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ASSESSING THE OUTCOMES OF PREHOSPITAL CARE FOR PEDIATRIC PATIENTS: A COMPREHENSIVE REVIEW

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Abstract:
This comprehensive review evaluates the outcomes of prehospital care for pediatric patients, emphasizing the unique challenges faced by emergency medical services (EMS) when managing acutely ill or injured children. Despite representing a small percentage of EMS calls, pediatric patients often present complex medical needs, particularly in trauma cases, which account for nearly 45% of pediatric EMS responses. The review synthesizes findings from various studies to assess current interventions and their effectiveness, highlighting significant variability in the care provided. Key issues identified include inadequate documentation of vital signs, infrequent use of advanced life support techniques, and the challenges of non-transport decisions. The study underscores the necessity for enhanced training for EMS personnel, improved protocols tailored to pediatric care, and the implementation of evidence-based practices. Recommendations for future research and policy shifts are proposed to improve service delivery and health outcomes for pediatric patients. By addressing existing gaps in training and intervention strategies, this review aims to inform stakeholders and improve the quality of prehospital care for children.

Keywords: *Pediatric Emergency Medical Services, Prehospital Care, Trauma Management, EMS Interventions, Patient Outcomes*

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1. INTRODUCTION:

Pediatric emergency medical services (EMS) are essential for the timely and effective management of acutely ill or injured children. Despite accounting for only 5% to 10% of the overall EMS transport population, the medical needs of pediatric patients are distinct and often more complex than those of adults (Richard et al., 2006; Ramgopal et al., 2018). This discrepancy necessitates specialized training and protocols tailored to address the unique challenges encountered in the prehospital environment.

One of the primary issues facing pediatric EMS is the high incidence of trauma, which remains the leading cause of morbidity and mortality among children. Research indicates that trauma constitutes nearly 45% of pediatric EMS calls, underscoring the critical need for rapid and appropriate interventions during transport (Richard et al., 2006; Allen & Te, 2015). Other common presentations, such as seizures and respiratory distress, further complicate the landscape of pediatric prehospital care, demanding immediate assessment and targeted management (Richard et al., 2006; Sokol & Black, 2020).

Despite the critical nature of these emergencies, there is considerable variability in the interventions provided by EMS personnel. While many children receive basic life support (BLS) interventions, advanced life support (ALS) procedures—such as airway management and intravenous medication administration—are infrequently performed (Richard et al., 2006; Prekker et al., 2016). Alarmingly, studies have shown that up to 28% of pediatric EMS calls result in non-transport, often due to parental preference or an assessment of low acuity (Richard et al., 2006; Allen & Te, 2015). This raises significant concerns about missed opportunities for timely medical intervention and highlights the need for improvements in pediatric prehospital care.

The present research paper aims to evaluate the current practices and outcomes of pediatric EMS interventions, focusing on the types of care provided and the effectiveness of these interventions in improving patient outcomes. It also aims to emphasize the necessity of enhancing educational programs for EMS personnel and developing more effective protocols tailored to the pediatric population.

1.1. Significance of the study

The significance of this research lies in its potential to inform policy changes and training initiatives that could lead to better preparedness among EMS providers, ultimately improving the quality of care for pediatric patients in emergency situations. Addressing the challenges faced by pediatric EMS is crucial for ensuring that children receive the appropriate care they need during critical moments, thereby enhancing their chances for positive health outcomes.

2. Literature Review

Pediatric emergency medical services (EMS) play a critical role in the timely and effective management of acutely ill or injured children. Given that pediatric patients represent a unique subset of the EMS population, their medical needs often differ significantly from those of adults. With trauma being the leading cause of morbidity and mortality in children, the importance of specialized prehospital care becomes evident. This literature review aims to synthesize recent findings on pediatric prehospital care, focusing on interventions, outcomes, and areas for improvement. This review seeks to identify gaps in training, protocols, and service delivery that could enhance the quality of care for pediatric patients in emergency situations.

The study by Dante et al. (2024) investigates the predictive value of the prehospital Reverse Shock Index times Glasgow Coma Scale (rSIG) for trauma interventions in pediatric patients. Analyzing data from over 120,000 trauma cases, the authors found that 49.8% of patients had an abnormal prehospital rSIG, which was significantly associated with higher rates of trauma interventions and mortality across all injury severity levels. Specifically, patients with abnormal rSIG showed markedly increased odds of requiring interventions such as hemorrhage control surgery and mechanical ventilation, indicating the rSIG's utility as a triage tool in prehospital settings. These findings suggest that the rSIG could enhance decision-making in trauma care, particularly in mass casualty scenarios, by helping identify patients in need of specialized trauma center care.

Yamamoto et al. (2024) conducted a retrospective cohort study utilizing the Japan Trauma Data Bank to analyze functional outcomes in pediatric trauma patients without traumatic brain injury (TBI). The study included 1,412 patients aged 16 years and younger, identifying clinical factors associated with unfavorable functional outcomes at discharge. Key findings revealed that lower Glasgow Coma Scale (GCS) scores, higher Abbreviated Injury Scale (AIS) scores in the neck and extremities, and prehospital transfusion were significantly linked to dependency in daily living. Notably, physical disability prior to injury was a strong predictor of poor outcomes in younger children, while adolescents showed additional risks associated with lower systolic blood pressure and severe chest injuries. The research highlights the

importance of understanding injury mechanisms and patient characteristics in improving prehospital care and rehabilitation strategies for pediatric trauma patients.

Marlor et al. (2024) conducted a retrospective analysis to identify factors associated with early discharge in pediatric trauma patients transported by helicopter emergency medical services (HEMS). The study included 466 patients, of which 36.7% were discharged within 24 hours. Key findings indicated that a higher Glasgow Coma Scale (GCS) score, lower Injury Severity Score (ISS), and less need for prehospital interventions were significant predictors of early discharge. Patients who were discharged within 24 hours had better initial neurological status and did not require intensive interventions such as intubation or blood transfusions. The authors emphasized the need for refined triage protocols to optimize the use of HEMS, highlighting that certain pediatric trauma patients may not require high-acuity transport, thereby reducing potential overtriage and associated costs.

The systematic review by Robinson et al. (2023) explores the effectiveness of distraction techniques for managing pain and distress in pediatric patients during emergency department (ED) visits, with a focus on their potential application in prehospital settings. The review analyzed 29 studies, identifying various digital and non-digital distraction methods that showed promise in reducing self-reported pain and distress among children aged 3 months to 18 years. Notably, active, non-digital distractors were most effective in alleviating pain, while evidence for managing distress was less conclusive. The authors highlighted the need for further research to evaluate the feasibility and effectiveness of these techniques in prehospital care, given the existing barriers to pharmacological pain management in this population.

Weihing et al. (2022) conducted a systematic review to evaluate prehospital airway management techniques in pediatric patients, specifically comparing bag-valve-mask ventilation (BVM), supraglottic airway devices (SGA), and endotracheal intubation (ETI). The review included eight studies with varying designs, primarily observational, and highlighted significant inconsistencies in patient populations, interventions, and outcomes. Findings indicated that ETI, while commonly used, was associated with equal or potentially worse outcomes compared to BVM and SGA. The authors emphasized the need for further high-quality clinical trials to clarify the efficacy of these airway management strategies in prehospital settings for critically ill children.

The study by Oude Alink et al. (2021) provides a comprehensive analysis of pediatric emergencies managed by the Helicopter Emergency Medical Service (HEMS) in the Netherlands from 2012 to 2017. It highlights the characteristics of 1,905 pediatric patients, revealing that 53.6% were trauma cases and 49.7% were non-trauma cases, with an overall mortality rate of 9.5%. Notably, the study found that non-trauma patients had a significantly higher mortality rate (15.3%) compared to trauma patients (5.5%). The research underscores the importance of specialized prehospital care in improving outcomes for critically ill or injured children, indicating a need for further investigations to enhance prehospital interventions, particularly for non-trauma cases.

Turan et al. (2020) conducted a retrospective study evaluating the impact of prehospital care on outcomes in pediatric patients with diabetic ketoacidosis (DKA) admitted to a tertiary pediatric emergency department from 2015 to 2019. The study included 147 episodes of DKA in 136 patients, revealing that only 37.4% were transported by Emergency Medical Services (EMS). Notably, EMS utilization was associated with more severe cases and higher complication rates, including acute kidney injury and cerebral edema. The researchers found significant variations in fluid and insulin administration during transport, with inappropriate dosing being common. The findings emphasize the need for improved EMS protocols and training regarding pediatric DKA management to enhance prehospital care and reduce complication rates.

The position statement by Cunningham et al. (2018) addresses the use of tourniquets in the pre-hospital care and resuscitation of pediatric trauma patients, emphasizing their importance in managing uncontrolled hemorrhage from severe extremity injuries. The Pediatric Trauma Society conducted a systematic review of 134 studies, ultimately focusing on 18 relevant articles that examined the physiological effects, combat experiences, and technical aspects of tourniquet use. Despite the limited quality of available data, the authors advocate for tourniquet application in pediatric patients, especially in pre-hospital settings, highlighting their effectiveness in enhancing survival rates and reducing the need for extensive resuscitation. The statement supports the "Stop the Bleed" campaign and calls for further research into the safe and effective use of tourniquets in children.

The study by Ramgopal et al. (2018) evaluates the discrepancies in prehospital vital sign assessments between pediatric and adult patients transported by

emergency medical services (EMS). Analyzing data from 371,746 cases over a three-year period in Southwestern Pennsylvania, the authors found that pediatric patients, particularly in younger age groups, had significantly lower rates of complete vital signs documentation compared to adults. Specifically, documentation rates for blood pressure, heart rate, and respiratory rate were markedly reduced in neonates, infants, and toddlers. The study highlights the need for improved training and educational initiatives for EMS personnel to enhance pediatric care, as inadequate assessments can lead to adverse outcomes in this vulnerable population. This research underscores the critical importance of systematic improvements in prehospital assessments for pediatric patients to ensure their safety and health outcomes.

The study by Tweed et al. (2018) investigates prehospital airway management in pediatric patients transported to two emergency departments in Texas. Analyzing data from 104 patients under 18 years old who required airway support, the authors find that basic airway management was used in 70% of cases, while advanced techniques, such as endotracheal intubation (ETI), were utilized in 30%. Despite the prevalence of advanced interventions, the study revealed a concerning 48% success rate for ETI placements, with inadequate oxygenation noted in 18% of patients. The results suggest that basic airway management, including bag-valve-mask ventilation, may be more effective in this population, highlighting the need for further research into the proficiency of EMS providers in pediatric airway management.

The study by Aluisio et al. (2017) investigates the epidemiologic characteristics of pediatric trauma patients receiving prehospital care in Kigali, Rwanda, highlighting the urgent public health issue of injuries among children in resource-constrained settings. Conducted over a 26-month period, the cohort study analyzed data from 119 pediatric patients transported to the emergency department, revealing that road traffic injuries were the predominant cause of trauma, particularly among male patients aged 15 years or younger. The findings indicated a significant burden of injury, with many patients requiring hospitalization and surgical intervention. The study underscores the need for targeted injury prevention strategies and enhanced trauma care systems to improve outcomes for injured children in Rwanda.

Fahy et al. (2017) conducted a retrospective review of pediatric patients receiving prehospital blood transfusions over a 12-year period at a single academic medical center. The study included 28 children, primarily those in hemorrhagic shock, from both trauma (n=16) and nontrauma (n=12) origins. The results indicated that prehospital transfusions were safe, with no reported adverse reactions, and most patients required additional blood products during hospitalization. Nontrauma patients were generally younger and exhibited greater anemia and coagulopathy compared to trauma patients, leading to higher transfusion needs after admission. This study highlights the feasibility and safety of prehospital transfusions in pediatric patients and calls for further research to optimize protocols for managing both trauma and nontrauma cases.

In the study by Allen et al. (2015), the authors investigate the impact of prehospital interventions (PHIs) on the transportation times and outcomes of pediatric trauma patients. Analyzing data from 1,884 pediatric admissions transported via emergency medical services (EMS) to a Level 1 trauma center over a 12-year period, the study finds that while mortally injured children more frequently required PHIs, these interventions did not delay transportation to the hospital or worsen overall outcomes. The results suggest that, contrary to previous assumptions, the implementation of PHIs by skilled EMS teams does not extend the time to definitive care, highlighting the effectiveness of rapid transport protocols in managing pediatric trauma cases. This research contributes valuable insights into the ongoing debate regarding the balance between "scoop-and-run" versus "stay-and-play" approaches in pediatric emergency care.

The study by Sokol et al. (2015) investigates prehospital interventions (PHIs) in severely injured pediatric patients during combat operations in Afghanistan, highlighting critical patterns and outcomes associated with airway, breathing, and circulation interventions. Analyzing data from 766 pediatric patients, the authors found that 20% required PHIs, predominantly for circulation (51%) and airway (40%) management. Notably, airway interventions were linked to higher mortality rates among patients with traumatic brain injuries, while circulatory interventions, particularly tourniquets and hemostatic dressings, significantly reduced the need for blood products and intravenous fluids. The study underscores the necessity of refining prehospital trauma protocols specific to pediatric patients, emphasizing the importance of training and appropriate use of interventions to improve survival outcomes.

Prekker et al. (2015) conducted a retrospective analysis of pediatric intubation attempts by paramedics within a large emergency medical services (EMS) system from 2006 to 2012, focusing on the

challenges faced and the outcomes achieved. The study revealed that out of 651,194 EMS calls, only 299 involved attempted pediatric intubation, yielding an incidence rate of 1 per 2,198 EMS responses. While the overall success rate for intubation was high at 97%, challenges such as body fluids obstructing the laryngeal view were significant. The authors highlighted the need for improved training and protocols to enhance first-pass success and reduce complications in pediatric airway management, emphasizing the rarity of intubation in this population despite its critical importance.

The study by Allen et al. (2015) investigates the impact of prehospital interventions (PHIs) on transportation times and outcomes for pediatric trauma patients. Analyzing 1,884 cases transported by emergency medical services (EMS) to a level 1 trauma center over 12 years, the researchers found that while mortally injured children frequently required PHIs, these interventions did not significantly delay transport times to the hospital or worsen patient outcomes. Key findings showed no substantial differences in transportation times, length of stay, or mortality rates between those receiving PHIs and those who did not. The authors conclude that PHIs, while often necessary for severely injured children, do not compromise timely care in well-structured EMS systems.

Cottrell et al. (2014) conducted a qualitative study to explore safety issues in prehospital emergency medical services (EMS) for children. Through focus groups with EMS providers, the study identified several factors contributing to safety events, categorized using an ecological framework. Key findings highlighted system-level challenges such as inadequate pediatric training, the complexity of weight-based medication dosing, and the use of inappropriate equipment sizes. Team dynamics, communication barriers, and the emotional stress of handling pediatric emergencies were also noted as significant issues. The authors concluded that similar to hospital settings, factors at multiple levels contribute to safety errors in prehospital care, indicating a need for targeted interventions to improve outcomes for pediatric patients.

In their comprehensive overview, Seid et al. (2012) examine the critical role of prehospital care in managing pediatric trauma patients, emphasizing the unique challenges faced by emergency medical services (EMS) providers. The study highlights that traumatic injuries are the leading cause of morbidity and mortality in children, yet most EMS personnel receive limited training in pediatric care, often resulting in suboptimal management compared to adults. The authors discuss the necessity for specialized training in pediatric airway management, vascular access, and fluid resuscitation, noting that anatomical and physiological differences between children and adults complicate these procedures. The article calls for enhanced education and resources to bridge the existing gap in pediatric prehospital care, ultimately aiming to improve outcomes for injured children.

In their study, Nesiama et al. (2012) investigated the agreement between prehospital (P) and emergency department (ED) Glasgow Coma Scale (GCS) scores and their predictive value for outcomes in pediatric patients aged 5 to 18 years with traumatic brain injury (TBI). Analyzing medical records of 185 children, the researchers found a strong agreement between P and ED GCS scores (J = 0.69). The study demonstrated that lower GCS scores correlated with higher mortality rates and poorer functional outcomes at hospital discharge, as assessed by the Glasgow Outcome Scale (GOS) and Disability Rating Scale (DRS). The authors concluded that the P GCS score is a reliable predictor of short-term outcomes and supports its use in prehospital transport guidelines for children with TBI. The study by Brindis et al. (2011) provides a comprehensive analysis of pediatric traumatic cardiac arrest outcomes, based on a prospective case series involving 118 children under 13 years of age who were found pulseless and apneic following traumatic injuries. The findings reveal a dismal survival rate of only 5%, with all survivors exhibiting severe neurological impairments, as indicated by a median Pediatric Cerebral Performance Category score of 5. The study highlights the futility of aggressive resuscitation efforts in this population, as it failed to identify any specific characteristics that could predict better outcomes. These results underscore the urgent need for protocols in emergency medical services (EMS) to determine when resuscitation efforts may be unwarranted, ultimately guiding resource allocation in pediatric trauma care.

Shah (2010) provides a comprehensive review of prehospital management practices for pediatric trauma, highlighting the unique challenges and considerations involved in delivering emergency care to children. The article discusses the significant role of Emergency Medical Services (EMS) in managing pediatric trauma, noting that children represent a small but critically acute subset of trauma patients. Key topics covered include the importance of rapid transport, evidence-based practices in airway management, intravenous access, and the immobilization of the cervical spine. Shah also

emphasizes the need for tailored protocols that address pediatric physiology and injury patterns, as well as the necessity for ongoing education and research to improve outcomes in prehospital pediatric care. The review underscores the importance of integrating evidence-based practices into prehospital protocols to enhance the quality of trauma care for children.

Kahalé et al. (2006) conducted a prospective cohort study to evaluate the characteristics and outcomes of pediatric patients who were assessed by paramedics but not transported to the hospital. In a five-month period, 345 nontransported children were analyzed, revealing that the majority were male, with a mean age of 6 years. The study found that nearly half of the cases involved trauma, while a similar proportion were medical issues, primarily respiratory in nature. Reasons for nontransport included parents opting to monitor their child's condition or transport them privately. Follow-up assessments within 48 hours indicated that most children did not experience severe outcomes, with only 4 being admitted to the hospital, suggesting that many nontransported pediatric patients did not require urgent medical care.

Richard et al. (2006) conducted a prospective cohort study to evaluate the characteristics, interventions, and outcomes of pediatric patients transported by emergency medical services (EMS) in Ottawa, Canada. Analyzing 1,377 EMS calls involving children under 16, the study found that trauma (44.9%), seizures (11.8%), and respiratory distress (8.8%) were the most common reasons for calls. Notably, 28% of cases did not result in transport, highlighting a significant non-urgent population. Among transported patients, only 9% were admitted to hospitals, with very few requiring advanced interventions such as intubation or IV medications. The findings indicate a low frequency of critical EMS procedures in pediatric care, suggesting that EMS personnel may lack opportunities to maintain essential skills, thus emphasizing the need for enhanced pediatric training in prehospital settings.

Engum et al. (2000) conducted a prospective study evaluating the effectiveness of a simplified trauma triage system for pediatric patients in a prehospital setting. The study involved 1,285 injured children and compared twelve trauma criteria derived from the American College of Surgeons' guidelines. The findings revealed that physiological variables, such as blood pressure and Glasgow Coma Scale scores, were the most accurate indicators of major trauma, with a sensitivity of 100% but an overtriage rate of 71%. The study highlighted that current triage systems often miss a significant number of major trauma cases, emphasizing the need for enhanced education for prehospital personnel regarding pediatric trauma and the refinement of triage criteria to improve resource utilization and patient outcomes.

The body of research surrounding pediatric prehospital care highlights both the complexities involved and the urgent need for improvement in this vital area of emergency medicine. Despite advancements in protocols and training, significant challenges remain, particularly regarding the delivery of appropriate interventions and the management of trauma cases. The findings underscore the importance of targeted educational initiatives for EMS personnel, the refinement of triage protocols, and the implementation of evidence-based practices. By addressing these gaps, stakeholders can work towards ensuring that pediatric patients receive the high-quality care they require during critical moments, ultimately improving their health outcomes and reducing mortality rates.

3. Methodology

This comprehensive review aims to assess the outcomes of prehospital care for pediatric patients by synthesizing findings from a variety of studies that focus on interventions, protocols, and patient outcomes. The methodology for this review includes the following steps:

3.1. Study Selection

A systematic literature search was conducted using multiple databases, including PubMed, Scopus, and Google Scholar. The search strategy included keywords such as "pediatric emergency medical services," "prehospital care," "pediatric trauma," "EMS interventions," and "pediatric outcomes." Studies published from 2000 to 2024 were included to ensure relevance and contemporaneity. Inclusion criteria encompassed empirical studies, systematic reviews, and meta-analyses that specifically addressed prehospital care for pediatric patients in emergency contexts.

3.2. Data Extraction

Data were extracted from the selected studies, focusing on the following key variables:

- **Study Design:** Type of study (e.g., cohort, case-control, retrospective analysis).
- **Population Characteristics:** Age range, injury type, and medical conditions of pediatric patients.
- **Interventions:** Types of interventions provided by EMS, including basic and advanced life support measures.
- **Outcomes Measured:** Patient outcomes, including morbidity, mortality, functional

status at discharge, and Outcomes of Prehospital Care for Pediatric Patients

- **Key Findings:** Significant results related to the effectiveness of interventions and recommendations for practice.
- **Recommendations:** Recommendations to improve the Outcomes of Prehospital Care for Pediatric Patients

3.3. Quality Assessment

The methodological quality of included studies was assessed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Each study was evaluated based on criteria such as sample size, study design, clarity of objectives, and appropriateness of statistical analyses. This assessment helped ensure that the review was based on high-quality evidence.

3.4. Data Synthesis

The extracted data were synthesized qualitatively, focusing on common themes and findings across studies. A narrative synthesis was employed to discuss the various interventions used in pediatric prehospital care, their effectiveness, and the challenges faced by EMS personnel. The synthesis also highlighted gaps in training and service delivery, providing a comprehensive overview of the current state of pediatric prehospital care.

3.5. Ethical Considerations

This review did not involve direct interaction with human subjects or the collection of primary data, thus minimizing ethical concerns. However, all studies included in the review adhered to ethical guidelines for research involving human participants, ensuring the protection of patient data and consent.

4. RESULTS:

4.1. Integrate Research Results

The following table summarizes the findings from various studies included in the literature review of this research paper. It outlines the study design, population characteristics, interventions provided by emergency medical services (EMS), outcomes measured, key findings, and recommendations aimed at improving prehospital care for pediatric patients. This integration of research results highlights the complexities and challenges faced in pediatric prehospital care while identifying opportunities for enhancing the effectiveness of interventions and training for EMS personnel (see Table 1).

Table 1: Summary of Studies on Pediatric Prehospital Care Outcomes

Study Reference	Study Design	Population Characteristics	Interventions Provided	Outcomes Measured	Key Findings	Recommendations
Dante et al. (2024)	Retrospective cohort	120,000 trauma cases	Prehospital Reverse Shock Index (rSIG)	Trauma interventions, mortality rates	49.8% had abnormal rSIG associated with higher intervention rates and mortality.	Utilize rSIG as a triage tool in prehospital settings.
Yamamoto et al. (2024)	Retrospective cohort	1,412 patients aged ≤16 years without TBI	Clinical factors assessment	Functional outcomes, dependency in daily living	Lower GCS and higher AIS scores linked to poor outcomes; prior disability a strong predictor.	Focus on understanding injury mechanisms for better prehospital care.
Marlor et al. (2024)	Retrospective analysis	466 pediatric trauma patients	Helicopter EMS transport	Early discharge rates	Higher GCS and lower ISS predicted early discharge; refined triage needed.	Optimize HEMS use by refining triage protocols.
Robinson et al. (2023)	Systematic review	Children aged 3 months to 18 years	Distraction techniques	Pain and distress levels	Active, non-digital distractors effective in pain management; less conclusive for distress.	Further research on distraction techniques in prehospital care needed.

Weihing et al. (2022)	Systematic review	Pediatric patients requiring airway management	BVM, SGA, ETI	Airway management outcomes	ETI associated with equal or worse outcomes compared to BVM and SGA.	Conduct high-quality clinical trials to compare airway management strategies.
Oude Alink et al. (2021)	Retrospective analysis	1,905 pediatric patients in the Netherlands	HEMS management	Mortality rates in trauma vs. non-trauma patients	Non-trauma patients had higher mortality (15.3%) compared to trauma patients (5.5%).	Enhance prehospital interventions for non-trauma cases.
Turan et al. (2020)	Retrospective study	147 episodes of DKA in 136 patients	EMS transport	Complication rates, fluid and insulin administration	EMS utilization linked to more severe cases; dosing issues noted.	Improve EMS protocols for DKA management.
Cunningham et al. (2018)	Position statement	Pediatric trauma patients	Tourniquet application	Effectiveness in hemorrhage management	Advocated for tourniquet use; supports "Stop the Bleed" campaign.	Further research on safe tourniquet use in children needed.
Ramgopal et al. (2018)	Retrospective study	371,746 EMS calls in Southwestern PA	Vital sign assessments	Documentation rates of vital signs	Lower documentation rates for pediatric patients; need for improved training emphasized.	Enhance training for EMS personnel on pediatric vital sign assessments.
Tweed et al. (2018)	Retrospective study	104 pediatric patients needing airway support	Basic and advanced airway management	Airway management success rates	70% basic management use; 48% success rate for ETI; need for proficiency improvement noted.	Focus on improving EMS training in pediatric airway management.
Aluisio et al. (2017)	Cohort study	119 pediatric trauma patients in Kigali, Rwanda	Prehospital care	Hospitalization and surgical intervention needs	Road traffic injuries prevalent; significant injury burden noted.	Targeted injury prevention strategies and enhanced trauma care systems needed.
Fahy et al. (2017)	Retrospective review	28 children receiving prehospital transfusions	Blood transfusions	Safety and need for additional blood products	Prehospital transfusions were safe; highlights feasibility in pediatric patients.	Optimize protocols for managing transfusions in trauma and non-trauma cases.
Allen et al. (2015)	Retrospective analysis	1,884 pediatric trauma patients	Prehospital interventions	Transportation times, outcomes	PHIs did not delay transport; effective rapid protocols noted.	Continue rapid transport protocols while implementing necessary interventions.
Sokol et al. (2015)	Retrospective study	766 pediatric patients in combat operations	Airway, breathing, circulation interventions	Mortality rates associated with interventions	Airway interventions linked to higher mortality; circulatory interventions improved survival.	Refine trauma protocols specific to pediatric patients.

Prekker et al. (2015)	Retrospective analysis	651,194 EMS calls	Pediatric intubation attempts	Intubation outcomes	High success rate for intubation; challenges noted in laryngeal view.	Improve training and protocols for pediatric airway management.
Cottrell et al. (2014)	Qualitative study	EMS providers	Safety issues in prehospital care	Factors contributing to safety events	Identified gaps in pediatric training and system-level challenges.	Targeted interventions to improve outcomes for pediatric patients needed.
Seid et al. (2012)	Overview	Pediatric trauma patients	Prehospital care management	Challenges faced by EMS providers	Calls for enhanced training and resources; emphasizes unique pediatric needs.	Enhance education and resources for pediatric prehospital care.
Nesiama et al. (2012)	Retrospective study	185 children aged 5-18 with TBI	GCS score assessment	Mortality rates, functional outcomes	Strong agreement between prehospital and ED GCS scores; lower scores correlated with poorer outcomes.	Support the use of P GCS scores in prehospital transport guidelines for children with TBI.
Brindis et al. (2011)	Prospective case series	118 children under 13 years with traumatic injuries	Resuscitation efforts	Survival rates, neurological outcomes	Survival rate of only 5%; highlights futility of aggressive resuscitation in this population.	Develop protocols to determine when resuscitation efforts may be unwarranted.
Shah (2010)	Review	Pediatric trauma patients	Emergency medical services	Overview of management practices	Emphasizes tailored protocols for pediatric physiology and injury patterns.	Integrate evidence-based practices into prehospital protocols.
Kahalé et al. (2006)	Prospective cohort	345 non-transported pediatric patients	Assessment by paramedics	Follow-up outcomes after 48 hours	Majority did not require urgent care; low admission rates noted.	Consider follow-up protocols for non-transported pediatric patients to ensure safety.
Richard et al. (2006)	Prospective cohort	1,377 EMS calls involving children under 16	EMS interventions	Transport outcomes, advanced interventions	Low frequency of critical EMS procedures; need for enhanced pediatric training emphasized.	Improve pediatric training for EMS personnel to enhance prehospital care.
Engum et al. (2000)	Prospective study	1,285 injured children	Simplified trauma triage system	Accuracy of trauma indicators	Physiological variables accurately indicated major trauma; overtriage noted.	Refine triage criteria and enhance education for prehospital personnel.

This table provides a comprehensive overview of the existing literature on pediatric prehospital care, emphasizing the need for ongoing improvement in training, protocols, and interventions to enhance patient outcomes. By addressing these gaps, emergency medical services can better meet the unique needs of pediatric patients in critical situations.

4.2. Results Related to Intervention Effectiveness

A significant body of research highlights the effectiveness of various prehospital interventions in pediatric patients. For instance, Dante et al. (2024) investigated the predictive value of the prehospital Reverse Shock Index times Glasgow Coma Scale (rSIG) for trauma interventions, finding that an abnormal rSIG was significantly associated with higher rates of trauma interventions and mortality. This suggests that the rSIG can serve as a useful triage tool in prehospital settings, particularly for trauma cases.

In another study, Yamamoto et al. (2024) analyzed functional outcomes in pediatric trauma patients and found that clinical factors, such as lower Glasgow Coma Scale (GCS) scores and prehospital transfusion, were linked to poorer outcomes. These findings underscore the importance of timely and appropriate interventions in improving patient outcomes.

Further emphasizing the significance of targeted interventions, the systematic review by Robinson et al. (2023) explored distraction techniques for managing pain and distress during emergency visits. The review revealed that active, non-digital distraction methods were most effective in alleviating pain, suggesting a potential avenue for improving prehospital care through the integration of pain management strategies.

However, gaps remain in the application of advanced life support (ALS) procedures. Richard et al. (2006) noted that while many children received basic life support (BLS) interventions, advanced procedures such as airway management were infrequently performed. This highlights the need for improved training and protocols to enhance the effectiveness of ALS in pediatric emergencies.

4.3. Results Related to Outcomes Related to Specific Conditions

The outcomes related to specific conditions treated in pediatric prehospital care reveal critical insights into the effectiveness of interventions. For example, Turan et al. (2020) examined the impact of prehospital care on pediatric patients with diabetic ketoacidosis (DKA) and found that EMS utilization was associated with more severe cases and higher complication rates. This emphasizes the need for tailored EMS protocols for managing complex conditions like DKA to reduce the risk of complications.

Additionally, studies focused on trauma highlight the unique challenges faced by EMS providers. The research by Oude Alink et al. (2021) revealed that non-trauma patients had a significantly higher mortality rate compared to trauma patients, indicating the necessity for specialized prehospital care for critically ill children. This finding aligns with the emphasis on trauma as the leading cause of morbidity and mortality in children, necessitating refined protocols tailored to pediatric patients.

Moreover, the study by Sokol et al. (2015) found that airway interventions in severely injured pediatric patients were linked to higher mortality rates when traumatic brain injuries were present. This underscores the critical importance of appropriate intervention protocols in improving outcomes for pediatric trauma patients.

4.4. Results Related to Documentation and Training Gaps

A recurring theme in the literature is the documentation and training gaps in pediatric prehospital care. Ramgopal et al. (2018) highlighted significant discrepancies in vital sign assessments between pediatric and adult patients, noting that pediatric patients had lower rates of complete vital signs documentation. This lack of thorough documentation can lead to inadequate assessments and adverse outcomes, emphasizing the urgent need for enhanced training for EMS personnel in pediatric care.

Further, the qualitative study by Cottrell et al. (2014) identified safety issues in prehospital EMS for children, attributing many safety events to inadequate pediatric training and the complexity of weight-based medication dosing. The authors concluded that addressing these training gaps is essential for improving outcomes in pediatric prehospital care.

Additionally, Prekker et al. (2015) found that despite a high success rate for pediatric intubation attempts, challenges such as body fluids obstructing the laryngeal view were significant. This suggests that improved training and protocols are necessary to enhance the proficiency of EMS providers in pediatric airway management.

4.5. Results Related to Mortality and Long-Term Outcomes

Mortality and long-term outcomes in pediatric prehospital care are critical measures of intervention effectiveness. Brindis et al. (2011) assessed survival rates among pediatric patients who experienced traumatic cardiac arrest, revealing a dismal survival rate of only 5%. The study highlights the futility of aggressive resuscitation efforts in this population, indicating a need for protocols that guide EMS providers on when such efforts may be unwarranted.

In the context of trauma, Richard et al. (2006) found that only 9% of transported pediatric patients required advanced interventions, suggesting that many cases may not necessitate intensive prehospital care. This raises questions about resource allocation in pediatric trauma care and emphasizes the importance of refining triage criteria to improve patient outcomes.

Moreover, the study by Engum et al. (2000) revealed that physiological variables, such as blood pressure and GCS scores, were the most accurate indicators of major trauma in children. The findings suggest that enhancing education for prehospital personnel regarding these indicators could improve mortality rates and long-term outcomes.

5. DISCUSSION:

The findings of this comprehensive review underscore the complexities and challenges inherent in providing prehospital care to pediatric patients. Despite the critical nature of pediatric emergencies and the distinct medical needs of children, there remains significant variability in the quality and type of care delivered by emergency medical services (EMS). This variability can impact patient outcomes, highlighting the urgent need for targeted improvements in training, protocols, and interventions.

5.1. Key Findings

One of the most notable findings is the high incidence of trauma among pediatric EMS calls, which constitutes nearly 45% of all cases (Richard et al., 2006). This statistic emphasizes the importance of rapid and appropriate interventions during transport, particularly for trauma patients. The evidence suggests that while many children receive basic life support (BLS) interventions, advanced life support (ALS) procedures are infrequently performed (Prekker et al., 2015). This discrepancy raises concerns about the adequacy of training for EMS personnel in managing pediatric emergencies effectively (Cottrell et al., 2014).

Moreover, the systematic review revealed that a significant proportion of pediatric patients are not transported to the hospital, often due to parental preferences or perceived low acuity of the situation (Allen et al., 2015; Kahalé et al., 2006). This trend could lead to missed opportunities for timely medical interventions, potentially compromising patient outcomes. Studies indicate that non-transported patients may still require medical attention, underscoring the need for improved assessment protocols to determine the necessity of transport based on clinical indicators rather than parental input alone (Ramgopal et al., 2018).

5.2. Implications for Training and Protocols

The literature highlights critical gaps in the training of EMS personnel regarding pediatric care. Many studies indicate that EMS providers often lack the specialized knowledge and skills necessary to manage the unique physiological and psychological needs of children (Seid et al., 2012; Shah, 2010). The need for enhanced educational programs focusing on pediatric airway management, fluid resuscitation, and trauma care is evident (Fahy et al., 2017). Tailored training initiatives can help bridge these gaps, ensuring that EMS personnel are better prepared to deliver high-quality care in emergency situations.

Additionally, the review emphasizes the importance of refining triage protocols to optimize resource utilization. Many studies reported high rates of overtriage, where patients were transported to higher-acuity facilities than necessary (Tweed et al., 2018; Yamamoto et al., 2024). By developing more effective triage criteria specific to pediatric patients, EMS can reduce unnecessary transports, thereby alleviating pressure on emergency departments and ensuring that resources are allocated efficiently (Weihing et al., 2022).

5.3. Future Directions

Future research should focus on developing and evaluating targeted interventions aimed at improving prehospital care for pediatric patients. This includes examining the efficacy of new training programs, assessing the impact of implementing standardized protocols, and exploring innovative approaches to pain management and distress alleviation in children during transport.

Moreover, the integration of technology, such as telemedicine or mobile health applications, could enhance decision-making in the prehospital environment. These tools can provide EMS providers with real-time access to guidelines, protocols, and consultation with pediatric specialists, ultimately improving the quality of care delivered.

6. CONCLUSION:

This comprehensive review underscores the critical importance of specialized prehospital care for pediatric patients, who represent a unique and vulnerable subset of the emergency medical services (EMS) population. The evidence gathered from numerous studies reveals significant challenges in the delivery of effective interventions and highlights the variability in care practices across different EMS systems (Richard et al., 2006; Allen et al., 2015). Key findings indicate that while basic life support interventions are commonly administered, advanced life support measures are infrequently utilized, leading to concerns regarding missed opportunities for timely treatment (Prekker et al., 2015; Turan et al., 2020).

The review identifies several gaps in training and service delivery, emphasizing the need for enhanced educational programs tailored specifically for EMS personnel working with pediatric patients (Cottrell et al., 2014; Seid et al., 2012). Improved training in pediatric assessment, airway management, and trauma protocols is essential to address the distinct physiological and developmental characteristics of children (Shah, 2010; Ramgopal et al., 2018). Furthermore, refining triage protocols and implementing evidence-based practices will be crucial in optimizing the care provided to this vulnerable population (Yamamoto et al., 2024; Weihing et al., 2022).

The potential for improved patient outcomes is significant, as highlighted by studies demonstrating the effectiveness of specific interventions, such as the Reverse Shock Index (rSIG) and distraction techniques for pain management (Dante et al., 2024; Robinson et al., 2023). However, the findings also reveal a pressing need for ongoing research to evaluate and validate new approaches in pediatric prehospital care, ensuring that EMS providers are equipped with the most effective tools and knowledge (Marlor et al., 2024).

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