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Managing A Case Of Acute Respiratory Distress By A Paramedic

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Abstract

Acute respiratory distress represents a critical medical emergency characterized by rapid onset of difficulty breathing and inadequate oxygenation due to lung dysfunction. Paramedics serve as the first clinical point of contact and are uniquely positioned to perform critical assessments, initiate oxygenation and ventilation support, and rapidly triage patients. Approximately 12% of non-traumatic, non-cardiac arrest EMS encounters involve respiratory distress, with increasing incidence among elderly populations and those with chronic comorbidities. Paramedics face challenges in evaluating acute respiratory distress due to limited diagnostic tools, patient history constraints, uncontrolled environments, multiple comorbidities, and urgency of care. The assessment process follows systematic principles to rapidly identify life-threatening conditions, prioritizing airway, breathing, and circulation. Paramedics perform critical interventions focused on airway management, oxygen therapy, ventilatory support, pharmacological therapies, and circulatory support. Continuous pulse oximetry and capnography enable monitoring of oxygenation and ventilation status. Pediatric patients present unique challenges due to distinct anatomical and physiological features. Geriatric patients with comorbidities may present atypically and are at higher risk for complications and mortality. Pregnant patients require prioritization of maternal stabilization and fetal monitoring. Trauma-related acute respiratory distress arises from direct airway compromise, pulmonary injury, or neurological impairment. Prehospital management is constrained by limited diagnostics, environmental factors, narrow intervention windows, and variability in paramedic training and equipment. Leading EMS guidelines emphasize early oxygenation support, non-invasive ventilation, and advanced airway management when necessary. Future directions include advances in portable respiratory monitoring, point-of-care lung ultrasound, AI-assisted triage and intervention protocols, and expanded scope for paramedics in critical respiratory cases.

Keywords Acute respiratory distress, paramedic management, prehospital care, airway management, oxygen therapy, CPAP, ARDS.

1. Introduction

Acute respiratory distress represents a critical medical emergency characterized by the rapid onset of difficulty in breathing and inadequate oxygenation due to lung dysfunction. It encompasses conditions such as acute respiratory distress syndrome (ARDS), which is defined in emergency medicine as a form of acute lung injury leading to diffuse inflammation and non-cardiogenic pulmonary edema, ultimately causing severe hypoxemia and respiratory failure. This syndrome may arise secondary to numerous insults including sepsis, pneumonia, trauma, aspiration, or other systemic inflammatory states, and can swiftly progress to life-threatening respiratory failure requiring urgent intervention (Matthay et al., 2019).

Immediate recognition and timely intervention in the prehospital setting are paramount to improve patient outcomes and reduce mortality. Paramedics and emergency medical services (EMS) providers serve as the first clinical point of contact for patients experiencing acute respiratory distress and are uniquely positioned to perform critical assessments, initiate oxygenation and ventilation support, and rapidly triage patients for definitive care. Prompt identification allows early administration of supplemental oxygen, management of airway patency, and interventions tailored to underlying causes, which can prevent progression to respiratory arrest, multi-organ dysfunction, and cardiac arrest (Long et al., 2025).

The epidemiology of acute respiratory distress in the prehospital environment reflects a substantial healthcare burden worldwide. Studies report that respiratory distress comprises approximately 10-12% of EMS non-trauma activations, with increasing incidence among elderly populations and those with chronic comorbidities such as chronic obstructive pulmonary disease (COPD) and heart failure. Globally, acute respiratory distress syndrome affects an estimated 9.5 cases per 100,000 person-years in adults, with regional variation influenced by healthcare resource availability, diagnostic criteria, and population demographics. Prehospital respiratory emergencies frequently lead to hospital admission, intensive care utilization, and significant mortality rates, underscoring the importance of prehospital care optimization (Prekker et al., 2014).

The purpose of this review is to synthesize current evidence on the paramedic role in the timely recognition, assessment, and management of acute respiratory distress during prehospital care. It aims to highlight contemporary best practices, clinical challenges, and emerging interventions pertinent to EMS providers. Additionally, this review seeks to inform EMS educators on training priorities, aid policy-makers in resource planning, and ultimately enhance patient-centered emergency respiratory care.

The target readership for this review includes practicing EMS professionals, paramedics, emergency medical technicians, EMS educators, clinical guideline developers, and policy-makers involved in prehospital health services. By addressing the critical aspects of acute respiratory distress management from a paramedic perspective, the review intends to facilitate improved clinical outcomes and drive advancements in prehospital emergency care protocols.

2. Pathophysiology of Acute Respiratory Distress

Acute respiratory distress syndrome (ARDS) is a complex and life-threatening condition characterized by severely impaired gas exchange and decreased lung compliance. Understanding its pathophysiology is essential for effective prehospital management.

2.1 Respiratory Anatomy and Physiology Relevant to ARDS

The respiratory system facilitates gas exchange through the alveolar-capillary membrane, where oxygen enters the blood, and carbon dioxide is expelled. The alveoli, the tiny air sacs in the lungs, are lined with surfactant and are surrounded by an extensive capillary network. Efficient gas exchange depends on the integrity of alveolar epithelial cells, endothelial cells, and the regulation of fluid within the alveoli (Swenson & Swenson, 2021).

2.2 Mechanisms Leading to Respiratory Distress

ARDS involves disruptions in the alveolar-capillary barrier due to inflammation, injury, or infection. This leads to increased permeability, resulting in alveolar flooding with protein-rich edema fluid, which hampers oxygen diffusion and may cause hypoxemia. Additionally, the loss of surfactant causes alveolar collapse, further impairing ventilation and increasing airway resistance (Diamond et al., 2024).

Hypoxemia in ARDS arises from various mechanisms, primarily from ventilation-perfusion (V/Q) mismatch, shunting, and diffusion impairment. These disturbances lead to inadequate oxygenation despite sufficient ventilation (Diamond et al., 2024).

Hypercapnia, or elevated carbon dioxide levels, occurs when alveolar ventilation is insufficient to remove CO2, either due to decreased lung compliance, airway obstruction, or both. It reflects hypoventilation and can contribute to respiratory acidosis (Diamond et al., 2024).

Airway resistance and obstruction are often increased due to airway edema, mucus plugging, or bronchospasm. Obstruction can severely limit airflow and worsen gas exchange (Diamond et al., 2024).

Alveolar damage involves destruction of alveolar walls, formation of hyaline membranes, and epithelial cell injury. This damage reduces surface area for gas exchange and contributes to pulmonary shunt, where blood bypasses ventilated alveoli (Bos & Ware, 2022).

2.3 Common Causes in the Prehospital Setting

In the emergency medical context, ARDS can result from multiple causes, including:

- **Asthma exacerbations**: airway narrowing and bronchospasm lead to increased airway resistance and hypoxemia.
- **COPD flare-ups**: airflow limitation and air trapping exacerbate ventilation-perfusion mismatch.
- **Pulmonary edema**: either cardiogenic, due to heart failure, or non-cardiogenic, as in sepsis or trauma, causes alveolar flooding.
- **Pneumonia and sepsis**: infection triggers inflammatory responses, increasing alveolar-capillary permeability.
- **Trauma**: thoracic injuries or airway trauma can impair ventilation and lead to hypoxia.
- **Anaphylaxis**: causes airway swelling and bronchospasm, compromising oxygenation.
- **Pulmonary embolism**: blocks blood flow, causing V/Q mismatch and hypoxemia.

2.4 Underlying Pathophysiological Processes

The initial injury in ARDS involves activation of alveolar macrophages by infectious or injury-related stimuli, releasing cytokines and chemokines. This inflammatory cascade recruits neutrophils, which release proteases and reactive oxygen species, injuring alveolar structures. The injury increases alveolar-capillary permeability, leading to edema, alveolar collapse, and impaired gas exchange. The alveolar epithelium attempts to repair via proliferation of type II pneumocytes, but persistent injury results in fibrosis and long-term lung dysfunction in some cases (Bos & Ware, 2022).

3. Epidemiology and Risk Factors of Acute Respiratory Distress in EMS

3.1 Prevalence of ARD Calls in EMS

Acute respiratory distress is a frequent and critical reason for emergency medical services (EMS) activation. Approximately 12% of non-traumatic, non-cardiac arrest EMS encounters involve respiratory distress, making it one of the most common presentations seen by paramedics in the prehospital setting. Advanced life support (ALS) providers encounter respiratory distress in nearly 18% of their cases, compared to 8.6% by basic life support (BLS) providers. Most respiratory distress calls originate from patients' homes (around 70%) and often require supplemental oxygen, airway management, or ventilation support before hospital arrival. Prehospital respiratory distress cases have a high rate of hospital admission (up to 50%), with a significant proportion requiring intensive care and mechanical ventilation. Hospital mortality for patients with severe respiratory distress can reach 10-23%, depending on care needs such as mechanical ventilation (Prekker et al., 2014).

3.2 Age- and Population-Specific Risks

Respiratory distress risk and presentation vary markedly with age and patient populations. Incidence rises with age, with geriatric patients representing a disproportionately high percentage of respiratory distress cases. The elderly commonly face respiratory distress from chronic obstructive pulmonary disease (COPD), congestive heart failure, and pneumonia, which contribute to increased morbidity and mortality. Pediatric patients, while less frequently represented overall, have unique risk factors primarily relating to lower respiratory tract infections and pneumonia. Pediatric acute respiratory distress syndrome (PARDS) often arises from direct lung injury such as pneumonia or viral infections, with additional risks from sepsis and other systemic illnesses. Cardiac patients also represent a high-risk group for ARD, where acute heart failure or pulmonary edema may mimic or precipitate respiratory distress episodes (Kohne & Flori, 2019).

3.3 Environmental and Occupational Exposures

Environmental factors significantly influence the risk of developing acute respiratory distress. Chronic exposure to air pollution, cigarette smoke, occupational inhalation hazards, and indoor air quality issues (such as mold, debris in ventilation systems, and poor HVAC maintenance) can increase susceptibility to respiratory distress. These exposures contribute to lung epithelial injury and inflammatory responses that may precipitate or exacerbate ARD events during emergencies. Workplace-related respiratory symptoms, particularly in office or industrial environments with poor ventilation, have been associated with increased lower respiratory tract symptoms and may predispose vulnerable populations to ARD (Bennett & Reilly, 2024).

3.4 Comorbidities Increasing Risk During Emergencies

Numerous comorbidities heighten the risk of ARD and adversely influence outcomes during respiratory distress emergencies. Chronic pulmonary illnesses such as COPD and asthma are prominent risk factors associated with higher ARD incidence. Other significant comorbidities include cardiovascular diseases, immune suppression, solid or hematologic malignancies, sepsis, and trauma. Patients with these comorbid conditions often experience more severe disease, require more intensive interventions like mechanical ventilation, and have higher ICU and hospital mortality rates. Moreover, comorbidities may alter the clinical management approach in the prehospital setting, requiring tailored interventions to avoid complications such as oxygen toxicity in COPD or fluid overload in heart failure (Lin et al., 2025).

4. Clinical Presentation of Acute Respiratory Distress in the Prehospital Setting

Acute respiratory distress (ARD) represents a critical emergency scenario commonly encountered by paramedics in the field. Recognizing its clinical presentation promptly is essential for effective prehospital management and improved patient outcomes.

4.1 Signs and Symptoms

- **Dyspnea (Shortness of Breath):** Patients typically present with an intense sensation of breathlessness, which can range from mild to severe and progress rapidly. This symptom is often the initial complaint and a hallmark of respiratory distress syndromes (Diamond et al., 2024).
- **Tachypnea (Rapid Breathing):** Elevated respiratory rates beyond the normal range reflect the body's attempt to compensate for hypoxia. Tachypnea is a consistent early clinical sign and is frequently observable in paramedic assessments (Diamond et al., 2024).
- **Use of Accessory Muscles:** The engagement of accessory respiratory muscles (e.g., sternocleidomastoid, intercostal muscles) indicates increased work of breathing. Retractions and visible muscle use signal clinically significant respiratory compromise.
- **Cyanosis:** Central or peripheral cyanosis presents as bluish discoloration of the skin, lips, or nail beds, indicating hypoxemia. It is a late but critical sign of inadequate oxygenation (Diamond et al., 2024).
- **Altered Mental Status:** Hypoxia and hypercapnia can impair cerebral function, resulting in confusion, agitation, restlessness, or reduced consciousness level. Persistent altered mental status is a red flag requiring urgent intervention.

4.2 Prehospital Challenges in Presentation Assessment

Paramedics face several difficulties in evaluating acute respiratory distress in the field:

- **Limited Diagnostic Tools:** Unlike hospital settings, the prehospital environment lacks complex diagnostic modalities (e.g., arterial blood gases, chest imaging), forcing reliance on physical exam and vital signs (Fuller et al., 2020).
- **Patient History Constraints:** Distressed patients may be unable to communicate effectively due to breathlessness or altered mental status, limiting history gathering. Family or bystander information may be incomplete or unavailable (Fuller et al., 2020).
- **Uncontrolled Environment:** Noise, limited space, and urgency can hamper thorough examination and increase assessment complexity (Fuller et al., 2020).
- **Multiple Comorbidities:** Patients may have overlapping cardiac, pulmonary, or systemic conditions complicating presentation and diagnosis (Fuller et al., 2020).
- **Urgency of Care:** The potential for rapid deterioration necessitates swift but accurate assessment to decide on immediate interventions such as oxygen therapy, airway management, or rapid transport.

Paramedic assessment thus emphasizes rapid recognition of key signs—dyspnea, tachypnea, accessory muscle use, cyanosis, and mental status changes—combined with a pragmatic approach given environment and resource limitations. This clinical vigilance enables timely stabilization and appropriate prehospital management of acute respiratory distress.

5. Prehospital Assessment by a Paramedic in Acute Respiratory Distress

When a paramedic arrives at the scene of a patient experiencing acute respiratory distress (ARD), the assessment process is critical and follows systematic principles to rapidly identify life-threatening conditions and begin appropriate management.

5.1 Scene Safety and Rapid Situational Evaluation

Before approaching the patient, the paramedic ensures that the scene is safe for both the patient and the responders. This involves identifying potential hazards such as traffic, fire, environmental dangers, or violence, and taking steps to mitigate these risks. Maintaining situational awareness continuously is essential because the scene dynamics may change unexpectedly (Klein & Tadi, 2023).

5.2 Airway, Breathing, Circulation (ABC) Prioritization

Using the ABCDE mnemonic, paramedics prioritize immediate life threats. First, they confirm airway patency, ensuring the airway is open; then assess breathing effort and adequacy; followed by evaluating circulation status. This approach is iterative and continuous throughout the prehospital care (Thim et al., 2012).

5.3 Initial Impressions

Paramedics use visual and auditory cues such as cyanosis, accessory muscle use, altered mental status, wheezing, stridor, or coughing to form a rapid impression of severity and possible causes of respiratory distress (Thim et al., 2012).

5.4 Primary Survey

This involves an immediate check for airway obstruction, the quality and rate of breathing, and the patient's circulatory condition including pulse presence and skin perfusion. Life-threatening issues are treated immediately upon identification (Thim et al., 2012).

5.5 Secondary Survey

- **Pulse oximetry**: to measure blood oxygen saturation, giving an objective measure of hypoxia.
- **Capnography** (if available): provides monitoring of ventilation status and can detect hypoventilation or airway obstruction even in non-intubated patients (Kober et al., 2004).
- **Vital signs**: Blood pressure, heart rate, respiratory rate documented to evaluate the patient's overall status.
- **Patient history**: Using SAMPLE (Signs/Symptoms, Allergies, Medications, Past medical history, Last oral intake, Events leading up) and OPQRST (Onset, Provocation, Quality, Radiation, Severity, Time) mnemonics to gather relevant information rapidly, acknowledging time constraints and patient's respiratory distress.

5.6 Differentiating ARD from Other Respiratory Presentations

Acute Respiratory Distress Syndrome (ARDS) is characterized by rapid onset, hypoxemia refractory to oxygen therapy, and bilateral infiltrates on imaging. Its acute inflammatory nature distinguishes it from chronic diseases like COPD or asthma. Paramedics must differentiate ARD from other causes of respiratory distress such as asthma exacerbation, COPD flare, pneumonia, pneumothorax, or cardiac causes, though prehospital diagnostic accuracy is often moderate. A syndromic approach focusing on supportive care including oxygenation and safe transport is essential (Fuller et al., 2020).

6. Immediate Prehospital Interventions for Acute Respiratory Distress by Paramedics

When managing acute respiratory distress in the prehospital setting, paramedics must perform a range of critical interventions focused on airway management, oxygen therapy, ventilatory support, pharmacological therapies, and circulatory support to stabilize patients effectively.

6.1 Airway Management

Manual airway maneuvers such as the head tilt–chin lift and jaw thrust are first-line maneuvers to open a compromised airway safely without instrumentation, especially in trauma or unconscious patients. Use of adjuncts assists airway patency: the oropharyngeal airway (OPA) is suited for unconscious patients without a gag reflex, while the nasopharyngeal airway (NPA) can be used in semi-conscious patients or when an oral airway is contraindicated. Suctioning techniques are employed to clear secretions or obstructions, preventing aspiration and facilitating effective ventilation (Avva et al., 2025).

6.2 Oxygen Therapy

Paramedics administer oxygen tailored to the patient's needs. High-flow oxygen is indicated in severe hypoxia, while titrated oxygen therapy aims to maintain target saturations, avoiding hyperoxia risks especially in COPD patients vulnerable to carbon dioxide retention. Delivery devices include the nasal cannula, suitable for mild hypoxia; the simple face mask for moderate needs; and the non-rebreather mask, which delivers high-concentration oxygen up to 90%. Despite the instinct to maximize oxygen, precise titration is critical to avoid oxygen toxicity and oxidative stress (Weekley et al., 2025).

6.3 Ventilatory Support

Bag-valve-mask (BVM) ventilation provides basic positive pressure ventilation during respiratory failure, ideally with adjunct airway devices. For patients with ongoing respiratory distress, non-invasive ventilation (NIV) options such as Continuous Positive Airway Pressure (CPAP) and Bilevel Positive Airway Pressure (BiPAP) improve oxygenation and reduce work of breathing without intubation. CPAP has demonstrated efficacy in reducing dyspnoea and tachypnea prehospital and is recommended in EMS protocols. Advanced airway management, including endotracheal intubation or placement of supraglottic devices, is reserved for patients unable to maintain airway patency or ventilation despite NIV efforts (Avva et al., 2025).

6.4 Pharmacological Support

Bronchodilators such as salbutamol (albuterol) are commonly administered to relieve bronchospasm in reactive airways disease. Corticosteroids, including prednisolone and dexamethasone, reduce airway inflammation and are used in asthma or COPD exacerbations, although benefits in ARDS remain supportive rather than curative. In cases of anaphylaxis, antihistamines and epinephrine are critical for reversing airway swelling and circulatory collapse. Nitroglycerin is employed for cardiogenic pulmonary edema to reduce preload and pulmonary congestion (Qadir & Chang, 2021).

6.5 Circulatory Support

Establishing intravenous access is essential for fluid therapy and medication administration. Fluid management must be carefully balanced, especially in respiratory distress with hypotension where volume expansion can worsen pulmonary edema, yet hypoperfusion risks organ damage. Vasopressors and inotropes may be considered in coordination with hospital-based care if hypotension persists alongside respiratory compromise (Dunand et al., 2021).

7. Monitoring and Ongoing Care in Acute Respiratory Distress by a Paramedic

Management of acute respiratory distress in the prehospital setting requires vigilant and continuous monitoring to assess the patient’s respiratory and hemodynamic status, guide treatment adjustments, and recognize early signs of deterioration that warrant escalation of care.

7.1 Continuous Pulse Oximetry and Capnography Monitoring

Pulse oximetry is an essential and non-invasive tool used continuously to monitor the patient’s peripheral oxygen saturation (SpO_2). It provides rapid feedback on oxygenation status, enabling paramedics to titrate supplemental oxygen to maintain target saturations, typically above 90-94% depending on the underlying condition. Continuous monitoring helps detect hypoxemia promptly and guides the adequacy of oxygen delivery interventions (Wick et al., 2022).

Capnography, through waveform analysis and measurement of end-tidal carbon dioxide (EtCO2), offers real-time assessment of ventilation effectiveness. It helps determine the adequacy of respiratory rate and tidal volume and can detect early hypoventilation, airway obstruction, or changes in cardiac output impacting ventilation status. Paramedics use capnography to titrate ventilation support, including continuous positive airway pressure (CPAP) or positive-pressure ventilation, and confirm airway patency (N. K. Pandya & Sharma, 2023).

7.2 Assessment of Patient's Response to Interventions

Focused assessment involves continual evaluation of the patient's airway, breathing, and circulation using a systematic approach such as the ABCDE (Airway, Breathing, Circulation, Disability, Exposure) framework. Paramedics must assess changes in respiratory rate, breath sounds, work of breathing, mental status, and oxygen saturation trends. Improvement or deterioration in these parameters guides the need to escalate or modify interventions such as oxygen delivery modes and airway management. Patient responsiveness to treatments such as supplementary oxygen, CPAP, or assisted ventilation is closely monitored. For example, the effects of CPAP documented in prehospital trials show a reduction in dyspnea and respiratory rates in severe distress, indicating the importance of adjusting therapy based on clinical response (Finn et al., 2022).

7.3 Adjusting Oxygen Delivery and Ventilation

Oxygen administration is titrated according to continuous pulse oximetry readings to avoid hypoxia but also prevent hyperoxia, which may cause harm in some respiratory conditions. Flow rates and delivery interfaces (nasal cannula, simple face mask, non-rebreather mask, CPAP) are adjusted to optimize oxygenation while ensuring patient comfort and cooperation. Ventilation support is similarly adjusted using capnography feedback to avoid hypoventilation or hyperventilation, aiming for normal EtCO2 ranges around 35–45 mmHg (Wick et al., 2022).

8. Special Populations

8.1 Pediatric Acute Respiratory Distress

Pediatric patients present unique challenges in ARD management due to distinct anatomical and physiological features. The pediatric airway is proportionally different from adults, with a larger head causing natural neck flexion in the supine position, a proportionally larger tongue that can obstruct the oropharynx, and a higher larynx located at C2–C3, which makes visualization more difficult during intubation. The epiglottis is U-shaped and stiffer, and the vocal cords have an upward slant, requiring specific techniques such as jaw-lift maneuvers for adequate ventilation. The narrowest part of the airway is at the cricoid ring, making it highly susceptible to obstruction from minor edema or secretions. Additionally, children have smaller residual lung capacity, leading to faster desaturation, necessitating close monitoring and early oxygenation (Harless et al., 2014).

The Pediatric Assessment Triangle (PAT) is a rapid, non-invasive tool used to assess respiratory status, focusing on work of breathing, mental status, and circulation. Signs such as retractions, nasal flaring, tracheal tugging, and head bobbing indicate increasing work of breathing, while lethargy or cyanosis suggests progression toward respiratory failure. Early recognition using PAT allows for timely intervention before the "Triangle of Death" — the simultaneous failure of all three components — occurs. Common causes include croup, which presents with stridor and responds to inhaled epinephrine and steroids, and bacterial tracheitis or epiglottitis, which require careful airway management due to risk of complete obstruction (Horeczko et al., 2013).

Initial management includes positioning the child in a position of comfort, often upright or lateral, to facilitate breathing and use of gravity for secretion clearance. Suctioning of nasal passages is critical, especially in infants who are obligate nose breathers, as minor congestion can lead to significant distress. Basic airway maneuvers such as head-tilt chin-lift (if no C-spine concern) or jaw thrust (if trauma suspected) should be performed, supplemented with oxygen as needed. Adjuncts like oral or nasal airways can be used if obstruction is suspected, though contraindications such as intact gag reflex or facial trauma must be respected. Non-invasive ventilation strategies like CPAP or BiPAP have shown benefit in improving oxygenation and reducing intubation needs in prehospital settings. Protocols for pediatric respiratory distress vary widely, emphasizing the need for standardized, evidence-based guidelines across EMS systems (Cheng et al., 2020).

8.2 Geriatric Patients with Comorbidities

Geriatric patients with ARD often present with multiple comorbidities that complicate management and worsen outcomes. According to the LUNG SAFE study, 60% of ARDS patients have one or more significant comorbidities, including chronic respiratory impairment (22.4%), congestive heart failure (10.3%), chronic renal failure (10.2%), immune incompetence (20.8%), and diabetes (21.8%). These conditions reduce physiological reserve, impair immune response, and increase susceptibility to complications such as ventilator-induced lung injury or multiorgan failure. Age-related changes such as decreased lung elasticity, weakened respiratory muscles, and reduced chest wall compliance further compromise respiratory function (Rezoagli et al., 2022).

Paramedics must recognize that geriatric patients may present atypically, with subtle signs of distress such as confusion or fatigue rather than overt dyspnea. Comorbidities like heart failure or COPD can mimic or coexist with ARDS, requiring careful differential diagnosis. Management should focus on lung-protective strategies, including controlled oxygen therapy to avoid hyperoxia, and early use of non-invasive ventilation when appropriate. However, invasive interventions like mechanical ventilation are associated with higher mortality in this population, with ICU mortality rising from 27% in those without comorbidities to 39% in those with any comorbidity. Congestive heart failure, chronic liver failure, and immune incompetence are independently associated with increased mortality (Castro Villamor et al., 2024).

Given these risks, paramedics should prioritize rapid transport to definitive care while stabilizing the patient with titrated oxygen, continuous monitoring, and judicious fluid administration to avoid exacerbating underlying conditions. Early identification of vulnerability using prehospital assessment tools can help predict ARDS risk and guide triage decisions. Education and protocol development targeting geriatric-specific ARD management are essential to improve outcomes in this high-risk population (Hope et al., 2019).

8.3 Pregnant Patients

Acute respiratory distress in pregnancy poses unique challenges due to physiological changes and the need to support both maternal and fetal well-being. Pregnancy increases oxygen consumption by 20–50%, decreases functional residual capacity (FRC), and lowers $PaCO_2$ to 27–34 mm Hg due to progesterone-driven hyperventilation. These changes predispose pregnant women to rapid desaturation and acute hypoxemia, which can lead to fetal compromise if not promptly addressed. The enlarging uterus causes diaphragmatic elevation and reduced lung compliance, further increasing the work of breathing (S. T. Pandya & Krishna, 2021).

Common causes of ARDS in pregnancy include infections (e.g., viral pneumonia, sepsis), hypertensive disorders, amniotic fluid embolism, and tocolytic-induced pulmonary edema. The incidence ranges from 1 in 6,000 to 1 in 10,000 deliveries, with maternal mortality rates of 30–50% and perinatal mortality of 20–25%. Management must prioritize maternal stabilization, as fetal oxygenation depends on maternal PaO_2, hemoglobin saturation, and uteroplacental perfusion. A maternal PaO_2 >75 mm Hg is required to prevent fetal hypoxia, and permissive hypercapnia is not safe due to risks of fetal acidosis and reduced perfusion (S. T. Pandya & Krishna, 2021).

Non-invasive ventilation (NIV) is safe and effective in pregnancy when used in experienced centers with protocolized care pathways. It avoids complications of intubation and can reduce ICU length of stay. However, NIV should be used cautiously due to increased risk of gastric aspiration from reduced lower esophageal sphincter tone. For invasive mechanical ventilation, lung-protective strategies consistent with ARDS Network guidelines are recommended: tidal volumes of 6 mL/kg predicted body weight, plateau pressure <30 cm H_2O, and PEEP titration to optimize oxygenation. Prone positioning is a safe rescue therapy for refractory hypoxemia and has been shown to improve survival in severe ARDS. Extracorporeal membrane oxygenation (ECMO) is also a viable option, with successful cases reported where delivery was delayed to achieve fetal viability (S. T. Pandya & Krishna, 2021).

The decision on timing and mode of delivery must be multidisciplinary, with maternal survival as the primary criterion. Fetal monitoring should be continuous, but clinical decisions should not be delayed solely for fetal assessment. Postdelivery, early maternal bonding and rehabilitation support faster weaning and reduce lactation failure.

8.4 Trauma-Related ARD

Trauma-related acute respiratory distress arises from direct airway compromise, pulmonary injury, or neurological impairment affecting respiratory drive. Common mechanisms include airway obstruction from blood or foreign bodies, tension pneumothorax, flail chest, pulmonary contusions, and neurogenic respiratory failure from spinal cord or brain injury. These conditions require immediate recognition and intervention to prevent hypoxia and hemodynamic instability (Jain & Waseem, 2025).

Paramedics must perform a systematic primary survey focusing on airway, breathing, and circulation. In patients with suspected cervical spine injury, airway maneuvers must be performed with spinal immobilization, using jaw thrust instead of head-tilt chin-lift. Suctioning is critical to clear blood or vomitus, and advanced airway management may be necessary in cases of severe obstruction or decreased level of consciousness. Needle decompression should be performed immediately for suspected tension pneumothorax, followed by chest tube placement when feasible (Planas et al., 2023).

Mechanical ventilation in trauma patients must be lung-protective to avoid ventilator-induced lung injury, especially in those with pulmonary contusions or rib fractures. Tidal volumes of 6–8 mL/kg, adequate PEEP, and avoidance of high peak pressures are recommended. Patients in hemorrhagic shock require careful ventilation to avoid exacerbating metabolic acidosis or compromising venous return. Continuous monitoring of oxygen saturation, end-tidal CO_2, and hemodynamic parameters is essential during transport (Sahota & Sayad, 2025).

In cases of refractory hypoxemia, rescue therapies such as prone positioning or ECMO may be considered, though these are typically initiated in hospital settings. Early transport to a trauma center capable of advanced interventions is crucial. Prehospital protocols should emphasize rapid assessment, stabilization, and timely escalation of care to improve survival in trauma-related ARD.

9. Challenges and Limitations in Prehospital ARD Management

Management of acute respiratory distress (ARD) in the prehospital setting presents significant challenges to paramedics, largely due to the nature of the environment and resource limitations.

9.1 Limited Diagnostics in Field Conditions

Paramedics must often diagnose and initiate treatment without access to sophisticated diagnostic tools available in hospitals such as chest X-rays, blood gas analysis, and advanced monitoring. Reliance is primarily on clinical assessment and basic monitoring like pulse oximetry and respiratory rate, which can limit the precision of diagnosis and appropriateness of interventions (Cimino & Braun, 2023).

9.2 Environmental Constraints

Environmental factors such as adverse weather (extreme cold, heat, rain) and confined operational spaces (vehicles, homes, crowded areas) hinder effective patient assessment and intervention. These conditions may complicate airway management, application of ventilation devices like CPAP or BVM, and safe patient handling (Jouffroy et al., 2021).

9.3 Short Time Windows for Effective Intervention

The prehospital phase requires rapid assessment and timely initiation of treatment to prevent respiratory failure progression. The window for effective interventions like oxygen supplementation, non-invasive ventilation (NIV), or advanced airway management is narrow, demanding paramedic expertise and decision-making under pressure (Cimino & Braun, 2023).

9.4 Variability in Paramedic Training and Equipment Availability

Training levels among paramedics and variability in equipment availability across EMS systems impact care consistency and quality. Some EMS teams may lack access to advanced airway devices, CPAP/BiPAP machines, or pharmacologic agents critical for managing ARD. Variability in protocols and experience further complicates standardized care delivery (Cimino & Braun, 2023).

10. Evidence-Based Protocols and Current Guidelines

10.1 Overview of Major EMS Guidelines for ARD

Leading emergency medical service (EMS) organizations including the American Heart Association (AHA), European Resuscitation Council (ERC), and various local protocols emphasize early oxygenation support tailored to hypoxia severity, with use of nasal cannula, non-rebreather masks, and non-invasive ventilation (NIV) modalities like continuous positive airway pressure (CPAP) for select patients. Advanced airway management (endotracheal intubation) is reserved for those unable to maintain airway patency or adequate oxygenation despite initial measures (Griffiths et al., 2019).

10.2 Clinical Research Supporting CPAP, Pharmacological Interventions, and Advanced Airway

Paramedics increasingly utilize CPAP in prehospital ARD to reduce work of breathing and improve oxygenation, supported by randomized controlled trials showing efficacy in reducing dyspnea and respiratory rate. However, full-scale trials assessing broader outcomes remain limited by challenges in accurate prehospital patient identification for CPAP benefits. Pharmacologic interventions such as bronchodilators, corticosteroids, and morphine are evidence-supported for specific ARD causes (e.g., exacerbations of COPD, acute pulmonary edema) and integrated into paramedic protocols. Endotracheal intubation remains critical in severe ARD unresponsive to non-invasive measures, with data supporting improved return of spontaneous circulation (ROSC) in related emergencies (Wolthers et al., 2024).

10.3 Integration of Telemedicine in Respiratory Emergencies

Emerging evidence highlights telemedicine's role in enhancing prehospital ARD management. Tele-EMS systems enable remote physician support for paramedics, facilitating guideline-adherent care and specialized decision-making despite resource constraints. Studies indicate telemedicine can maintain high safety standards with structured protocols, although physical presence of in-hospital resources remains superior. Telemedicine also improves communication between prehospital and hospital teams, optimizing treatment continuity (Maret et al., 2020).

11. Future Directions in Prehospital Acute Respiratory Distress (ARD) Care

11.1 Advances in Portable Respiratory Monitoring Tools

Portable respiratory monitors such as the Capnostream™ 35 provide continuous, noninvasive, real-time respiratory status monitoring by measuring end-tidal CO2 (etCO2), oxygen saturation (SpO2), respiratory rate, and pulse rate. These monitors utilize advanced algorithms to alert paramedics early to respiratory compromise, helping mitigate alarm fatigue and supporting effective clinical decision-making in the prehospital setting. Their lightweight, rugged designs are optimized for demanding environments, facilitating seamless patient transport and intervention by paramedics (Mälberg et al., 2021).

11.2 Use of Ultrasound in the Field (Lung Assessment)

Point-of-care lung ultrasound (LUS) is emerging as a valuable prehospital diagnostic tool for respiratory distress. Paramedics can use handheld ultrasound devices to rapidly assess lung conditions such as acute heart failure, pneumonia, or pneumothorax with accuracy comparable to in-hospital imaging. Studies demonstrate that even paramedics new to ultrasound achieve reliable results after brief, focused training, with lung ultrasound substantially improving diagnostic accuracy and early treatment initiation in the field. LUS use has been shown to significantly increase the proportion of patients receiving appropriate therapy before hospital arrival, potentially reducing hospital stay duration and improving outcomes (Donovan et al., 2023).

11.3 AI-Assisted Triage and Intervention Protocols

Artificial intelligence (AI) and machine learning (ML) models are increasingly integrated into prehospital care to improve triage accuracy for time-critical respiratory conditions. These AI systems analyze multiple patient parameters and predict the likelihood of severe respiratory distress or need for critical care with high accuracy. Compared to conventional scoring systems, AI-assisted protocols reduce undertriage and overtriage, facilitating timely and precise decisions on transport destinations and interventions. Despite promising retrospective data, future research must focus on prospective validation, workflow integration, user acceptability, and ethical considerations to fully realize AI's potential in augmenting paramedic decision-making (Tahernejad et al., 2024).

Conclusion

Acute respiratory distress is a life-threatening emergency that demands rapid recognition and decisive intervention by paramedics in the prehospital setting. Paramedics serve as the first clinical link in the chain of survival, responsible for assessing airway patency, oxygenation, ventilation, and circulatory stability under challenging conditions. Evidence-based interventions such as oxygen therapy, non-invasive ventilation, pharmacological support, and advanced airway management, when indicated, play a pivotal role in preventing deterioration and improving outcomes. Special consideration must be given to vulnerable populations such as pediatric, geriatric, pregnant, and trauma patients, where anatomical, physiological, and comorbid factors alter presentation and management. Despite limitations in diagnostics and environmental constraints, paramedics continue to adapt their skills with evolving guidelines, telemedicine integration, and emerging technologies such as point-of-care ultrasound and AI-assisted triage. Strengthening training, standardizing protocols, and expanding the paramedic scope of practice will further enhance prehospital management of respiratory emergencies, ultimately reducing morbidity and mortality associated with acute respiratory distress.

References

1. Avva, U., Lata, J. M., Hendrix, J. M., & Kiel, J. (2025). Airway Management. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK470403/
2. Bennett, R. M., & Reilly, J. P. (2024). Environmental Risk Factors for Acute Respiratory Distress Syndrome. Clinics in Chest Medicine, 45(4), 797–807. https://doi.org/10.1016/j.ccm.2024.08.002

3. Bos, L. D. J., & Ware, L. B. (2022). Acute respiratory distress syndrome: Causes, pathophysiology, and phenotypes. The Lancet, 400(10358), 1145–1156. https://doi.org/10.1016/S0140-6736(22)01485-4
4. Castro Villamor, M. A., Alonso-Sanz, M., López-Izquierdo, R., Delgado Benito, J. F., del Pozo Vegas, C., López Torres, S., Soriano, J. B., Martín-Conty, J. L., Sanz-García, A., & Martín-Rodríguez, F. (2024). Comparison of eight prehospital early warning scores in life-threatening acute respiratory distress: A prospective, observational, multicentre, ambulance-based, external validation study. The Lancet Digital Health, 6(3), e166–e175. https://doi.org/10.1016/S2589-7500(23)00243-1
5. Cheng, T., Farah, J., Aldridge, N., Tamir, S., & Donofrio-Odmann, J. J. (2020). Pediatric respiratory distress: California out-of-hospital protocols and evidence-based recommendations. JACEP Open, 1(5), 955–964. https://doi.org/10.1002/emp2.12103
6. Cimino, J., & Braun, C. (2023). Clinical Research in Prehospital Care: Current and Future Challenges. Clinics and Practice, 13(5), 1266–1285. https://doi.org/10.3390/clinpract13050114
7. Diamond, M., Peniston, H. L., Sanghavi, D. K., & Mahapatra, S. (2024). Acute Respiratory Distress Syndrome. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK436002/
8. Donovan, J. K., Burton, S. O., Jones, S. L., Phillips, L. M., Anderson, D., & Meadley, B. N. (2023). Use of Point-of-Care Ultrasound by Intensive Care Paramedics to Assess Respiratory Distress in the Out-of-Hospital Environment: A Pilot Study. Prehospital Emergency Care, 27(6), 800–806. https://doi.org/10.1080/10903127.2022.2107123
9. Dunand, A., Beysard, N., Maudet, L., Carron, P.-N., Dami, F., Piquilloud, L., Caillet-Bois, D., & Pasquier, M. (2021). Management of respiratory distress following prehospital implementation of noninvasive ventilation in a physician-staffed emergency medical service: A single-center retrospective study. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 29(1), 85. https://doi.org/10.1186/s13049-021-00900-7
10. Finn, J. C., Brink, D., Mckenzie, N., Garcia, A., Tohira, H., Perkins, G. D., Arendts, G., Fatovich, D. M., Hendrie, D., McQuillan, B., Summers, Q., Celenza, A., Mukherjee, A., Smedley, B., Pereira, G., Ball, S., Williams, T., & Bailey, P. (2022). Prehospital continuous positive airway pressure (CPAP) for acute respiratory distress: A randomised controlled trial. Emergency Medicine Journal, 39(1), 37–44. https://doi.org/10.1136/emermed-2020-210256
11. Fuller, G. W., Goodacre, S., Keating, S., Herbert, E., Perkins, G., Ward, M., Rosser, A., Gunson, I., Miller, J., Bradburn, M., Harris, T., & Cooper, C. (2020). The diagnostic accuracy of pre-hospital assessment of acute respiratory failure. British Paramedic Journal, 5(3), 15–22. https://doi.org/10.29045/14784726.2020.12.5.3.15
12. Griffiths, M. J. D., McAuley, D. F., Perkins, G. D., Barrett, N., Blackwood, B., Boyle, A., Chee, N., Connolly, B., Dark, P., Finney, S., Salam, A., Silversides, J., Tarmey, N., Wise, M. P., & Baudouin, S. V. (2019). Guidelines on the management of acute respiratory distress syndrome. BMJ Open Respiratory Research, 6(1), e000420. https://doi.org/10.1136/bmjresp-2019-000420
13. Harless, J., Ramaiah, R., & Bhananker, S. M. (2014). Pediatric airway management. International Journal of Critical Illness and Injury Science, 4(1), 65–70. https://doi.org/10.4103/2229-5151.128015
14. Hope, A. A., Chen, J.-T., Kaufman, D. A., Talmor, D. S., Kor, D. J., Gajic, O., & Gong, M. N. (2019). The Association between Prehospital Vulnerability, ARDS Development, and Mortality among At-Risk Adults. Results from the LIPS-A Clinical Trial. Annals of the American Thoracic Society, 16(11), 1399–1404. https://doi.org/10.1513/AnnalsATS.201902-116OC
15. Horeczko, T., Enriquez, B., McGrath, N. E., Gausche-Hill, M., & Lewis, R. J. (2013). The Pediatric Assessment Triangle: Accuracy of Its Application by Nurses in the Triage of Children. Journal of Emergency Nursing: JEN : Official Publication of the Emergency Department Nurses Association, 39(2), 182–189. https://doi.org/10.1016/j.jen.2011.12.020
16. Jain, A., & Waseem, M. (2025). Chest Trauma. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK482194/

17. Jouffroy, R., Lemoine, S., Derkenne, C., Kedzierewicz, R., Scannavino, M., Bertho, K., Frattini, B., Lemoine, F., Jost, D., & Prunet, B. (2021). Prehospital management of acute respiratory distress in suspected COVID-19 patients. The American Journal of Emergency Medicine, 45, 410–414. https://doi.org/10.1016/j.ajem.2020.09.022
18. Klein, T. A., & Tadi, P. (2023). EMS Scene Safety. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK557615/
19. Kober, A., Schubert, B., Bertalanffy, P., Gorove, L., Puskas, T., Gustorff, B., Joldzo, A., & Hoerauf, K. (2004). Capnography in non-tracheally intubated emergency patients as an additional tool in pulse oximetry for prehospital monitoring of respiration. Anesthesia and Analgesia, 98(1), 206–210. https://doi.org/10.1213/01.ANE.0000090145.73834.2F
20. Kohne, J. G., & Flori, H. R. (2019). Risk Factors and Etiologies of Pediatric Acute Respiratory Distress Syndrome. Pediatric Acute Respiratory Distress Syndrome, 33–46. https://doi.org/10.1007/978-3-030-21840-9_4
21. Lin, X., Liu, Y., Kong, L., Ba, T., Bao, B., Zhang, S., & Liu, W. (2025). Comorbidity-related risk factors for acute respiratory distress syndrome in sepsis patients: A systematic review and meta-analysis. Advances in Clinical and Experimental Medicine: Official Organ Wroclaw Medical University, 34(8), 1255–1265. https://doi.org/10.17219/acem/191594
22. Long, B., Lentz, S., & Gottlieb, M. (2025). Emergency medicine updates: Acute respiratory distress Syndrome. The American Journal of Emergency Medicine, 96, 208–216. https://doi.org/10.1016/j.ajem.2025.06.066
23. Mälberg, J., Hadziosmanovic, N., & Smekal, D. (2021). Physiological respiratory parameters in pre-hospital patients with suspected COVID-19: A prospective cohort study. PloS One, 16(9), e0257018. https://doi.org/10.1371/journal.pone.0257018
24. Maret, D., Peters, O. A., Vaysse, F., & Vigarios, E. (2020). Integration of telemedicine into the public health response to COVID-19 must include dentists. International Endodontic Journal, 53(6), 880–881. https://doi.org/10.1111/iej.13312
25. Matthay, M. A., Zemans, R. L., Zimmerman, G. A., Arabi, Y. M., Beitler, J. R., Mercat, A., Herridge, M., Randolph, A. G., & Calfee, C. S. (2019). Acute respiratory distress syndrome. Nature Reviews. Disease Primers, 5(1), 18. https://doi.org/10.1038/s41572-019-0069-0
26. Pandya, N. K., & Sharma, S. (2023). Capnography and Pulse Oximetry. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK539754/
27. Pandya, S. T., & Krishna, S. J. (2021). Acute Respiratory Distress Syndrome in Pregnancy. Indian Journal of Critical Care Medicine : Peer-Reviewed, Official Publication of Indian Society of Critical Care Medicine, 25(Suppl 3), S241–S247. https://doi.org/10.5005/jp-journals-10071-24036
28. Planas, J. H., Waseem, M., & Sigmon, D. F. (2023). Trauma Primary Survey. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK430800/
29. Prekker, M. E., Feemster, L. C., Hough, C. L., Carlbom, D., Crothers, K., Au, D. H., Rea, T. D., & Seymour, C. W. (2014). The Epidemiology and Outcome of Prehospital Respiratory Distress. Academic Emergency Medicine : Official Journal of the Society for Academic Emergency Medicine, 21(5), 543–550. https://doi.org/10.1111/acem.12380
30. Qadir, N., & Chang, S. Y. (2021). Pharmacologic Treatments for Acute Respiratory Distress Syndrome. Critical Care Clinics, 37(4), 877–893. https://doi.org/10.1016/j.ccc.2021.05.009
31. Rezoagli, E., McNicholas, B. A., Madotto, F., Pham, T., Bellani, G., & Laffey, J. G. (2022). Presence of comorbidities alters management and worsens outcome of patients with acute respiratory distress syndrome: Insights from the LUNG SAFE study. Annals of Intensive Care, 12, 42. https://doi.org/10.1186/s13613-022-01015-7
32. Sahota, R. J., & Sayad, E. (2025). Tension Pneumothorax. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK559090/
33. Swenson, K. E., & Swenson, E. R. (2021). Pathophysiology of Acute Respiratory Distress Syndrome and COVID-19 Lung Injury. Critical Care Clinics, 37(4), 749–776. https://doi.org/10.1016/j.ccc.2021.05.003

34. Tahernejad, A., Sahebi, A., Abadi, A. S. S., & Safari, M. (2024). Application of artificial intelligence in triage in emergencies and disasters: A systematic review. BMC Public Health, 24, 3203. https://doi.org/10.1186/s12889-024-20447-3
35. Thim, T., Krarup, N. H. V., Grove, E. L., Rohde, C. V., & Løfgren, B. (2012). Initial assessment and treatment with the Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach. International Journal of General Medicine, 5, 117–121. https://doi.org/10.2147/IJGM.S28478
36. Weekley, M. S., Lobo, C. M., & Bland, L. E. (2025). Oxygen Administration. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK551617/
37. Wick, K. D., Matthay, M. A., & Ware, L. B. (2022). Pulse oximetry for the diagnosis and management of acute respiratory distress syndrome. The Lancet. Respiratory Medicine, 10(11), 1086–1098. https://doi.org/10.1016/S2213-2600(22)00058-3
38. Wolthers, S. A., Breindahl, N., Jensen, T. W., Holgersen, M. G., Møller, T. P., Blomberg, S. N. F., Andersen, L. B., Mikkelsen, S., Steinmetz, J., & Christensen, H. C. (2024). Prehospital interventions and outcomes in traumatic cardiac arrest: A population-based cohort study using the Danish Helicopter Emergency Medical Services data. European Journal of Emergency Medicine: Official Journal of the European Society for Emergency Medicine, 31(5), 324–331. https://doi.org/10.1097/MEJ.0000000000001108