Critical measles in children

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Abstract

Measles is a highly contagious viral illness that remains a major vaccine-preventable cause of severe pediatric illness. It has re-emerged in the United States through recent outbreaks in under-immunized communities. Although most cases are self-limited, a significant portion of children develop critical illness requiring pediatric intensive care. Complications, including severe pneumonia, pediatric acute respiratory distress syndrome, acute encephalitis, shock, and secondary bacterial infection, are among the top reasons for PICU admission. Severe measles reflects both direct viral injury and immune dysregulation, which can increase susceptibility to superinfection and multiorgan dysfunction. Diagnosis relies on recognition of characteristic clinical features in the appropriate epidemiologic setting and is confirmed by reverse transcription polymerase chain reaction and serologic testing. Management is primarily supportive and heavily relies on early recognition of respiratory, neurologic, and hemodynamic compromise. It includes escalating respiratory support and lung-protective ventilation when indicated, vitamin A supplementation, nutritional support, and careful evaluation for complications and bacterial superinfection. Strict isolation and outbreak preparedness remain essential to prevent nosocomial transmission. This review summarizes the epidemiology, pathophysiology, diagnosis, complications, and pediatric critical care management of severe measles in children.

Keywords: Measles; children; pediatric intensive care unit; pediatric acute respiratory distress syndrome; encephalitis; pneumonia; vitamin A; respiratory failure

Introduction

Measles remains one of the most contagious human infections and can re-emerge rapidly when imported virus reaches under-immunized communities. Although endemic transmission was declared eliminated in the United States in 2000, the country recorded 2,284 confirmed cases in 2025 across 48 outbreaks, and CDC had already reported 1,362 confirmed cases by March 12, 2026; most 2026 cases were outbreak-associated, and many were linked to outbreaks that began in 2025.[1] These data show that measles remains a current pediatric and public health threat in the United States rather than a historical disease.

The recent West Texas outbreak is especially relevant to pediatric critical care. Texas DSHS reported 762 confirmed cases, 99 hospitalizations, and 2 deaths in school-aged children by the end of the 2025 outbreak, with more than two-thirds of cases occurring in children.[2] Critical care reports during the outbreak described high fever refractory to treatment, conjunctivitis, rash, sepsis, neurologic deterioration and respiratory tract involvement ranging from pneumonia to ARDS.[3] Together, these reports support a PICU-focused discussion of measles severity in children.[4]

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Search Strategy

A targeted literature search was conducted across PubMed, Embase, Scopus, and Web of Science for

English language articles published through March 2026 using combinations of the terms measles, children, pediatric intensive care, respiratory failure, encephalitis, acute respiratory distress syndrome, and outbreak. We also reviewed current guidance from the Centers for Disease Control and Prevention, and state public health agencies, as well as relevant references from identified articles, to inform this narrative review.

Pathophysiology

Measles virus is an enveloped, single-stranded, negative-sense RNA virus transmitted by the respiratory route. After inhalation, the virus initially infects respiratory epithelial and immune cells, then disseminates through local lymphoid tissue and the bloodstream. The measles virus uses receptors such as signaling lymphocytic activation molecule and nectin-4 to enter immune and epithelial cells, facilitating systemic spread and efficient transmission. The classic prodrome and rash reflect both viral replication and the host immune response.[5–7]

In severe measles, PICU-level illness usually results from a combination of direct viral lung injury, immune dysregulation, and secondary bacterial infection. Measles can cause diffuse pneumonitis and, in some children, pediatric acute respiratory distress syndrome (PARDS). At the same time, the virus induces profound but transient immune suppression, increasing susceptibility to bacterial pneumonia, sepsis, and multiorgan deterioration. Fatal outcomes are most often related to respiratory failure, encephalitis, shock, myocarditis or superimposed infection rather than to uncomplicated measles alone.[7]

Clinical Presentation & Diagnosis

Measles is an acute viral respiratory illness with a characteristic, although sometimes variable clinical presentation. Following an incubation period of approximately 7 to 14 days, patients develop a prodrome of high fever, malaise, anorexia, cough, coryza and conjunctivitis. Fever may be marked, often reaching 40°C. Koplik spots, the pathognomonic enanthem, appearing as small white lesions with red background, usually found on the buccal mucosa 1 to 2 days before rash onset, and may persist briefly after the rash develops.[7,8]

The classic morbilliform rash is an exanthem that begins on the face, and spreads in a cephalocaudal, centrifugal pattern to the trunk and extremities. The rash is usually maculopapular and blanching at onset, may become confluent and can appear red, purple, or brown depending on skin tone. The rash lasts about 5 to 7 days and fades in the order in which it appeared, sometimes followed by desquamation. Patients are considered to be contagious from 4 days before to 4 days after the rash appears.[7,9]

Severe complications may evolve after rash onset including pneumonia and acute encephalitis. Encephalitis typically occurs within several days to 2 weeks, whereas severe pulmonary disease may progress to respiratory failure or less commonly, PARDS. Shock may occur in fulminant cases, particularly when severe pulmonary involvement or secondary bacterial sepsis is present. Clinicians should maintain a high index of suspicion for measles in children with compatible signs and symptoms, relevant exposure history, and outbreak epidemiology.[7,8]

Red Flags for PICU Admission

Intensive care evaluation is warranted when children with suspected or confirmed measles develop severe respiratory, neurologic, or hemodynamic compromise, or when high-risk host factors are present. Respiratory red flags include impending or established respiratory failure with tachypnea, increased work of breathing, inability to maintain adequate oxygenation on low flow oxygen, recurrent apnea, or inability to protect the airway. Severe hypoxemia, diffuse infiltrates, escalating oxygen or requiring positive pressure ventilation, pneumothorax, pneumomediastinum, large pleural effusions, or empyema should raise concern for severe measles pneumonitis or pediatric acute respiratory distress syndrome.[8–10]

Neurologic red flags include altered mental status, new seizures or status epilepticus, focal neurologic deficits, or concern for encephalitis or meningoencephalitis. Hemodynamic and multiorgan warning signs

Table 1. Clinical Red Flags for Severe Measles Requiring PICU Evaluation

Author (Year)	Study Design	Main Focus	Key ICU Message
Abramson et al (1995)[13]	Case series 15 children	Pneumonia, ARDS, shock, encephalopathy	Severe measles can cause respiratory failure, ARDS, shock, sepsis, and neurologic complications. Death was mainly seen in children with ARDS.
Piastra et al (2010)[14]	Case series in 5 infants	ARDS/air-leak	Infants with measles may rapidly worsen with ARDS, pneumothorax, and need for advanced respiratory support.
Coetzee et al (2014)[15]	Retrospective study 58 children	Pneumonia/ respiratory failure	Pneumonia was the main reason for PICU admission. Mortality was high, especially in infants and children with HIV or poor nutrition.
Li et al (2015)[16]	Retrospective cohort 58 infants	Severe measles pneumonia	Important complications included ARDS, sepsis, pneumothorax, and multiorgan dysfunction. These findings support early ICU admission in severe cases.
CDC guidance[7]	Public health guidance	Severe complications/ risk groups	Pneumonia and encephalitis are major severe complications. Young children and immunocompromised patients are at higher risk of critical illness.

Legend: The most important ICU warning signs in severe measles are respiratory failure, ARDS, shock or sepsis, and neurologic changes such as encephalopathy or encephalitis. Infants, malnourished children, and immunocompromised patients have higher risk and may need earlier PICU consultation.
Abbreviations: ARDS, acute respiratory distress syndrome; CDC, Centers for Disease Control and Prevention; HIV, human immunodeficiency virus; ICU, intensive care unit; PICU, pediatric intensive care unit.

include hypotension despite appropriate fluid resuscitation, need for vasoactive support, rising lactate, oliguria, coagulopathy, and rapid clinical deterioration. Very young age, malnutrition, incomplete vaccination, and immunocompromising conditions further increase the risk of severe disease and should lower the threshold for pediatric intensive care unit consultation. These red flags are summarized in Table 1.[10–12]

Differential Diagnosis

In the PICU, the key differential diagnosis depends on the dominant syndrome, such as respiratory failure, altered mental status or seizures, and hemodynamic collapse. Table 2 focuses on disorders that most closely mimic critical measles and that may need simultaneous empiric management while measles testing and infection control precautions are being arranged.

Lab Findings

Laboratory abnormalities in children with severe measles requiring pediatric intensive care are often nonspecific, but they may help identify complications, guide supportive care, and support early escalation of monitoring. Common hematologic findings include leukopenia or neutropenia, lymphopenia, and, in more severe disease, thrombocytopenia and coagulopathy. In published pediatric ICU series, critically ill children with measles and respiratory failure frequently had severe hypoxemia, and some also demonstrated hypocalcemia, thrombocytopenia, and coagulation abnormalities, particularly in the setting of PARDS, shock, or sepsis.[13] Mild transaminase elevation and hyponatremia have also been reported in hospitalized children with measles, especially in those with systemic illness or dehydration. Elevated inflammatory markers such as C-reactive protein are not specific for measles itself, but higher levels should prompt evaluation for bacterial superinfection, pneumonia, or evolving critical illness.[4,18,19]

In the PICU, laboratory assessment should therefore extend beyond confirmation of measles infection and include evaluation for end-organ dysfunction and competing diagnoses. A practical initial panel includes complete blood count with differential,

Table 2. Differential Diagnosis of Severe Measles in the Pediatric Intensive Care Unit

Alternative Diagnosis	Mimics Measles By	Clues Against Diagnosis	Helpful Tests
Severe viral pneumonia (influenza, RSV, adenovirus, COVID-19, varicella)[7,14,16]	Fever, cough, hypoxemia, diffuse infiltrates, ARDS	No classic prodrome/rash pattern, no Koplik spots, positive viral PCR	Viral PCR panel, chest imaging, blood gas
Bacterial pneumonia with sepsis[13,16]	Respiratory failure, shock, effusion or empyema	Lobar consolidation, purulent secretions, bacteremia, neutropenia	Blood culture, CBC, CRP/procalcitonin, chest US/CT
Meningococcemia or invasive bacterial sepsis[13]	Fever, rash, shock, coagulopathy, MODS	Petechial/purpura, fulminant shock, meningismus, no measles sequence	Blood culture, coagulation studies, lactate, LP if safe
Viral or autoimmune encephalitis[11]	Altered mental status, seizures, focal deficits	CSF/MRI suggests another cause, no clear measles exposure	LP, CSF PCR, brain MRI, EEG
MIS-C/Kawasaki disease/toxic shock syndrome[7]	Fever, rash, shock, mucocutaneous findings, multiorgan involvement	GI symptoms, myocarditis, coronary features, very high inflammatory markers;	ECG/echo, troponin/ BNP, inflammatory markers, cultures
Drug eruption or SJS/TEN[17]	Fever, rash, mucosal involvement, systemic illness	Recent drug exposure; targetoid, bullous lesions	Drug history, dermatology review, biopsy if uncertain

Legend: This table summarizes alternative diagnoses that can resemble severe measles in children presenting with respiratory failure, encephalopathy, shock, or multiorgan dysfunction. Distinguishing features such as rash morphology, exposure history, associated organ involvement, and targeted laboratory or imaging findings can help differentiate measles from other infectious, inflammatory, neurologic, or drug-related conditions.
Abbreviations: ARDS, acute respiratory distress syndrome; BNP, B-type natriuretic peptide; CBC, complete blood count; CRP, C-reactive protein; CSF, cerebrospinal fluid; CT, computed tomography; ECG, electrocardiogram; EEG, electroencephalogram; GI, gastrointestinal; LP, lumbar puncture; MIS-C, multisystem inflammatory syndrome in children; MODS, multiorgan dysfunction syndrome; MRI, magnetic resonance imaging; PCR, polymerase chain reaction; RSV, respiratory syncytial virus; SJS/TEN, Stevens-Johnson syndrome/toxic epidermal necrolysis; US, ultrasound.

arterial or venous blood gas, serum electrolytes, calcium, renal and liver function tests, C-reactive protein and/or procalcitonin, coagulation studies, lactate, and blood cultures when sepsis is suspected.[13] Laboratory confirmation of measles remains essential in sporadic cases and outbreaks and should include serum measles Immunoglobulin M together with reverse-transcription polymerase chain reaction from a respiratory specimen; obtaining both tests at first contact improves diagnostic yield, and urine may provide an additional specimen for viral detection. In children with suspected measles-associated encephalitis, further evaluation should include cerebrospinal fluid (CSF) analysis, neuroimaging, and targeted testing for alternative infectious or inflammatory causes of encephalopathy.[11]

Critical Care Management

Respiratory failure and PARDS

Respiratory complications are the leading cause of PICU admission in severe measles. Measles pneumonitis may result from direct viral injury or secondary bacterial infection and may progress to PARDS. Management should follow contemporary PARDS principles, with lung protective ventilation, avoidance of ventilator-induced lung injury, and careful titration of oxygen and positive end-expiratory pressure.[20,21]

For intubated children with moderate to severe PARDS, PALICC and PALICC-2 support low tidal volume ventilation, generally about 4–6 mL/kg predicted body weight, while limiting plateau pressure and

individualizing PEEP to optimize recruitment and oxygenation. Permissive hypercapnia may be acceptable when necessary to reduce injurious ventilator pressures, provided there is no major contraindication such as severe intracranial hypertension or profound hemodynamic instability.[20,21]

Adjunctive Ventilatory Strategies

In severe PARDS refractory to conventional ventilation, adjunctive strategies may be required. Prone positioning may improve oxygenation and ventilation–perfusion and is recommended as a rescue strategy in severe disease after optimization of ventilator settings. Inhaled nitric oxide is not recommended routinely, but it may be considered selectively in children with severe hypoxemia accompanied by pulmonary hypertension or right ventricular dysfunction.[21]

ECMO Considerations in Severe Measles

ECMO may be appropriate for selected children with severe measles and refractory respiratory or cardiorespiratory failure. Veno-venous ECMO is typically preferred for isolated severe respiratory failure, whereas veno-arterial ECMO may be required when significant cardiac dysfunction or cardiogenic shock is present. Candidacy should be individualized according to disease reversibility, severity of multiorgan dysfunction, bleeding risk, and institutional expertise.[21]

Vitamin A Therapy and Supportive Care

Vitamin A is an important component of supportive care in hospitalized children with measles and should be given promptly under clinical supervision. Current guidance recommends the following age-based dosing for two consecutive days:

> *50,000 IU for infants younger than 6 months, 100,000 IU for infants 6–11 months, and 200,000 IU for children aged 12 months or older, repeated the following day for a total of 2 doses. A third dose may be considered 2–4 weeks later in children with ophthalmologic evidence of deficiency.*[7]

Supportive management should also include careful fluid balance, treatment of fever and discomfort, surveillance for bacterial superinfection, and early enteral nutrition when feasible. After initial resuscitation, fluid administration should be reassessed frequently in children with respiratory failure to avoid worsening pulmonary edema.[7]

Neurologic Complications and Measles Encephalitis

Neurologic complications occur in a minority of measles cases but may be devastating. Acute measles encephalitis typically develops within days to 2 weeks after rash onset and may present with seizures, encephalopathy, focal deficits, or rapid neurologic deterioration. Management is largely supportive and should follow neurocritical care principles, including neurologic monitoring, airway protection when needed, seizure surveillance, and evaluation for cerebral edema or raised intracranial pressure.[7,11,22]

Children with suspected encephalitis should undergo targeted diagnostic evaluation, including CSF analysis when safe, EEG when seizures are suspected, and neuroimaging when focal deficits, depressed mental status, or concern for intracranial complications are present. [11,22]

Immune-Mediated Neurologic Disease

Immune-mediated complications such as acute disseminated encephalomyelitis should be considered when neurologic deficits progress after the acute infection or when imaging suggests demyelination rather than direct viral encephalitis. In such cases, high dose corticosteroids are commonly used first-line, and intravenous immunoglobulin or plasma exchange may be considered in refractory diseases in consultation with neurology and neurocritical care teams. Evidence specific to measles-associated immune-mediated disease remains limited, so treatment should be individualized.[11,23]

Seizure Management

Acute seizures should be treated according to standard status epilepticus pathways, beginning with benzodiazepines and escalating promptly to second

Table 3. Nursing & Bedside Considerations in Severe Measles

1. Strict airborne isolation: Ensure proper PPE (N95/ PAPR) and minimize room entry to reduce exposure
2. High secretion burden: Frequent suctioning and airway clearance; monitor for mucus plugging and desaturation
3. Respiratory monitoring: Continuous pulse oximetry and close assessment for escalating work of breathing
4. Skin and eye care: Manage rash discomfort and prevent secondary skin breakdown or infection
5. Fluid balance: Careful intake/output monitoring to avoid fluid overload in respiratory failure
6. Neurologic vigilance: Early recognition of altered mental status or seizures
7. Family support & education: Communicate isolation precautions and disease course clearly

line antiseizure therapy if seizures persist. Refractory status epilepticus may require continuous anesthetic infusion and intensive EEG monitoring.[11]

Cardiovascular Complications

Myocarditis is an uncommon but potentially life-threatening complications of measles and may present with tachycardia out of proportion to fever, ventricular dysfunction, arrhythmia, or cardiogenic shock. Management is supportive and includes hemodynamic monitoring, vasoactive support when indicated, judicious fluid administration, and echocardiographic assessment. In severe cases, mechanical circulatory support or veno-arterial ECMO may be required.[11]

Key bedside and interprofessional considerations are summarized in Table 3, highlighting the importance of multidisciplinary ICU care.

Conclusion

Measles is a vaccine-preventable disease that can still cause severe and fatal illness in children. In critically ill patients, rapid recognition of respiratory, neurologic, and hemodynamic deterioration is essential to guide timely intensive care and improve outcomes. Recent United States outbreaks underscore the continued importance of vaccination, early diagnosis, and aggressive supportive management in reducing measles-related morbidity and mortality.

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