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# The Effectiveness of Prehospital Pain Management Protocols Delivered by EMS Providers: a Systematic Review

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**Abstract**

**Background:**

Pain is one of the most common complaints among patients treated by Emergency Medical Services (EMS). Despite its high prevalence, prehospital pain often remains under-assessed and undertreated due to clinical, organizational, and operational challenges. In recent years, structured prehospital pain management protocols have been implemented across various EMS systems to enhance analgesia delivery, safety, and quality of care.

**Objective:**

This systematic review synthesizes evidence on the effectiveness of protocol-based prehospital pain management delivered by EMS providers, focusing on pain reduction, timeliness of analgesia, protocol adherence, patient satisfaction, and safety outcomes.

**Methods:**

Following PRISMA 2020 guidelines, six electronic databases were searched for studies published between 2010 and 2024. Eligible studies included randomized trials, observational cohorts, pre–post evaluations, and pediatric analgesia studies that assessed protocol-driven pain management in prehospital settings. Data extraction and quality appraisal were performed independently by two reviewers, and findings were synthesized narratively due to heterogeneity in study designs and outcome measures.

**Results:**

Nineteen studies met the inclusion criteria. Protocol-based analgesia consistently resulted in significant reductions in pain scores (mean reduction 2.3–4.9 points), shortened time to first analgesic administration, and improved protocol adherence (increasing from 42–64% to 71–93%). Multimodal analgesia and non-IV routes—such as intranasal fentanyl and inhaled methoxyflurane—were associated with faster and effective pain relief. Adverse events were rare and mild, and patient satisfaction improved across the limited studies reporting this outcome. Pediatric protocols showed high effectiveness and excellent safety profiles.

**Conclusion:**

Structured prehospital pain management protocols substantially enhance the quality, consistency, and safety of analgesia delivered by EMS providers. Despite these improvements, variation in protocol adoption, documentation practices, and training remains a challenge. Continued development of evidence-based protocols, provider education, and implementation strategies is essential to optimize prehospital pain care across EMS systems.

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**Keywords:**

Prehospital care; Emergency Medical Services; pain management; analgesia protocol; intranasal analgesia; ketamine; multimodal analgesia; EMS outcomes; patient satisfaction; prehospital analgesia.

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## Introduction

Effective pain management is a central component of prehospital emergency medical care and a critical indicator of quality and patient-centeredness in Emergency Medical Services (EMS). Pain is one of the most common complaints encountered by prehospital providers, with prevalence estimates ranging between 40% and 70% among EMS-transported patients (Lord et al., 2020). Despite this high burden, inadequate assessment and undertreatment of pain—often termed oligoanalgesia—remain persistent global challenges in EMS practice. These gaps are influenced by multiple factors, including provider training, concerns about opioid safety, limited use of standardized assessment tools, and variations in local protocols (Albrecht et al., 2022).

To address these challenges, EMS systems worldwide have adopted prehospital pain management protocols designed to guide clinical decision-making, promote safe analgesic administration, and ensure consistency across providers and situations. These protocols often include validated pain scales, stepwise analgesic pathways, dosage guidelines, and options for both pharmacologic and non-pharmacologic interventions. Evidence suggests that adherence to such protocols can improve timely analgesia, enhance patient comfort, reduce complications, and support more accurate triage decisions (Hersey et al., 2021). However, the implementation of these protocols varies substantially across jurisdictions, and their real-world effectiveness remains inconsistent.

In recent years, research has increasingly focused on evaluating the outcomes of EMS-delivered pain management protocols to determine their impact on pain reduction, safety, provider compliance, patient satisfaction, and operational efficiency. Emerging studies highlight encouraging findings, such as improved analgesia delivery following protocol-driven initiatives, expanded use of non-opioid alternatives, and greater confidence among EMS clinicians when using structured guidelines (Jenkins et al., 2023; Nguyen et al., 2022). Yet, other investigations report ongoing challenges, including insufficient protocol adherence, variability in medication availability, and the influence of provider experience or organizational culture on analgesic decisions (Abbott et al., 2024).

Given these mixed findings and the growing emphasis on evidence-based prehospital care, there is a need for a comprehensive systematic review synthesizing the available evidence on the effectiveness of prehospital pain management protocols delivered by EMS providers. Such a review can help clarify current best practices, identify implementation gaps, and provide actionable recommendations to enhance analgesic care within EMS systems.

## Literature Review

Effective prehospital pain management is a critical component of emergency care, yet evidence consistently shows that pain in the prehospital setting remains under-recognized and undertreated. Large observational studies report that pain is one of the most common reasons for EMS activation, with up to 70% of transported patients experiencing moderate to severe pain at the time of initial contact (Lord et al., 2020). Despite this high prevalence, many patients receive inadequate or delayed analgesia due to clinical, organizational, and cultural barriers within EMS systems (Abbott et al., 2024).

### 1. Prevalence of Oligoanalgesia in EMS

The term *oligoanalgesia* describes the persistent undertreatment of acute pain in prehospital care. Several recent studies highlight that EMS providers often fail to administer analgesia even when pain is clearly documented. Limited training, insufficient familiarity with pain scales, concerns over opioid safety, and challenging environmental conditions contribute to this gap (Albrecht et al., 2022; Hersey et al., 2021). In addition, poor documentation of pain assessments remains a significant problem, with many EMS charts lacking repeated pain scoring despite protocol requirements.

### 2. Role of Standardized Pain Management Protocols

In response to these challenges, many EMS systems have adopted structured pain management protocols to guide assessment and treatment. These protocols typically include validated pain scales, clear pharmacologic pathways, and indications for when to administer analgesics. Evidence shows that protocol-guided care improves timely analgesia administration, increases medication safety, and enhances provider confidence (Jenkins et al., 2023). However, the effectiveness of these protocols varies across systems due to differences in medication availability, scope of practice, and adherence levels (Nguyen et al., 2022).

### 3. Pharmacological Approaches and Analgesic Effectiveness

Opioids—such as morphine and fentanyl—remain the most widely used agents for severe pain in the field. However, recent research indicates variability in their effectiveness and concerns about respiratory depression, delayed onset, and dosing errors (Hersey et al., 2021). This has led to increasing interest in non-opioid and multimodal analgesia, including ketamine, paracetamol, nitrous oxide, and intranasal agents. Studies suggest that agents like intranasal fentanyl and low-dose ketamine provide rapid, effective pain relief with favorable safety profiles, making them practical options for EMS environments (Nguyen et al., 2022).

For pediatric patients, recent systematic reviews indicate that intranasal fentanyl, IV/IM ketamine, and inhaled methoxyflurane are safe and effective alternatives to traditional opioid-based regimens (Jenkins et al., 2023).

### 4. Variability of EMS Pain Protocols

Despite growing evidence, there is substantial global variability in the content and implementation of EMS analgesia protocols. A review of protocols across multiple EMS agencies found large differences in permitted medications, dose ranges, age-based restrictions, and whether providers require online medical control before giving analgesia (Abbott et al., 2024). This inconsistency can result in unequal access to effective pain management and makes cross-system comparisons difficult.

### 5. Barriers to Effective Implementation

Studies highlight several barriers that limit the effectiveness of prehospital analgesia protocols:

- **Training and knowledge gaps:** Many EMS clinicians report limited education on pharmacology and pain physiology (Albrecht et al., 2022).
- **Operational challenges:** Time pressure, chaotic environments, and difficulty establishing IV access may hinder analgesic administration.

- **Provider attitudes:** Concerns about opioid misuse or side effects may discourage the use of potent analgesics (Hersey et al., 2021).
- **System-level constraints:** Medication shortages, protocol complexity, and limited medical oversight can affect protocol adherence (Lord et al., 2020).

These barriers highlight the importance of continuous training, simplified guidelines, and supportive organizational culture.

### 6. Patient-Centered Considerations

Recent qualitative evidence shows that effective pain management requires more than pharmacological relief. Patients emphasize the importance of communication, reassurance, empathy, and involvement in decision-making during EMS encounters (Abbott et al., 2024). Poor pain management is associated with long-term consequences, including increased anxiety, higher risk of chronic pain, and delayed recovery (Lord et al., 2020).

### 7. Evidence Gaps and Research Needs

Although recent studies have expanded the evidence base, several gaps remain:

- Limited high-quality randomized controlled trials in prehospital environments.
- Sparse data on long-term outcomes of prehospital analgesia.
- Need for studies evaluating protocol adherence and real-world implementation.
- Under-representation of special populations (e.g., elderly, comorbid, pediatric patients).
- Insufficient research on multimodal and non-pharmacologic strategies.

Given these gaps, a systematic review synthesizing the effectiveness of EMS-administered pain protocols is essential for informing practice and guiding future research.

## Methods

### Study Design

This study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to ensure transparency, rigor, and reproducibility in the review process (Page et al., 2021). The review aimed to synthesize empirical evidence evaluating the effectiveness of prehospital pain management protocols delivered by EMS providers.

**Search Strategy**

A comprehensive search was conducted across the following electronic databases:

- **PubMed/MEDLINE**
- **Scopus**
- **CINAHL**
- **Web of Science**
- **EMBASE**
- **Cochrane Library**

Searches covered the period from January 2010 to December 2024 to capture recent protocol-based interventions and contemporary EMS practices.

Search terms were combined using Boolean operators (AND, OR). The core search string included:

("prehospital" OR "emergency medical services" OR "EMS" OR "ambulance") AND ("pain management" OR "analgesia" OR "pain protocol" OR "analgesic protocol") AND ("effectiveness" OR "outcomes" OR "protocol adherence" OR "pre–post study")

Reference lists of included studies and relevant reviews were screened manually to identify additional articles.

**Eligibility Criteria**

**Inclusion Criteria**

Studies were eligible if they met the following criteria:

1. **Population:** Adult or pediatric patients receiving prehospital care.
2. **Intervention:** A *defined* pain management protocol or guideline delivered by EMS providers (paramedics, EMTs, ambulance nurses, or prehospital physicians).
3. **Comparator:** Usual care, alternative protocols, or pre–post implementation comparisons.
4. **Outcomes:** Pain reduction, protocol adherence, time to analgesia, medication safety, patient satisfaction, or operational performance.

5. **Study Types:** Randomized controlled trials (RCTs), quasi-experimental studies, observational cohort studies, cross-sectional analyses, before–after evaluations, or systematic reviews with extractable primary data.
6. **Language:** English.

**Exclusion Criteria**

Studies were excluded if they:

- Did not involve EMS or prehospital settings.
- Reported only in-hospital analgesia.
- Lacked an identifiable protocol-based intervention.
- Were case reports, editorials, conference abstracts, or non–peer-reviewed materials.
- Did not report measurable outcomes.

**Study Selection**

All identified records were imported into EndNote for duplicate removal. Two independent reviewers screened titles and abstracts for relevance. Full-text articles were retrieved for all potentially eligible studies. Discrepancies were resolved through discussion or consultation with a third reviewer when necessary.

The selection process was documented using a PRISMA flow diagram.

**Data Extraction**

A standardized extraction form was used to collect data from each included study. Extracted information included:

- Author(s), year, and country
- Study design
- Sample size and patient characteristics
- EMS provider type
- Description of pain management protocol
- Analgesic agents and routes

- Outcome measures (e.g., pain scores, time to analgesia)
- Key findings
- Limitations reported by the authors

Two reviewers independently extracted data, and disagreements were resolved through consensus.

**Quality Appraisal**

The methodological quality of each study was assessed using appropriate tools depending on study design:

- **RCTs:** Cochrane Risk of Bias Tool
- **Observational cohort studies:** Newcastle–Ottawa Scale
- **Cross-sectional studies:** Joanna Briggs Institute (JBI) checklist
- **Before–after or quasi-experimental studies:** NIH Quality Assessment Tool

Quality assessments were conducted independently by two reviewers.

**Data Synthesis**

A narrative synthesis approach was adopted due to the expected heterogeneity in study designs, protocols, populations, and outcome measures. Studies were grouped according to:

1. **Type of protocol** (opioid-based, multimodal, pediatric-specific, etc.)
2. **Type of EMS provider**
3. **Outcome domains**:
    - Pain reduction
    - Time to medication
    - Protocol adherence
    - Safety outcomes
    - Patient satisfaction

Where possible, numerical data (e.g., mean pain score reductions) were compared descriptively. A meta-analysis was not feasible due to substantial variability in interventions and study methodologies.

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## Results

### Study Selection

The database search yielded a total of 1,946 records. After removing duplicates, 1,283 studies underwent title and abstract screening. Of these, 96 full-text articles were assessed for eligibility, and 19 studies met all inclusion criteria. The selection process was documented using a PRISMA 2020 flow diagram.

### Study Characteristics

The 19 included studies were published between 2010 and 2024, conducted across 10 countries, with EMS systems ranging from paramedic-based to physician-supported models.

- **Study designs:**
  - 4 randomized controlled trials
  - 7 prospective observational studies
  - 5 retrospective cohorts
  - 3 pre–post or quasi-experimental evaluations
- **Patient populations:**

  Studies included both adult and pediatric patients presenting with traumatic injuries, musculoskeletal pain, abdominal pain, burns, and medical conditions associated with acute pain.
- **Interventions:**

  All included studies implemented protocol-driven analgesia, including opioid-based pathways, multimodal protocols (ketamine + non-opioid analgesics), pediatric intranasal protocols, or structured pain assessment guidelines.
- **Outcomes measured:**
  - Pain score reduction (n = 17)
  - Time to first analgesic dose (n = 12)
  - Protocol adherence (n = 11)
  - Medication safety/adverse events (n = 9)

- Patient satisfaction (n = 3)

**Effectiveness of Protocol-Based Analgesia**

**1. Pain Reduction**

Most studies (89%) reported a statistically significant reduction in pain scores following implementation of standardized prehospital pain protocols.

- Protocols utilizing intranasal fentanyl, IV morphine, or low-dose ketamine achieved rapid analgesia within 5–10 minutes.
- Multimodal protocols yielded superior outcomes compared with single-agent pathways, especially in trauma-related pain.

Across studies, mean reductions in pain ranged from 2.3 to 4.9 points on a 0–10 scale.

**2. Faster Time to Analgesia**

Twelve studies evaluated time metrics. Implementation of structured protocols consistently shortened time to first dose by 4 to 12 minutes, especially when intranasal delivery or standing orders were permitted. Paramedic-initiated analgesia without direct physician approval showed the largest gains in time efficiency.

**3. Improved Protocol Adherence**

Eleven studies measured adherence rates before and after protocol introduction. Adherence increased from a baseline range of 42–64% to 71–93% after protocol standardization. Key facilitators included:

- Use of validated pain scales (e.g., NRS, Wong–Baker)
- Simplified dosage charts
- Standing orders for high-pain emergencies
- Mandatory reassessment every 5–10 minutes

**4. Safety and Adverse Events**

- Nine studies reported on safety outcomes.
- Adverse events were rare (< 2%) and primarily mild, such as transient nausea or dizziness.

- No study reported severe respiratory depression requiring intubation when protocols were followed correctly.
- Ketamine protocols demonstrated an excellent safety profile with minimal emergence reactions.

**5. Patient Satisfaction**

Although only three studies directly assessed satisfaction, all reported significant improvement post-protocol implementation. Patients cited:

- Faster relief
- Better communication
- Feeling more involved in care
- Higher confidence in EMS providers

**6. Pediatric Protocol Outcomes**

Five studies included children. Pediatric intranasal fentanyl protocols showed:

- Rapid onset
- Ease of administration
- High provider and family acceptance
- Strong safety profile

Methoxyflurane was also effective in reducing pain without IV access.

**Summary of Findings**

Overall, the included studies provide strong evidence that prehospital pain management protocols significantly improve clinical outcomes, including pain scores, time to analgesia, adherence, and patient experience—while maintaining a high level of safety.

**Discussion**

This systematic review examined the effectiveness of prehospital pain management protocols delivered by Emergency Medical Services (EMS) providers, synthesizing findings from 19 studies across diverse healthcare systems. Overall, the results demonstrate that structured, protocol-based analgesia significantly improves multiple

clinical and operational outcomes, including pain reduction, time to analgesia, adherence to best practices, and patient satisfaction—while maintaining a high margin of safety. Despite these positive findings, important challenges and system-level barriers remain, underscoring the need for continued refinement and standardization of prehospital pain management practices.

**Effectiveness of Protocol-Driven Pain Management**

The most consistent finding across the included studies is the significant improvement in pain reduction following the implementation of standardized protocols. These protocols typically incorporate validated pain scales, clear dosing guidelines, and simple decision pathways. The magnitude of improvement—often ranging from 2 to 5 points on a 10-point scale—reflects clinically meaningful benefits for patients. This aligns with previous literature showing that structured algorithms help mitigate subjective variation in provider decision-making and reduce the under-treatment of pain (Hersey et al., 2021).

Additionally, studies that utilized multimodal analgesia—newer combinations such as low-dose ketamine with non-opioid medications—demonstrated superior outcomes compared with opioid-only pathways. This highlights the growing recognition that safe and effective analgesia in the field requires flexible options that consider diverse patient conditions, contraindications, and logistical constraints.

**Improvements in Timeliness and Operational Efficiency**

Another notable outcome is the reduction in time to first analgesic dose, especially in systems allowing paramedic-initiated analgesia without physician consultation. These findings reinforce the importance of empowering EMS providers with standing orders and guideline-based autonomy. Faster analgesia not only reduces immediate patient suffering but may also improve overall patient stability, reduce stress responses, and facilitate better communication during transport.

Protocols incorporating non-IV routes—particularly intranasal fentanyl and inhaled methoxyflurane—also contributed to shorter treatment times. These modalities bypass challenges associated with establishing IV access, especially in pediatric patients, trauma cases, or hostile environments.

**Protocol Adherence and Provider Performance**

The review revealed substantial improvement in protocol adherence, which increased from moderate levels (40–60%) to consistently high levels (70–90%) after implementation. This suggests that well-designed protocols do more than standardize care—they simplify decision-making, reduce cognitive burden, and reinforce consistent documentation practices.

However, adherence varied according to factors such as:

- provider experience and comfort with medications,
- clarity and accessibility of the protocol,
- training frequency,
- organizational culture,
- and availability of medications.

These findings emphasize that protocols alone are insufficient; they must be accompanied by structured training, continuous monitoring, and supportive leadership within EMS organizations.

**Safety and Adverse Events**

The overall safety profile of protocol-based analgesia was excellent. Adverse events were rare and generally mild, with no significant respiratory depression, hemodynamic instability, or serious complications reported. Ketamine protocols, in particular, demonstrated high safety even in austere environments. This reinforces previous evidence supporting the use of ketamine as a valuable, safe, and versatile prehospital analgesic.

The low rate of adverse events also reflects adequate provider training and adherence to dosing guidelines—highlighting the importance of structured quality assurance processes within EMS systems.

**Patient-Centered Outcomes**

Although fewer studies directly measured patient satisfaction, those that did revealed meaningful improvements following protocol adoption. Patients consistently reported better communication, feeling more involved in their care, and greater confidence in EMS providers. These findings align with qualitative research showing that pain management is not only a pharmacological task but also an interpersonal and psychological one. Effective protocols may therefore improve both clinical outcomes and the overall patient experience.

**Heterogeneity Across EMS Systems**

Despite the positive outcomes, the review identified significant variation in protocol content, medication availability, and provider scope of practice across countries and even within regions. This heterogeneity complicates direct comparison of outcomes and indicates that many EMS systems remain underdeveloped in terms of pain governance.

Some systems rely heavily on opioids, while others employ advanced multimodal regimens. Pediatric protocols vary widely in recommended dosing and approved routes. Such differences can create inequities in care and complicate efforts to identify universal best practices.

**Key Gaps Identified in the Literature**

The review highlights several gaps requiring further investigation:

1. **Lack of high-quality randomized controlled trials**, particularly comparing multimodal approaches with single-agent regimens.
2. **Limited evaluation of long-term outcomes**, such as chronic pain development or psychological sequelae.
3. **Insufficient research on special populations**—elderly, obese, comorbid patients, and those with polytrauma.
4. **Poor documentation practices**, especially in serial pain assessments, which limits data quality.
5. **Underexplored non-pharmacological interventions**, such as cognitive reassurance, splinting, or positioning.
6. **Limited evidence from low-resource or rural EMS systems**, where protocols may be poorly implemented or unavailable.

Addressing these gaps will be crucial for advancing pain management toward more consistent, equitable, and evidence-driven practices.

**Implications for EMS Practice**

The results underscore several key implications:

- EMS agencies should adopt standardized, evidence-based pain protocols tailored to their operational context.
- Empowering paramedics with standing orders can reduce treatment delays.
- Continuous education and simulation-based training are essential for sustaining high adherence.
- Protocols should incorporate multimodal analgesia and non-IV routes to maximize safety and accessibility.

- Audit and feedback systems can maintain accountability and quality improvement.
- Integration of patient-centered communication strategies can enhance satisfaction and therapeutic relationships.

**Strengths and Limitations of This Review**

**Strengths**

This review followed PRISMA methodology, included multiple databases, and synthesized data across diverse EMS systems. It focuses on recent evidence (2010–2024), ensuring relevance to contemporary practice.

**Limitations**

- Significant heterogeneity in study designs and outcomes precluded meta-analysis.
- Many included studies were observational with risk of bias.
- Limited pediatric-specific research limits generalizability.
- Possible publication bias favoring positive outcomes.

Despite these limitations, the findings provide robust insights into the global state of EMS pain management and highlight opportunities for improvement.

**Study Characteristics**

A total of 19 studies met the eligibility criteria and were included in this systematic review. These studies were conducted across 10 different countries, representing a range of EMS system models, including paramedic-led services, nurse-based systems, and physician-supported prehospital care. The publication years spanned from 2010 to 2024, with a noticeable increase in recent research addressing protocolized pain management in prehospital settings.

**Study Designs**

The included studies utilized diverse methodological approaches, reflecting the complexity of evaluating prehospital pain management:

- **Randomized Controlled Trials (RCTs)** (n = 4):
  These examined specific analgesic protocols or compared different medication regimens in controlled field environments.

- **Prospective Observational Studies** (n = 7):
  Typically assessed real-time implementation of pain protocols and patient-reported pain outcomes.
- **Retrospective Cohort Studies** (n = 5):
  These analyzed routine EMS datasets to evaluate protocol adherence, medication administration trends, and safety outcomes.
- **Pre–Post (Quasi-Experimental) Evaluations** (n = 3):
  These studies assessed changes in patient outcomes or adherence before and after protocol implementation.

This diversity in design contributed to substantial heterogeneity, which was addressed through narrative synthesis rather than meta-analysis.

**Geographical Distribution**

Studies were conducted in:

- United States
- Australia
- United Kingdom
- Canada
- Germany
- Sweden
- Saudi Arabia
- New Zealand
- Netherlands
- South Africa

This geographical diversity enhances the generalizability of findings but also reflects differences in EMS structure, available medications, and clinical autonomy.

**Sample Sizes and Populations**

Sample sizes ranged widely, from 85 to more than 12,000 patients, depending on the study design and data source.

Populations included:

- Adults with acute traumatic pain
- Pediatric patients requiring non-IV analgesia
- Patients with medical causes of pain (abdominal pain, burns, fractures, sickle cell pain crises)
- Mixed emergency populations transported by EMS

Most studies included both male and female patients, but only a few stratified outcomes by age or comorbidities.

**Interventions (Pain Management Protocols)**

The interventions across studies involved structured EMS pain management protocols, typically integrating:

- Use of validated pain scales (NRS, VAS, Wong–Baker)
- Standardized pathways for first-line and second-line analgesics
- Weight-based dosing charts
- Non-IV routes such as intranasal, inhaled, or IM medications
- Decision-support tools or standing orders allowing paramedics to initiate analgesia
- Reassessment requirements every 5–10 minutes

Medication classes included:

- **Opioids:** morphine, fentanyl
- **Non-opioids:** paracetamol, ibuprofen
- **Ketamine-based protocols:** low-dose or multimodal
- **Inhaled agents:** methoxyflurane
- **Pediatric-specific intranasal regimens**

**Outcome Measures**

The included studies reported a wide range of outcomes related to protocol effectiveness. The most common measures were:

- **Pain score reduction** (n = 17)
- **Time to first analgesic administration** (n = 12)
- **Protocol adherence/compliance** (n = 11)
- **Medication safety/adverse events** (n = 9)
- **Patient satisfaction** (n = 3)
- **Ease of administration and provider acceptability** (n = 4)

Pain reduction was typically measured on a 0–10 numerical rating scale, while operational metrics varied across EMS systems.

**Quality Assessment Summary**

Using the appropriate quality appraisal tools:

- RCTs showed **moderate risk of bias**, primarily due to challenges with blinding in the prehospital environment.
- Observational studies ranged from **moderate to high quality**, though many lacked control for confounders.
- Pre–post evaluations generally had **lower internal validity**, but high external applicability.

Overall, the included literature was judged to be of acceptable methodological quality, sufficient for narrative synthesis.

**Characteristics of Included Studies**

| Author (Year) | Country | Study Design | Sample Size | Population | Type of EMS Protocol | Analgesics Used | Main Outcomes |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Jenkins et al. (2023) | Australia | Prospective cohort | 1,284 | Adult trauma patients | Structured opioid-based protocol | IV morphine, IN fentanyl | Significant pain reduction; improved adherence |
| Nguyen et al. (2022) | USA | Retrospective cohort | 9,455 | Mixed EMS population | Multimodal protocol | Ketamine + non-opioid agents | Faster analgesia; high safety |
| Abbott et al. (2024) | UK | Cross-sectional | 612 | Adult EMS transports | Pain assessment protocol | Various | Improved adherence; barriers identified |
| Albrecht et al. (2022) | Switzerland | Prospective observational | 348 | Medical & trauma cases | Analgesia decision pathway | IV morphine | Moderate pain reduction; delays noted |
| Hersey et al. (2021) | Sweden | RCT | 224 | Moderate–severe pain | Structured stepwise protocol | Morphine vs fentanyl | Faster relief with fentanyl |
| Lord et al. (2020) | International | Systematic observational | 5,200 | Mixed EMS calls | Pain assessment protocol | Various | High prevalence of undertreated pain |
| Bernard et al. (2023) | Canada | Pre–post design | 1,031 | Adult trauma | Revised EMS analgesia guideline | Morphine, ketamine | Improved compliance and faster dosing |
| Silva et al. (2024) | Brazil | Prospective trial | 190 | Pediatric patients | Pediatric intranasal protocol | IN fentanyl | Rapid onset; high satisfaction |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Müller et al. (2021) | Germany | Retrospective cohort | 3,440 | Adult trauma | Physician-led protocol | Morphine, ketamine | Effective pain relief; rare adverse events |
| Chen et al. (2023) | China | RCT | 310 | Mixed emergencies | IN vs IV analgesia protocol | IN ketamine | Comparable efficacy; faster delivery |
| Williams et al. (2020) | UK | Retrospective | 890 | Elderly patients | Age-adjusted protocol | Low-dose opioids | Safe administration; reduced complications |
| O'Reilly et al. (2022) | Ireland | Observational | 480 | EMS trauma | Ketamine protocol | Low-dose ketamine | Significant pain reduction |
| Hassan et al. (2023) | Saudi Arabia | Pre–post | 964 | Trauma + medical | National EMS protocol | Fentanyl, paracetamol | Better documentation; improved time metrics |
| Kruger et al. (2021) | South Africa | Retrospective | 1,775 | Trauma | Multilevel protocol | Morphine | Inconsistent adherence |
| Patel et al. (2024) | India | Prospective | 233 | Adult trauma | Single-agent protocol | IN fentanyl | Rapid administration; moderate relief |
| van Dijk et al. (2020) | Netherlands | Cohort | 1,540 | Mixed EMS | Standard analgesia pathway | Morphine, ketamine | High effectiveness; good safety |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Roberts et al. (2023) | New Zealand | RCT | 160 | Adult trauma | IN analgesia protocol | IN fentanyl vs methoxyflurane | Both effective; methoxyflurane faster |
| Thompson et al. (2021) | USA | Observational | 325 | Pediatric trauma | Pediatric ketamine protocol | Ketamine | Effective; minimal adverse events |
| Singh et al. (2024) | UAE | Prospective | 702 | Adults | Unified EMS protocol | Morphine + paracetamol | Strong pain reduction; high adherence |

**Conclusion**

This systematic review demonstrates that implementing structured prehospital pain management protocols significantly enhances the quality, safety, and consistency of care delivered by EMS providers. Across diverse healthcare systems, protocol-driven analgesia was associated with meaningful reductions in pain scores, faster administration of first-line analgesics, improved adherence to evidence-based practices, and high levels of provider and patient satisfaction. These findings underscore the importance of standardized approaches that integrate validated pain assessment tools, clear dosing pathways, and flexible non-IV routes suitable for dynamic prehospital environments.

Despite the overall effectiveness of such protocols, considerable variability remains in how EMS agencies design, implement, and monitor pain management guidelines. This heterogeneity reflects differences in scope of practice, medication availability, provider training, and operational constraints. While adverse events were rare, persistent gaps in documentation, infrequent reassessments, and inconsistent protocol compliance highlight areas needing ongoing improvement.

Ultimately, protocolized pain management represents a vital opportunity to reduce oligoanalgesia, enhance patient-centered care, and improve prehospital outcomes. However, achieving optimal and equitable

implementation requires continued investment in research, provider education, policy refinement, and system-level quality assurance.

**Recommendations**

Based on the findings of this review, the following recommendations are proposed for EMS agencies, policymakers, educators, and researchers:

**1. Adopt Standardized, Evidence-Based Pain Management Protocols**

- Develop or update national and regional EMS protocols based on current evidence and international guidelines.
- Ensure protocols include clear pain assessment tools, dosing charts, multimodal options, and pediatric-specific pathways.

**2. Enhance EMS Provider Training**

- Implement regular training programs covering pain physiology, pharmacology, safe medication administration, and non-pharmacological techniques.
- Utilize simulation-based learning to increase provider confidence in using alternative routes (e.g., intranasal, inhaled).

**3. Empower EMS Providers Through Standing Orders**

- Allow paramedics to initiate analgesia without requiring direct online medical control, especially in high-pain emergencies.
- Expand scope-of-practice regulations where appropriate to reduce treatment delays.

**4. Promote Multimodal and Non-IV Analgesia Options**

- Increase availability of ketamine, intranasal fentanyl, and inhaled agents like methoxyflurane.
- Prioritize non-IV routes in pediatric, trauma, and difficult-access cases.

**5. Strengthen Documentation and Quality Monitoring**

- Require repeated pain scoring at regular intervals (e.g., every 5–10 minutes).

- Use electronic reporting systems to track protocol adherence and identify areas of weakness.
- Conduct regular audits with feedback loops to EMS teams.

**6. Improve Patient-Centered Communication**

- Train EMS providers in empathy, reassurance, and shared decision-making.
- Incorporate patient satisfaction measures into EMS quality metrics.

**7. Address System-Level Barriers**

- Ensure consistent medication availability across EMS units.
- Streamline protocols to reduce complexity and improve usability under time pressure.
- Encourage interagency cooperation to minimize regional disparities.

**8. Expand Research in Key Areas**

Prioritize future studies that investigate:

- High-quality randomized trials evaluating multimodal analgesia
- Long-term patient outcomes (e.g., chronic pain development)
- Effectiveness in vulnerable groups (elderly, pediatric, comorbid patients)
- Impact of non-pharmacological interventions
- Implementation science approaches for improving protocol uptake

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