculum/mt [Methods]
13. *Education/mt [Methods] or
14. *Teaching/mt, st [Methods, Standards]
15. 10 or 11 or 12 or 13 or 14
16. 9 and 15

Scopus search strategy

1. ((TITLE-ABS-KEY (emt) OR TITLE-ABS-KEY (ems) OR TITLE-ABS-KEY (ambulance) OR TITLE-ABS-KEY (paramedic*) OR TITLE-ABS-KEY (emergency medical technician) OR TITLE-ABS-KEY (emergency medical services) OR TITLE-ABS-KEY (emergency medical technician AND education) OR TITLE-ABS-KEY (emergency medical technician AND standards)))
2. ((TITLE-ABS-KEY (curriculum) OR TITLE-ABS-KEY (curriculum AND standards) OR TITLE-ABS-KEY (curriculum AND methods) OR TITLE-ABS-KEY (*education AND methods) OR TITLE-ABS-KEY (*teaching AND methods) OR TITLE-ABS-KEY (*teaching AND standards)))
3. (EXCLUDE (SUBJAREA, "ENGI") OR EXCLUDE (SUBJAREA, "AGRI") OR EXCLUDE (SUBJAREA, "BIOC") OR EXCLUDE (SUBJAREA, "COMP") OR EXCLUDE (SUBJAREA, "PHYS") OR EXCLUDE (SUBJAREA, "SOCI") OR EXCLUDE (SUBJAREA, "VETE") OR EXCLUDE (SUBJAREA, "ENVI") OR EXCLUDE (SUBJAREA, "MATH") OR EXCLUDE (SUBJAREA, "MATE") OR EXCLUDE (SUBJAREA, "PHAR") OR EXCLUDE (SUBJAREA, "EART") OR EXCLUDE (SUBJAREA, "CHEM") OR EXCLUDE (SUBJAREA, "IMMU") OR EXCLUDE (SUBJAREA, "NEUR") OR EXCLUDE (SUBJAREA, "PSYC") OR EXCLUDE (SUBJAREA, "CENG") OR EXCLUDE (SUBJAREA, "ENER") OR EXCLUDE (SUBJAREA, "BUSI") OR EXCLUDE (SUBJAREA, "DECI") OR EXCLUDE (SUBJAREA, "ARTS") OR EXCLUDE (SUBJAREA, "ECON") OR EXCLUDE (SUBJAREA, "MULT") OR EXCLUDE (SUBJAREA, "DENT") OR EXCLUDE (SUBJAREA, "Undefined")))
4. 1 and 2 and 3

ERIC search strategy

1. (EMT OR (EMS OR ambulance) OR (paramedic* OR emergency medical technician) OR (emergency medical services))
2. (curriculum OR standards OR methods OR education OR teaching)
3. 1 and 2

Narrow down by source type

(Scholarly Journals OR Reports OR Dissertations & Theses) NOT (Other Sources AND Books AND Encyclopedias & Reference Works)

Abbreviations: AMED, Allied and Complementary Medicine Database; ERIC, Education Resources Information Center.