AUSTRALASIAN JOURNAL OF **PARAMEDICINE**

Improving paramedic confidence with paediatric patients: A scoping review

James Fowler

Monash University, Melbourne, Victoria

Bronwyn Beovich

Monash University, Melbourne, Victoria

Brett Williams

Monash University, Melbourne, Victoria

Review

Improving paramedic confidence with paediatric patients: A scoping review

James Fowler BNurs, BEmergHlth(PMed) is Research Assistant¹, Bronwyn Beovich DipAppSc(Nsg), BAppSc(Ch), MChSc is Research Assistant¹, Brett Williams PhD is Head of Department¹

Affiliations:

¹Department of Community Emergency Health and Paramedic Practice, Monash University, Melbourne, Victoria

Abstract

Introduction

Paediatric patients comprise a reasonable minority of paramedic workload, but cases involving children often evoke anxiety and discomfort. Subsequent feelings of low confidence and self-efficacy have been linked with a reluctance to initiate treatment and possibly, poorer care. It is unknown to what extent these apprehension-producing perceptions are held by paramedics and what educational strategies can improve them. This study aims to fill this gap by reporting on a scoping review that examined and mapped the effectiveness of educational interventions on improving paramedic perceptions of caring for paediatric patients.

Methods

Arksey and O'Malley's scoping methodology was used. CINAHL, AMED, EMBASE, MEDLINE and PsychINFO databases were searched, alongside several networks and grey literature services. The search strategy was validated by a subject research-librarian. Two reviewers independently reviewed retrieved articles against inclusion and exclusion criteria determined in advance.

Results

Seventeen articles were included in the review, comprising six conference abstracts, one letter to the editor and 10 journal articles. These articles were categorised into three themes: identifying educational needs and preferences, novel education programs and evaluating education delivery methods.

Conclusion

Paramedics feel uncomfortable treating paediatric patients and desire more paediatric training, particularly simulation and exposure to children. There is insufficient evidence to demonstrate superior effectiveness of any particular training program. While the most effective education delivery method is unclear, it seems web-based learning can be as effective as traditional teaching. The efficacy of existing pre-established paediatric training programs needs to be investigated, alongside paediatric education in the initial training curriculum. Further research, particularly from outside the United States of America, is needed to identify and develop the most effective educational intervention to improve paramedic confidence with paediatric patients.

Keywords:

pediatrics; pre-hospital care; emotions; self efficacy; education

Corresponding author: James Fowler, james.fowler01@gmail.com

Introduction

Paramedics are often the first responders to cases of paediatric trauma or acute illness. It is therefore vital that they have the appropriate knowledge, skills and confidence to render effective assistance. Paediatric patients make up 4.5–13% of total ambulance calls (1-5); with trauma being a major cause of child mortality (6-8). Observational and anecdotal evidence suggests that the pre-hospital management of paediatric patients is inherently stressful, causing anxiety and discomfort for many paramedics (9-12). Although only a small proportion of paediatric cases require emergency intervention due to a life-threatening condition (4), children still present unique challenges to emergency care professionals as they are anatomically, physiologically and developmentally different to adults (13).

As a minority of pre-hospital clinical work involves a paediatric emergency it can be challenging to maintain confidence with limited opportunities for clinical practice. In Australia, it has been estimated that a paramedic will attend a paediatric cardiac arrest only once every 12.5 years (14) and as such, paediatric pre-hospital emergency management is often viewed as a 'low frequency, high risk event' by paramedics (15). Despite this, there is a general view that adequate paediatric education is lacking, both in initial education as well as in ongoing professional development (16-18). A recent paper highlights that minimum paediatric education standards for pre-hospital providers have been proposed for initial and ongoing certification in the United States of America (USA), however, it is not mandatory to adopt them and as such standards are highly variable (19). In Australia, the majority of paramedic education is undertaken within various university settings, however several vocational courses remain an option for those wishing to work as a paramedic (20). It is therefore reasonable to assume that there may be considerable variation in paediatric knowledge and skill within the workforce.

The identified lack of paediatric training and experience along with the anxiety and discomfort of caring for this patient group may be linked with pre-hospital treatment errors (11). This can involve errors of commission such as administering an incorrect drug dose, or more commonly errors of omission such as reluctance to initiate required treatment in a timely manner (11). Some paramedics may prefer to quickly transport the patient to a well-resourced emergency department ('scoop and run') in preference to stabilising the child at the scene (12). It is possible that such situations contribute adversely to patient safety (12,21) and are at odds with the developing professional identity of paramedics as advanced clinical decision-makers (21-23).

It is largely unknown what educational interventions have a positive effect on paramedic confidence and self-efficacy

when providing care for paediatric patients. A preliminary search revealed no existing reviews relating to this concept. Scoping reviews allow mapping of the key concepts and the evidence supporting a research domain of interest (24-26). Compared to systematic reviews with strict criteria for study inclusion, scoping reviews incorporate a wider range of research materials that are both peer-reviewed and non-peer-reviewed in order to provide a broader understanding of the topic (24,25). Considered alongside the breadth of the concept of interest, exploration of literature surrounding this topic therefore lends itself to a scoping review. The objective of this study was to fill the aforementioned identified gap in the literature by performing a scoping review to examine and map the effectiveness of educational interventions on improving paramedic perceptions of providing care for paediatric patients.

Methods

Arksey and O'Malley's (25) six-stage scoping methodology was used as the framework for this scoping review, alongside consideration of enhancements suggested by Levac, Colquhoun and O'Brien (27) and the Joanna Briggs Institute methodology for scoping reviews (28). The six stages described by Arksey and O'Malley (25) are:

1. Identifying the research question
2. Identifying relevant studies
3. Study selection
4. Charting the data
5. Collating, summarising and reporting the results
6. Consultation (optional).

Each of these stages is outlined below.

Identifying the research question

The research question guiding this scoping review was 'What educational interventions improve paramedic confidence when dealing with paediatric patients?'

Identify relevant studies

Preliminary searches of online databases CINAHL and EMBASE were performed to enable familiarisation with keywords and to aid in the development of the final search strategy. Following advice from a subject research-librarian, search terms were clustered under four search strategy components that were later combined to produce the full strategy:

1. Paramedic component, for which a previously developed pre-hospital search filter was used (29)
2. Paediatric component
3. Educational interventions component
4. Confidence component.

The full search strategy was ratified by a subject research librarian and is included in Appendix 1. This strategy was used to search five online databases in October 2015: CINAHL, AMED, EMBASE, MEDLINE and PsychINFO. Google Scholar, the grey literature site greyliit.org and seven relevant professional networks were also searched using a modified search strategy based on the aforementioned search components. There were no restrictions on dates of publication. The bibliographies of articles that were included following the title and abstract screen were also reviewed, producing no new articles.

Study selection

Articles retrieved from stage two were screened against a documented inclusion and exclusion criteria determined in advance (Appendix 2). Following the Joanna Briggs Institute methodology (28), the inclusion criteria were divided into three

components: population, concept and context.

One author screened 2001 retrieved articles by title and abstract, yielding 34 included articles. A further full text screen was performed by two authors, yielding 17 articles included in the final review. Reasons for exclusion at the full text screening stage were recorded by both reviewers. Common reasons included non-paramedic population and/or context and educational interventions not addressing paramedic confidence. Figure 1 summarises the study selection process.

Charting the data

The following information was extracted from all included articles and recorded in a table: author(s), date of publication, study location, study purpose, study methodology and relevant results. Table 1 provides this overview of included articles.

Figure 1. Stage three: article selection

Table 1. Included articles

Author(s) and date	Study location	Study purpose	Study population	Study methodology	Relevant results	Theme(s)
Breon et al (2011) ¹⁸	Oregon, USA	To identify paediatric educational needs, barriers, and preferences	64 pre-hospital care providers	Focus groups with predetermined questions, followed by iterative theme identification	Four categories of educational needs, barriers and solution strategies identified: experience with children, cost and distance, access to training, content and quality	Identifying educational needs and preferences
Breon et al (2011) ³³	Oregon, USA	To identify paediatric educational needs, barriers, and preferences, and compare these with international pre-hospital care services	64 pre-hospital care providers	Focus groups with predetermined questions, followed by iterative theme identification. Narrative literature review to compare findings with international literature	Pre-hospital care providers in both the United Kingdom and the USA feel less comfortable with paediatric patients and desire more training. Possible strategies to improve paediatric education: increased time with children, exposure to paediatric chronic illness, interactive and online training tools, simulation training	Identifying educational needs and preferences
Calhoun et al (2012) ³⁶	USA	To evaluate the effect of a simulation-based paediatric critical care education program	54 health care providers, including 15 emergency medical technicians (EMTs)	Multimedia test and survey administered before and after participation in education program	Significant improvement in provider comfort in all domains (median 1-2 points improvement, all $p < 0.001$). Program quality scores averaged 4.6-4.9/5	Novel education programs
Fleischman et al (2011) ³²	Oregon, USA	To assess educational needs in paediatric care	219 pre-hospital care providers, comparing rural and urban providers	Anonymous 62-question written survey in three sections: feelings towards paediatric care, comfort with specific aspects of care, and training experiences and preferences. Statistical analysis comparing rural and urban providers	72% of respondents reported feeling less than 'comfortable' with paediatric care. 76% desired more paediatric training. Highly realistic simulation most beneficial training modality. 'Quality of training' largest barrier. Minimal differences between urban and rural providers	Identifying educational needs and preferences
Gerard et al (2006) ⁴²	St Louis, USA	To assess the educational efficacy of a web-based paediatric advance life support (PALS) course	86 health professionals, including 31 paramedics	Theory and practical exam results of 44 web-based PALS participants compared with 42 who undertook a traditional face-to-face PALS course. Self-confidence questionnaire administered before and after course. Evaluative post-course survey administered to web-based PALS participants	Self-confidence improved by similar amounts in both groups. 96% of web-based participants felt course met stated objectives, 100% said they would recommend the web-based course to colleagues	Evaluating education delivery methods Novel education programs
Glaeser et al (2000) ³⁴	USA	To describe pre-hospital care providers perceived educational needs in paediatric care	18,218 pre-hospital care providers	10-question written survey examining paediatric training experiences and requirements, barriers to training, perceived training need, and comfort with paediatric patients	Continuing education main source of paediatric knowledge and skills. Over 70% of respondents 'comfortable to some degree' with paediatric care. 76% supported increased mandatory paediatric education, to which cost and travel distance were the largest barriers	Identifying educational needs and preferences

Table 1. Included articles [AUTHOR: PLEASE PLACE REFERENCES NEXT TO AUTHOR AND DATE AS SHOWN]

Author(s) and date	Study location	Study purpose	Study population	Study methodology	Relevant results	Theme(s)
Jaeger et al (2010) ⁴⁶	Utah, USA	To examine the effect of a paediatric pain management lecture upon self-efficacy	62 pre-hospital care providers	10-question survey assessing self-efficacy administered before and after attending a paediatric pain management lecture	Self-efficacy increased for all paediatric age groups	Evaluating education delivery methods
Jaeger et al (2011) ⁴⁷	Utah, USA	To evaluate the decline of self-efficacy following paediatric pain management education	Initial: 252 pre-hospital care providers.	10-question survey assessing self-efficacy administered before and after attending a paediatric pain management lecture (initial), and administered again at 6-10 months (longitudinal)	Self-efficacy increased for all paediatric age groups in initial population, but was maintained only for toddler age group in longitudinal population	Evaluating education delivery methods
Jaeger et al (2012) ³⁸	USA	To evaluate the decline of self-efficacy following paediatric pain protocol implementation	Initial: 264 pre-hospital care providers. Longitudinal: 146 pre-hospital care providers	10-question survey assessing self-efficacy administered before and after implementation of a paediatric pain protocol (initial), and administered again at 13 months (longitudinal)	Self-efficacy increased for all paediatric age groups in initial population, but was maintained only for toddler age group in longitudinal population	Novel education programs
Roach and Medina (1994) ³⁵	Miami, USA	To determine factors increasing paramedic confidence with paediatric patients	441 paramedics	10-question survey assessing participants self-reported comfort and skill with paediatric patients	Comfort increased by PALS course ($p=0.0001$), and greater than 1-year paramedic experience ($p=0.0001$). Participants reported exposure to children as most beneficial training	Identifying educational needs and preferences Novel education programs
Smith et al (1997) ³⁷	Ohio, USA	To evaluate the impact of a multifaceted paediatric care project upon knowledge and confidence	93 emergency care providers, including 76 pre-hospital care providers	Knowledge test and evaluative survey administered before and after implementing multifaceted project. Results compared between intervention and control county	Decreased anxiety among pre-hospital providers with paediatric respiratory arrest ($p=0.03$). Increased confidence with airway management ($p=0.0007$) and increased perception of paediatric training adequacy ($p=0.000005$)	Novel education programs
Spaite et al (2000) ³⁹	USA	To describe and evaluate a self-study continuing education program designed to enhance knowledge and comfort with children with special health care needs	52 paramedics	Multimodal education program presenting information about children with special health care needs was developed. Perceptions of program, and paramedic comfort with children with special health care needs evaluated with survey administered before and after completion of program	Significant increase in comfort with children with special health care needs following program ($M=2.83$ to $M=4.20$, $p<0.01$). Practical session perceived as most useful, then self-study manual	Novel education programs

Table 1. Included articles

Author(s) and date	Study location	Study purpose	Study population	Study methodology	Relevant results	Theme(s)
Spaite et al (2000) ²³	USA	To determine if a self-study continuing education program increases paramedic knowledge and comfort with children with special health care needs	52 paramedics	Knowledge test and survey evaluating participant comfort with paediatric life support and children with special health care needs administered before, after, and four months after self-study continuing education program	Significant increase in comfort with children with special health care needs following program (M=2.83 to M=4.20, $p<0.01$), with some decrease at four months (M=3.85, $p=0.05$). Significant increase in comfort with paediatric life support from pre-program to 4 months post-program (M=4.12 to M=4.35, $p<0.01$). More paramedic experience associated with greater comfort in both areas	Novel education programs
Van Dillen et al (2015) ⁴⁵	Florida, USA	To evaluate the effect of simulation training on knowledge and comfort with needle cricothyrotomy	92 paramedics	Survey assessing knowledge and comfort administered before and after completing simulation training featuring a paediatric needle cricothyrotomy	Significant increase in both knowledge (mean 5.65/10 to 6.63/10, $p=0.0084$), and comfort (mean 3.17/5 to 4.06/5, $p<0.0001$) following simulation training	Evaluating education delivery methods
Weeks and Molsberry (2008) ⁴⁴	USA	To determine if videoconference instruction of PALS re-training was as effective as face-to-face instruction	73 health care providers, including nine EMS providers	Participants randomised to receive either videoconference or face-to-face teaching. Practical and theoretical knowledge assessed before, after, and one year after training. Confidence assessed only after training	No significant difference in knowledge, skills, or confidence between two groups. Slight decrease in skills and knowledge at one year in both groups	Evaluating education delivery methods
Werner and Bruzzini (2012) ⁴³		To assess the impact of the Society for Critical Care Medicine paediatric fundamental critical care support course upon health care provider self-efficacy	144 health care providers, including 73 non-physician providers (respiratory therapists, nurse practitioners, registered nurses, EMTs)	10-question, 5-point Likert scale survey assessing self-efficacy administered before and after completing the course	Significant improvement in self-efficacy following course for both physicians (average improvement 2.21, $p<0.001$), and non-physician providers (average improvement 1.72, $p<0.001$)	Novel education programs
Youngquist et al (2008) ⁴⁶	California, USA	To determine the effect of paediatric airway management training on paramedic self-efficacy and skill performance and to determine which of several retraining methods was superior	Initial training: 2520 paramedics. Re-training 245 paramedics	Skills testing performed and self-efficacy survey administered before and after both initial training, and re-training. Participants assigned to one of three re-training modalities	Both initial training and re-training increased self-efficacy, although no individual re-training modality was superior. Decreased exposure to paediatric patients associated with decline in self-efficacy, while not associated with time elapsed since training	Evaluating education delivery methods

Results

Collating, summarising and reporting the results

The 17 included articles were comprised of six conference abstracts, one letter to the editor and 10 journal articles. The study location of one article could not be determined; the remainder were from the USA. Years of publication ranged from 1994 to 2015. There was notable repetition of authors, with one lead author contributing three included articles and another two authors contributing two each. An iterative process of thematic analysis produced three broad themes under which included articles could be categorised:

1. Identifying educational needs and preferences (n=5)
2. Novel education programs (n=8)
3. Evaluating education delivery methods (n=6).

One author performed the initial theme development and article categorisation, which was subsequently validated by a second author.

Consultation (optional)

Arksey and O'Malley's (25) scoping methodology features an optional sixth stage of consulting relevant parties external to the authors, such as experts in the area of interest or pertinent community organisations. Given the time constraints, no expert in paramedic education in paediatric care could be located, nor could any relevant community organisation. This stage was therefore omitted.

Discussion

As the subject of 4.5–13.0% of total call-outs, paediatric patients represent a reasonable minority of paramedics' workload (1-5). Previous research suggests that cases involving children can evoke anxiety and discomfort, and that resultant feelings of low confidence and self-efficacy can cause a reluctance to initiate timely appropriate treatment, possibly contributing to patient morbidity and mortality (21,30,31). However, it is unknown to what extent these apprehension-producing perceptions are held by paramedics and what educational strategies can improve them. The objective of this study was to fill this gap by performing a scoping review to examine and map the effectiveness of educational interventions on improving paramedic perceptions of caring for paediatric patients. To achieve this, included articles were categorised into three themes: identifying educational needs and preferences, because to examine effectiveness, criterion of success must first be established; novel education programs, in order to evaluate published educational interventions; and evaluating education delivery methods, to assess whether teaching methodology can influence the ability of educational interventions to improve paramedic confidence with paediatric patients.

Identifying educational needs and preferences

Both subjective focus group studies and objective survey-based studies found that paramedics are less comfortable with paediatric patients than adults (18,32,33). In Fleischman et al's (32) survey of 219 pre-hospital care providers, 72% of respondents reported feeling less than 'comfortable' across 17 topics in paediatric care. Multiple studies echoed these findings, reporting that younger patient age is associated with greater discomfort (18,32,34). Paramedics appear more comfortable with specific procedural skills, for example airway management, than broader tasks such as assessing a child with a long-term illness (18,32).

All articles demonstrated that pre-hospital care providers desire more education in paediatric care (18,32-35). The duration and amount of training preferred however, is less clear ranging from 1 to 16 hours in duration (32,34). Simulation appears to be the preferred type of education, as it can replicate both the clinical and emotional aspects of caring for paediatric patients (18,32,33). Two articles identified exposure to children as a beneficial form of education, whether through parenthood or placements in local schools, paediatrician clinics or paediatric hospitals (18,35). Perspectives of online training also varied between studies. While Breon et al's (18) subjective information suggested online training was preferred, only 2% of respondents to Fleischman et al's (32) survey preferred internet-based training.

All articles examined barriers to paediatric education, the most common being cost, time and quality of training (18,32-35). Costs associated with both the education itself and travel to education sites were significant barriers for many, the latter of which could be overcome with online education (18,32,34). Despite Roach and Medina (35) recommending in 1994 that the paediatric advanced life support course be specifically adapted for a pre-hospital provider audience, it appears this has not occurred, with many in Breon et al's (18) 2011 study stating that pre-established courses such as PALS were not relevant to pre-hospital care.

Novel education programs

Articles categorised under this theme evaluated how effectively education programs, many of which were original and new, improved paramedic perceptions of providing care for paediatric patients. In their conference abstract, Calhoun et al (36) describe a novel simulation-based mobile outreach. Although the results of 54 participants (comprising only 15 EMTs) are presented in aggregate, comfort levels significantly increased in all domains ($p < 0.001$), suggesting this mobile simulation program could be an effective way of educating rural paramedics (36). Smith et al (37) developed a multifaceted program focussed on rural practitioners spanning initial and ongoing training, equipment acquisition and clinical

guideline development. Interestingly, despite its extensive nature, this program did not have a more noticeable positive effect on paramedic confidence when compared with other included articles. For example, although not described in as much detail, following Jaeger et al's (38) simpler paediatric pain protocol, paramedic self-efficacy at paediatric pain assessment and management significantly improved for all patient age groups (all $p < 0.05$). This could be reflective of Smith's more rigorous methodology and broader scope of evaluation, or it could suggest that wide-reaching complexity does not necessarily result in proportionally greater improvements to paramedic confidence (37).

Two included articles published in the same year with almost identical authors both describe a novel program designed to increase paramedic comfort when working with children with special health care needs (23,39). It is likely that these articles are both evaluating the same education program, and hence they are discussed together. In both studies, following a comprehensive process of literature review and stakeholder consultation, Spaite et al (23,39) developed a self-study program featuring videos, a self-study manual, quizzes, case scenarios and a 2-hour practical session involving feedback from experts. This program had remarkably positive results; the aggregate comfort score regarding specialised management skills improved from 2.83 to 4.20 ($p < 0.01$) on a 5-point Likert scale, while confidence with standard paediatric advanced life support skills also significantly improved (4.12 to 4.35, $p < 0.01$), suggesting specialised education programs may have flow-on effects to other areas of paediatric care (39). The success of this program demonstrates the importance of thorough consultation during curriculum development. While the self-study format appears effective, participants perceived the practical skills evaluation as the most useful component (rated 4 or 5 out of 5 for usefulness by 81.4% of respondents), highlighting the continued importance of some face-to-face teaching (39).

Pre-established programs such as the PALS and advanced paediatric life support (APLS) courses have been shown to increase confidence with paediatric care in other health care professions, although the efficacy within paramedic practice remains unclear (40,41). In their letter to the editor, Roach and Medina (35) found that paramedics who had completed a PALS course had higher perceived comfort (3.6 vs. 3.2 on a 5-point Likert scale, $p = 0.0001$) and skill (3.97 vs. 3.48, $p = 0.0001$) with paediatric care than those who had not. However, PALS has undergone numerous curriculum adjustments since this article's publication in 1994, limiting applicability to a modern context. More recently and although not the primary objective, Gerard et al (42) found that the PALS course increased aggregate mean self-confidence among 42 health care practitioners (comprising 15 paramedics) from 3.57 to 4.24 on a 5-point Likert scale, although no statistical significance data were provided. Werner and Bruzzini (43) similarly found that the less-renowned Society for Critical Care Medicine Paediatric Fundamental Critical Care Support course

improved feelings of preparedness for paediatric care among the non-physician group, indicating prefabricated programs may be effective in a paramedic context, although more research is needed.

Evaluating education delivery methods

Articles categorised under this theme primarily evaluated the way in which education programs were delivered, often comparing different program modalities.

Online training has many theoretical benefits; reduced instructor related costs, ensuring material is taught in a consistent manner, reduced travel and onsite time and enabling students to review material at a convenient time at their own pace (42,44). Gerard et al (42) sought to validate these benefits by comparing the effects of a web-based PALS course with a traditionally taught face-to-face course. Both delivery methods resulted in comparable improvements in mean paediatric care self-confidence across a 39-item, 5-point Likert scale survey (web-based 3.77–4.28, difference 0.51; traditional 3.57–4.24, difference 0.67) (42). Weeks and Molsberry (44) reached similar conclusions in a planned non-inferiority trial in which 73 health care professionals were randomised to receive identical PALS re-certification education either via web-based videoconference or traditional face-to-face teaching. There was no significant difference in post-course aggregated average paediatric confidence scores (web-based 8.3, traditional 8.5, $p = 0.598$) (44). Although paramedics comprised a significant proportion of the study populations in both of these articles, data were presented in aggregate from a diverse population of health care professions, which may limit applicability to exclusively the paramedic context (42,44).

In the only included article evaluating simulation, Van Dillen et al's (45) conference abstract found that paediatric airway simulation significantly improved mean comfort scores with paediatric needle cricothyrotomy (3.17–4.06, $p < 0.0001$). This absence of literature assessing simulation is curious given its aforementioned popularity as a teaching methodology (18,32). Jaeger et al (46) showed that traditional teaching remains effective, demonstrating significant improvements in paediatric pain management self-efficacy among paramedics following a 1-hour lecture. Despite this, the most effective education methodology remains to be definitively established.

Implications for research

Throughout all included studies there was no standardised validated tool to measure paramedic perceptions or confidence when dealing with paediatric patients. Development of such a tool may enable better comparison between future studies, as well as simplifying implementation of research protocols. The absence of any included studies from outside the USA suggests a need to conduct research elsewhere. There was a curious lack of studies evaluating simulation, especially considering its popularity, and future research could further explore simulation as an educational methodology.

Despite being regarded as somewhat of a mainstay of paediatric pre-hospital education, evidence surrounding pre-established programs such as PALS and APLS is divided and often out dated given these programs rapidly evolving curricula. Comprehensive evaluation of such programs within a modern context and exclusively pre-hospital population could assist in determining efficacy and what, if any, modifications need to be made to ensure applicability to paramedic practice. The most effective educational program or teaching methodology remains unclear, and further research is required to clarify this. Of particular interest could be research that follows an education intervention throughout its lifespan; beginning with an assessment of educational needs and subsequent development of a customised program followed by consistent evaluation throughout its implementation. All included articles featured educational interventions targeting paramedics who had completed their initial training, and hence the influence of paediatric education within the pre-qualification curriculum remains unexplored.

Limitations

All but one of the included articles was from the USA, with the location of the final article unable to be determined. This limited range of available evidence may reduce the ability to generalise findings to other areas. The year of publication of included articles ranged from 1994 to 2015, with over half published before 2011. This may limit the applicability of some articles to contemporary paramedic practice. The repetition of authors within included studies may have limited the breadth of information available, but this is reflective of the limited research within this area. The methodology of this study excluded articles not in English and did not include hand searching of journals, and hence some relevant results may have been omitted. The focus of scoping reviews is on mapping of key concepts and the evidence supporting a research domain of interest, and hence no appraisal of the research methodology of included articles was performed (25,26).

Conclusion

Paramedics desire more paediatric training, particularly simulation and exposure to children. However, while various paediatric education programs have been developed there is insufficient evidence to demonstrate superior effectiveness of any particular program. More research evaluating the benefits of simulation as an educational methodology to improve paramedic perceptions when dealing with paediatric patients is required. The efficacy and applicability of pre-established programs such as APLS and PALS remains unclear, and further research is required to evaluate such programs within a modern pre-hospital context. While the most effective education delivery method is unclear, it seems web-based learning can be as effective as traditional teaching. Further research is needed to identify and develop the most effective educational

interventions to improve paramedic confidence with paediatric patients.

Conflict of interest

The authors declare no competing interests. The authors of this paper have completed the ICMJE conflict of interest statement.

References

1. Klotz K, Salzman S, Kilpatrick S, Baker T, Brumby SA. Initial destination hospital of paediatric prehospital patients in rural Victoria. *Emerg Med Australas* 2016;28:205–10.
2. Harve H, Salmi H, Rahiala E, Pohjalainen P, Kuusma M. Out of hospital paediatric emergencies: a prospective, population-based study. *Acta Anaesthesiol Scand* 2016;60:360–9.
3. Eich C, Russo SG, Heuer JF, et al. Characteristics of out-of-hospital paediatric emergencies attended by ambulance- and helicopter-based emergency physicians. *Resuscitation* 2009;80:888–92.
4. Drayna PC, Browne LR, Guse CE, Brousseau DC, Lerner EB. Prehospital pediatric care: opportunities for training, treatment, and research. *Prehosp Emerg Care* 2015;19:441–7.
5. Shah MN, Cushman JT, Davis CO, Bazarian JJ, Auinger P, Friedman B. The epidemiology of emergency medical services use by children: an analysis of the National Hospital Ambulatory Medical Care Survey. *ibid.* 2008;12:269–76.
6. Australian Institute of Health and Welfare. A picture of Australia's children 2012. Cat. no. PHE 167 Canberra: AIHW; 2012. Available at: www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=10737423340
7. Centers for Disease Control and Prevention. 10 leading causes of death by age group, United States - 2014: National Centre for Injury Prevention and Control, CDC; 2014. Available at: www.cdc.gov/injury/images/lc-charts/leading-causes_of_death_age_group_2014_1050w760h.gif
8. World Health Organization. Child and adolescent injury prevention: a global call to action. Geneva, Switzerland, 2005. Available at: http://apps.who.int/iris/bitstream/10665/43279/1/9241593415_eng.pdf
9. Stevens SL, Alexander JL. The impact of training and experience on EMS providers' feelings toward pediatric emergencies in a rural state. *Pediatr Emerg Care* 2005;21:12–7.
10. Guise J, Meckler G, O'Brien K, et al. Patient safety perceptions in pediatric out-of-hospital emergency care: Children's Safety Initiative. *J Pediatr* 2015;167:1143–8.
11. Cushman JT, Fairbanks RJ, O'Gara KG, et al. Ambulance personnel perceptions of near misses and adverse events in pediatric patients. *Prehosp Emerg Care* 2010;14:477–84.
12. Cottrell EK, O'Brien K, Curry M, et al. Understanding safety in prehospital emergency medical services for children. *ibid.* 2014;18:350–8.

References (continued)

13. Institute of Medicine. Emergency care for children: growing pains Washington D.C., U.S.A.: National Academies Press; 2007. Available at: www.nap.edu/catalog/11655/emergency-care-for-children-growing-pains
14. Dyson K, Bray J, Smith K, Bernard S, Straney L, Finn J. Paramedic exposure to out-of-hospital cardiac arrest is rare and declining in Victoria, Australia. *Resuscitation* 2015;89:93–8.
15. Hoyle Jr JD, Sleight D, Henry R, Chassee T, Fales B, Mavis B. Pediatric prehospital medication dosing errors: a mixed-methods study. *Prehosp Emerg Care* 2016;20:117–24.
16. Miller DR, Kalinowski EJ, Wood D. Pediatric continuing education for EMTs: recommendations for content, method, and frequency. *Pediatr Emerg Care* 2004;20:269–72.
17. Hansen M, Meckler G, Dickinson C, et al. Children's Safety Initiative: a national assessment of pediatric educational needs among emergency medical services providers. *Prehosp Emerg Care* 2015;19:287–91.
18. Breon A, Yarris L, Law J, Meckler G. Determining the paediatric educational needs of prehospital providers: part 1. *Journal of Paramedic Practice* 2011;3:450–6.
19. Ngo TL, Belli K, Shah MI. EMSC program manager survey on education of prehospital providers. *Prehosp Emerg Care* 2014;18:424–8.
20. Eburn M, Bendall J. The provision of Ambulance services in Australia: a legal argument for the national registration of paramedics. *Australasian Journal of Paramedicine* 2010;8:1–9.
21. Reavley P. The challenges of pre-hospital paediatric trauma care. *Journal of Paramedic Practice* 2014;6:18–20.
22. O'Meara P. Paramedics marching toward professionalism. *Australasian Journal of Paramedicine* 2009;7:1–5.
23. Spaite DW, Karriker KJ, Seng M, et al. Increasing paramedics' comfort and knowledge about children with special health care needs. *Am J Emerg Med* 2000;18:747–52.
24. Armstrong R, Hall BJ, Doyle J, Waters E. 'Scoping the scope' of a Cochrane review. *J Public Health* 2011;33:147–50.
25. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
26. Daudt HML, van Mossel C, Scott SJ. Enhancing the scoping study methodology: a large, inter-professional team's experience with Arksey and O'Malley's framework. *BMC Med Res Methodol* 2013;13(48).
27. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5(69).
28. The Joanna Briggs Institute. The Joanna Briggs Institute Reviewers' Manual 2015: Methodology for JBI Scoping Reviews. Adelaide, Australia: The Joanna Briggs Institute; 2015.
29. Burgess S, Smith E, Piper S, Archer F. The development of an updated prehospital search filter for the Cochrane Library: Prehospital Search Filter Version 2.0 *Australasian Journal of Paramedicine* 2010;8:1–4.
30. Maibach E, Schieber R, Carroll M. Self-efficacy in pediatric resuscitation: Implications for education and performance. *Pediatr* 1996;97:94–9.
31. Turner NM, Lukkassen I, Bakker N, Draaisma JMT, ten Cate O. The effect of the APLS-course on self-efficacy and its relationship to behavioural decisions in paediatric resuscitation. *Resuscitation* 2009;80:913–8.
32. Fleischman RJ, Yarris LM, Curry MT, Yuen SC, Breon AR, Meckler GD. Pediatric educational needs assessment for urban and rural emergency medical technicians. *Pediatr Emerg Care* 2011;27:1130–5.
33. Breon A, Yarris L, Law J, Meckler G. Determining the paediatric educational needs of prehospital providers: part 2. *Journal of Paramedic Practice* 2011;3:510–4.
34. Glaeser PW, Linzer J, Tunik MG, Henderson DP, Ball J. Survey of nationally registered emergency medical services providers. *Pediatr Educ Ann Emerg Med* 2000;36:33–8.
35. Roach CL, Medina FA. Paramedic comfort level with children in medical and trauma emergencies: does the PALS course make a difference? *Am J Emerg Med* 1994;12:260–2.
36. Calhoun A, Porter M, Maus-Granholm P, Montgomery V, Orman K. Enhancing the emergency care of critically ill children using mobile simulation technology. *Crit Care Med* 2012;40:153.
37. Smith GA, Thompson JD, Shields BJ, Manley LK, Haley KJ. Evaluation of a model for improving emergency medical and trauma services for children in rural areas. *Ann Emerg Med* 1997;29:504–10.
38. Jaeger A, Holsti M, Dudley N, Sheng X, Gurley K, Adelgais K. EMS provider self-efficacy retention after pediatric pain protocol implementation. *Acad Emerg Med* 2012;19:S86.
39. Spaite DW, Karriker KJ, Seng M, et al. Training paramedics: emergency care for children with special health care needs. *Prehosp Emerg Care* 2000;4:178–85.
40. Turner NM, Dierselhuis MP, Draaisma JMT, ten Cate O. The effect of the advanced paediatric life support course on perceived self-efficacy and use of resuscitation skills. *Resuscitation* 2007;73:430–6.
41. Dhingra P, Ngeth P, Prak M, Ung S. Assessment of the effect of advanced paediatric life support training on level of self-perceived preparedness among health-care workers in Cambodia. *Emerg Med Australas* 2012;24:329–35.
42. Gerard JM, Scalzo AJ, Laffey SP, Sinks G, Fendya D, Seratti P. Evaluation of a novel web-based pediatric advanced life support course. *Arch Pediatr Adolesc Med* 2006;160:649–55.
43. Werner J, Bruzzini D. PFCCS improves perceived self-efficacy in a variety of providers. *Crit Care Med* 2012;40:155.
44. Weeks DL, Molsberry DM. Pediatric advanced life support re-training by videoconferencing compared to face-to-face instruction: a planned non-inferiority trial. *Resuscitation* 2008;79:109–17.

References (continued)

45. Van Dillen C, Fitzpatrick D, Rowe J, Weeks E. effect of simulation training on prehospital provider competence and knowledge with needle cricothyrotomy. *Acad Emerg Med* 2015;22:S245–6.
46. Jaeger A, Holsti M, Dudley N, Sheng X, Gurley K, Adelgais K. Pain management education effect on EMS provider self-efficacy. *ibid.* 2010;17:S173–4.
47. Jaeger A, Holsti M, Dudley N, Sheng X, Gurley K, Adelgais K. Prehospital provider self-efficacy decline after pediatric pain management education. *Acad Emerg Med* 2011;1:S116.
48. Youngquist ST, Henderson DP, Gausche-Hill M, Goodrich SM, Poore PD, Lewis RJ. Paramedic self-efficacy and skill retention in pediatric airway management. *ibid.* 2008;15:1295–303.

Appendix 1. Search strategy

Component one: pre-hospital search filter. From Burgess S, Smith E, Piper S, Archer F. The development of an updated prehospital search filter for the Cochrane Library: Pre-hospital Search Filter Version 2.0 *Journal of Emergency Primary Health Care*. 2010;8:1–4.

1. [MeSH] 'Emergency Medical Services'
2. [MeSH] 'Emergency Medical Technicians'
3. [MeSH] 'Emergency Treatment'
4. [MeSH] 'Emergency Medicine'
5. [MeSH] 'Ambulances'
6. MeSH] 'First Aid'
7. [MeSH] 'Military Medicine'
8. prehospital
9. pre-hospital
10. paramedic*
11. ambulance*
12. out-of-hospital
13. out of hospital
14. ems
15. emt
16. emergency services
17. emergency medical service*
18. emergency technician*
19. emergency practitioner
20. emergency dispatch*
21. emergency despatch*
22. first responder*
23. public access defibrillation
24. emergency rescue
25. emergency resus*
26. emergency triage
27. advanced life support
28. community support co-ordinator
29. community support coordinator
30. emergency care practitioner
31. extended care practitioner
32. physician assistant

33. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31 OR 32

Component two: paediatric

1. [MeSH] 'Child'
2. [MeSH] 'Infant'
3. [MeSH] 'Adolescence'
4. [MeSH] 'Pediatrics'
5. pediatric*
6. child*
7. paediatric*
8. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7

Component three: educational interventions

1. [MeSH] 'Education'
2. [MeSH] 'Teaching'
3. training in some databases as [MeSH] 'Inservice Training'
4. 1 OR 2 OR 3

Component four: confidence

1. [MeSH] "Self-Efficacy"
2. [MeSH] 'Anxiety'
3. [MeSH] 'Anticipatory Anxiety'
4. [MeSH] 'Emotions'
5. [MeSH] 'Courage' (only available in some databases)
6. comfort*
7. opinion*
8. confiden*
9. 'knowledge gap*'
10. prepar* NOT disaster
11. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9

Final strategy

Combine the final line of each component with the Boolean operator "AND"

Appendix 2. Inclusion and exclusion criteria

Inclusion criteria:

1. Population
 - a. Pre-hospital care providers of any skill level
 - b. Paramedic students - included as paramedics are often exposed to educational interventions whilst students.
2. Concept
 - a. Appraisal of paramedic perceptions of, or confidence when dealing with paediatric patients
 - b. Description or evaluation of educational intervention(s) aimed at improving paramedic confidence when dealing with paediatric patients. Educational interventions became defined as: anything featuring teaching, training, or practice supervision.

3. Context

- a. Care providers practising in a pre-hospital setting
- b. Relating to paediatric patients. Paediatric was defined as less than or equal to 18 years of age.

Exclusion criteria:

1. Articles not written in English due to financial and time restraints preventing translation.
2. Examination of only clinical skills without any reference to paramedic perceptions of, or confidence when dealing with paediatric patients.
3. Study population of physicians or nurses, even if practising in the pre-hospital field. This was established to supplement the population inclusion criteria and ensure only paramedics were included, rather than retrieval nurses and physicians.