

Bronchiolitis in Infants: What Helps, What Doesn't, and Why

Dr. Ahmad Khamees Radad ^{1*}, Dr. Wael Abdulrahman Salah ²

^{1*} Specialist in Emergency Medicine, Al Meshaf Health Center, Primary Health Care Corporation, Qatar

² Specialist Pediatrician, Al Meshaf Health Center, Primary Health Care Corporation, Qatar

Abstract

Bronchiolitis is the most common lower respiratory tract infection in infants and the leading cause of hospitalization in children younger than one year of age. Globally, respiratory syncytial virus (RSV) alone accounts for approximately 33 million episodes of acute lower respiratory tract infection annually in children under five years, with 3 million hospitalizations and over 100,000 deaths worldwide. Despite its substantial burden, decades of research have failed to identify effective pharmacological treatments, and management remains fundamentally supportive. This comprehensive review synthesizes current evidence on bronchiolitis management, emphasizing the critical distinction between interventions with proven benefit and those that, despite widespread historical use, lack efficacy. Evidence strongly supports supportive care consisting of supplemental oxygen for hypoxemia, adequate hydration through oral, nasogastric, or intravenous routes, and gentle nasal suctioning to facilitate feeding. High-flow nasal cannula therapy has emerged as an option for escalating respiratory support. In contrast, robust evidence demonstrates that bronchodilators, corticosteroids, nebulized epinephrine, hypertonic saline in the emergency department, antibiotics, and chest physiotherapy do not improve clinically meaningful outcomes and should not be routinely used. Recent advances in prevention, including nirsevimab and maternal RSV vaccination, represent a paradigm shift in reducing disease burden. The key clinical message is that effective bronchiolitis management requires not just providing supportive care but also avoiding ineffective interventions. In bronchiolitis, less is often more.

Keywords: *bronchiolitis, respiratory syncytial virus, RSV, infants, supportive care, bronchodilators, corticosteroids, evidence-based medicine*

Introduction

Bronchiolitis is an acute inflammatory illness of the lower respiratory tract that represents the most common cause of hospitalization among infants in the developed world [1,2]. Characterized by small airway obstruction due to edema, mucus accumulation, and epithelial debris, bronchiolitis typically affects infants younger than 24 months of age and peaks in incidence between two and six months of age [3]. The disease follows a predictable seasonal pattern in temperate climates, with cases rising in late fall, peaking during winter months, and declining by early spring [4].

The healthcare burden of bronchiolitis is substantial. In the United States, bronchiolitis accounts for approximately 100,000 to 150,000 hospitalizations annually among children younger than two years, with hospitalization rates of 25 to 30 per 1,000 infants in the first year of life [5,6]. Bronchiolitis is responsible for an estimated one in every 13 primary care visits during the peak season [7]. Globally,

respiratory syncytial virus (RSV), the predominant cause of bronchiolitis, is responsible for approximately 33 million episodes of acute lower respiratory tract infection annually in children under five years of age, resulting in over 3 million hospitalizations and approximately 100,000 to 120,000 deaths, with 99% mortality occurring in low- and middle-income countries [8,9].

Despite the enormous burden of disease, decades of clinical research have consistently failed to identify pharmacological interventions that meaningfully alter the natural course of bronchiolitis. Management remains fundamentally supportive, focusing on maintaining oxygenation and hydration while the illness runs its self-limited course [10]. Paradoxically, the absence of effective specific treatments has not prevented widespread use of interventions lacking evidence of benefit. Studies consistently demonstrate substantial variation in bronchiolitis management across institutions and providers, with frequent administration of bronchodilators, corticosteroids, and antibiotics despite strong evidence against their routine use [11,12].

The objective of this review is to provide clinicians with a comprehensive, evidence-based framework for bronchiolitis management, clearly delineating interventions with proven benefit from those that, despite historical popularity, lack efficacy and may cause harm. We will examine the pathophysiology underlying the disease, evidence-based approaches to assessment and supportive care, the extensive literature demonstrating lack of benefit for commonly used pharmacological interventions, and emerging strategies for prevention.

2. Etiology And Pathophysiology

2.1 Viral Causes

Respiratory syncytial virus (RSV) is the predominant etiological agent, responsible for 50% to 80% of bronchiolitis cases and the vast majority of severe cases requiring hospitalization [13,14]. RSV is a negative-sense, single-stranded RNA virus belonging to the Pneumoviridae family. Two major antigenic groups (A and B) co-circulate during each season, with group A often associated with more severe disease [15]. Nearly all children are infected with RSV by two years of age, and reinfection occurs throughout life due to incomplete and waning immunity [16].

Human rhinovirus (HRV) is the second most common cause of bronchiolitis, accounting for 15% to 25% of cases [17]. Rhinovirus-associated bronchiolitis tends to have a shorter, milder course compared to RSV, though HRV infection during infancy has been associated with subsequent development of recurrent wheezing and asthma [18]. Human metapneumovirus (hMPV), discovered in 2001, causes a clinical syndrome indistinguishable from RSV bronchiolitis and accounts for approximately 5% to 15% of cases [19]. Other causative agents include parainfluenza viruses (particularly types 1 and 3), influenza viruses, adenoviruses, and coronaviruses [20]. Viral co-infections are detected in 10% to 30% of hospitalized infants, though whether co-infection increases disease severity remains debated [21].

2.2 Pathophysiology

The pathological hallmark of bronchiolitis is acute inflammation of the small airways, specifically the bronchioles [22]. Following viral inoculation of the nasopharyngeal epithelium, infection spreads to the lower respiratory tract within one to three days. The virus infects ciliated epithelial cells lining the bronchioles, triggering a cascade of inflammatory events [23].

The inflammatory response involves infiltration of neutrophils, lymphocytes, and macrophages into the peribronchiolar tissues and airway lumen [24]. Infected epithelial cells undergo necrosis and sloughing, contributing to intraluminal debris. Goblet cell hyperplasia and submucosal gland stimulation increase mucus production. Edema of the bronchiolar wall and surrounding tissues further

narrows the already small airways. The combination of epithelial necrosis, mucus hypersecretion, inflammatory cell infiltration, and submucosal edema results in partial or complete obstruction of small airways [25].

The physiological consequences of bronchiolar obstruction include increased airway resistance, air trapping, ventilation-perfusion mismatch, and hypoxemia [26]. Because the obstruction is primarily intraluminal (mucus, debris) and involves the airway wall (edema), rather than smooth muscle contraction, bronchodilators that target smooth muscle relaxation have limited physiological rationale for benefit. This pathophysiological distinction from asthma explains why treatments effective in asthma consistently fail in bronchiolitis [27].

2.3 Why Infants Are Vulnerable

Several anatomical and immunological factors render infants particularly susceptible to severe bronchiolitis [28]. The infant airway is proportionally smaller, with bronchiolar diameter of approximately 0.1 to 0.2 mm compared to 0.5 to 1.0 mm in adults. According to Poiseuilles law, airway resistance is inversely proportional to the fourth power of the radius, meaning that even modest mucosal edema of 1 mm produces a dramatic increase in resistance in small infant airways [29]. Infants are preferential nasal breathers during the first months of life, and nasal congestion from upper respiratory involvement compounds respiratory difficulty [30].

Immunologically, young infants have immature innate and adaptive immune responses that limit viral clearance [31]. Maternal antibodies provide partial protection during the first weeks of life but wane over the following months. The infant immune system generates a predominantly Th2-skewed response to RSV infection that is less effective at viral clearance than the Th1 response seen in older children and adults [32]. Collateral ventilation pathways between alveoli, which allow airflow around obstructed airways in older children and adults, are poorly developed in infants, increasing susceptibility to atelectasis [33].

2.4 Natural Disease Course

Understanding the natural history of bronchiolitis is essential for appropriate management and family counseling. The illness typically begins with two to three days of upper respiratory symptoms including rhinorrhea, nasal congestion, and low-grade fever [34]. Lower respiratory symptoms emerge as the infection spreads distally, with cough, tachypnea, wheezing, and increased work of breathing developing over the following one to two days. Symptoms typically peak on days three to five of illness before gradual improvement begins [35].

The median duration of illness is 12 to 15 days, though cough may persist for two to three weeks in some infants [36]. Approximately 2% to 3% of infants with bronchiolitis require hospitalization, with median hospital stays of two to three days for those admitted [37]. Among hospitalized infants, 5% to 15% require intensive care, and 1% to 3% require mechanical ventilation [38]. Mortality in developed countries is rare (less than 0.1% of hospitalized infants) but remains substantial in resource-limited settings [9].

3. Clinical Assessment And Diagnosis

3.1 Clinical Diagnosis

Bronchiolitis is a clinical diagnosis based on history and physical examination findings in an infant with acute respiratory illness during the appropriate season [10]. The typical presentation includes a prodrome of upper respiratory symptoms followed by lower respiratory tract involvement with cough, tachypnea, wheezing or crackles, and signs of respiratory distress including nasal flaring, retractions,

and grunting [39]. The American Academy of Pediatrics (AAP) defines bronchiolitis as a constellation of clinical symptoms and signs including rhinitis, tachypnea, wheezing, cough, crackles, use of accessory muscles, and/or nasal flaring in children younger than 24 months [10].

No laboratory tests are required for diagnosis in the typical case. The diagnosis should be made based on clinical assessment, and testing should not delay initiation of supportive care. The emphasis on clinical diagnosis reflects the lack of impact that identifying a specific viral etiology has on management decisions for the individual patient [40].

3.2 Severity Assessment

Accurate severity assessment guides management decisions regarding need for hospitalization and level of care. Key clinical indicators include respiratory rate, oxygen saturation, adequacy of feeding and hydration, and overall work of breathing [41].

Respiratory rate should be interpreted in the context of age-appropriate norms, with tachypnea defined as rates exceeding 60 breaths per minute in infants younger than two months, 50 in infants aged two to twelve months, and 40 in children over one year [42]. However, respiratory rate alone has limited predictive value and should be considered alongside other findings. Work of breathing, assessed by the presence and severity of retractions (subcostal, intercostal, suprasternal), nasal flaring, head bobbing, and grunting, provides important information about severity [43].

Oxygen saturation measured by pulse oximetry is widely used but requires careful interpretation. Current guidelines recommend considering supplemental oxygen when saturation persistently falls below 90% to 92% [10,44]. Importantly, brief desaturations are common and may not require intervention. Continuous pulse oximetry may detect clinically insignificant fluctuations that lead to unnecessary oxygen therapy and prolonged hospitalization [45]. Feeding ability is a practical indicator of respiratory reserve; infants who can feed without significant distress or desaturation generally have adequate respiratory function.

Multiple clinical scoring systems have been developed to standardize severity assessment, including the Respiratory Distress Assessment Instrument (RDAI), the Wang bronchiolitis severity score, and others [46]. However, no single scoring system has achieved widespread adoption or validation demonstrating superiority over clinical judgment. Guidelines generally do not mandate use of specific scores, though they may facilitate communication and research standardization [10].

3.3 Role of Diagnostic Testing

Viral Testing: Routine viral testing is not recommended for infants with typical bronchiolitis and does not alter management in most cases [10]. Identifying a specific viral etiology has not been shown to affect clinical outcomes at the individual patient level [40]. Viral testing may be considered in specific circumstances: for infection control purposes when cohorting hospitalized patients, in young febrile infants where identification of a viral etiology may reduce the extent of bacterial sepsis evaluation, or when influenza is suspected and antiviral treatment would be indicated [47]. Polymerase chain reaction (PCR) assay results should be interpreted cautiously, as PCR may detect prolonged viral shedding from a previous illness, particularly with rhinovirus [48].

Chest Radiography: Current evidence does not support routine chest radiography in children with bronchiolitis [10,49]. Although many infants with bronchiolitis have abnormalities on chest radiographs, including hyperinflation, peribronchial thickening, and areas of atelectasis, these findings do not correlate well with disease severity or alter management. More concerning, chest radiographs in bronchiolitis frequently reveal nonspecific infiltrates that are misinterpreted as bacterial pneumonia, leading to inappropriate antibiotic prescribing [50]. Studies consistently show that obtaining chest radiographs is associated with increased antibiotic use without improvement in clinical outcomes [51].

Radiography should be reserved for cases where an alternative diagnosis is suspected, clinical deterioration suggests a complication such as pneumothorax, or the presentation is atypical.

Laboratory Studies: Routine blood tests, including complete blood count and inflammatory markers, are not indicated in typical bronchiolitis [10]. These tests do not reliably distinguish viral from bacterial infection and do not predict clinical course. Blood gas analysis is rarely needed; clinical assessment of respiratory status is generally sufficient, and arterial blood gas measurement should be reserved for infants with impending respiratory failure [52].

4. Supportive Care What Actually Works

The foundation of bronchiolitis management consists of supportive measures that maintain oxygenation, ensure adequate hydration, and keep airways clear [10]. These interventions address the physiological consequences of the disease while it runs its natural course.

4.1 Oxygen Therapy

Supplemental oxygen is indicated for infants with persistent hypoxemia. Current guidelines recommend administering oxygen when saturation persistently falls below 90%, with some guidelines using a threshold of 92% [10,44,53]. The choice of threshold reflects a balance between ensuring adequate oxygenation and avoiding unnecessary intervention that prolongs hospitalization.

The BIDS (Bronchiolitis in Infants Placebo versus Normal Saline) trial and subsequent studies have challenged the clinical significance of targeting higher oxygen saturations [54]. Healthy infants may have transient saturations below 90% during sleep, and the clinical importance of brief desaturations in bronchiolitis is unclear. Several randomized controlled trials have demonstrated that targeting lower saturation thresholds (90% versus 94%) reduces length of hospitalization without increasing adverse outcomes [55]. The COAST trial found that a saturation target of 90% compared to 94% reduced duration of oxygen therapy and hospital stay by approximately one day [56].

Continuous pulse oximetry monitoring may lead to detection of clinically insignificant desaturations that prompt unnecessary intervention. Guidelines suggest that continuous monitoring is optional rather than mandatory for stable infants, and intermittent monitoring may be appropriate once an infant is clinically improving and no longer requiring supplemental oxygen [10,57].

4.2 Hydration and Feeding Support

Maintaining adequate hydration is essential, as tachypnea and increased work of breathing increase insensible fluid losses while simultaneously impairing oral intake [58]. Infants with mild disease can typically maintain oral feeding, though smaller, more frequent feeds may be better tolerated. Oral rehydration should be the first choice when safe and feasible.

When oral intake is inadequate, nasogastric tube feeding is an effective and safe alternative to intravenous fluids [59]. A randomized controlled trial comparing nasogastric to intravenous hydration in infants hospitalized with bronchiolitis found no difference in time to full oral feeding or length of stay, with nasogastric feeding offering advantages of easier placement, lower cost, and fewer placement attempts [60]. Nasogastric feeding also maintains gut function and allows continuation of breast milk or formula.

Intravenous fluids are reserved for infants who cannot tolerate enteral feeding due to severe respiratory distress or are at risk of aspiration [61]. When intravenous fluids are used, isotonic solutions are preferred to reduce risk of hyponatremia, which can occur with hypotonic fluids in the setting of increased antidiuretic hormone secretion [62].

4.3 Nasal Suctioning

Nasal suctioning addresses the upper airway congestion that contributes to respiratory difficulty, particularly given infants preferential nasal breathing [63]. However, the evidence distinguishes between superficial and deep suctioning, with importantly different implications.

Superficial nasal suctioning, using bulb syringes or similar devices to clear the nares of visible secretions, is generally helpful and well-tolerated. It may facilitate feeding by improving nasal patency and can be taught to parents for home use [64]. Suctioning before feeding and before sleep is often beneficial.

In contrast, deep nasopharyngeal suctioning has not been shown to improve outcomes and may cause harm [65]. Deep suctioning can traumatize the nasal mucosa, causing edema and bleeding that worsen obstruction. It is uncomfortable for infants and may increase oxygen requirements transiently. Current evidence suggests that deep suctioning should be avoided, while gentle superficial suctioning remains appropriate [66].

4.4 High-Flow Nasal Cannula

High-flow nasal cannula (HFNC) therapy has emerged as an intermediate level of respiratory support between conventional low-flow oxygen and continuous positive airway pressure (CPAP) or mechanical ventilation [67]. HFNC delivers heated, humidified gas at flows of 1 to 2 L/kg/min, providing modest positive airway pressure, washout of nasopharyngeal dead space, and reduced work of breathing [68].

The evidence base for HFNC in bronchiolitis has evolved considerably. Initial observational studies suggested dramatic benefits, but subsequent randomized controlled trials have provided more nuanced results [69]. The landmark PARIS trial randomized infants with bronchiolitis requiring supplemental oxygen to high-flow (2 L/kg/min) or standard oxygen therapy [70]. High-flow therapy reduced the rate of treatment escalation (12% versus 23%, $p < 0.001$) but did not reduce length of stay or duration of oxygen therapy. Importantly, 61% of infants randomized to standard therapy who met failure criteria responded successfully to rescue high-flow therapy, suggesting that early universal high-flow may not be necessary.

A 2024 Cochrane review found that HFNC may have modest benefits over low-flow oxygen, including reduced treatment escalation, improved respiratory and heart rates, and a small reduction in length of stay [71]. However, HFNC has not been shown to reduce rates of intubation or ICU admission. Current evidence supports HFNC as a reasonable option for infants failing standard oxygen therapy but does not support its routine use for all infants with hypoxemia. Evidence comparing HFNC to CPAP remains insufficient to determine superiority of either approach [72].

5. Therapies That Dont Work The Evidence

Perhaps no area of pediatric practice demonstrates the gap between evidence and practice more clearly than bronchiolitis treatment. Despite decades of negative trials and explicit guideline recommendations against their use, bronchodilators, corticosteroids, and other ineffective interventions continue to be widely administered [11,12].

5.1 Bronchodilators

Bronchodilators, including albuterol (salbutamol) and other beta-2 agonists, have been studied extensively in bronchiolitis with consistently negative results [73]. The pathophysiological rationale for their failure is straightforward: bronchiolitis is characterized by intraluminal obstruction from mucus, cellular debris, and mucosal edema, not by smooth muscle bronchospasm. Beta-agonists relax airway smooth muscle but do not address the primary pathology [27].

Multiple Cochrane reviews have concluded that bronchodilators do not improve oxygen saturation, hospital admission rates from the emergency department, duration of hospitalization, or time to resolution of illness at home [74]. While some studies have shown transient improvement in clinical

scores, this effect does not translate into meaningful clinical outcomes such as reduced hospitalization or faster recovery. A meta-analysis of over 30 trials confirmed no benefit for any clinically important outcome [75].

The 2014 AAP guideline explicitly recommends against routine use of albuterol or salbutamol in infants with bronchiolitis [10]. The guideline acknowledges that some clinicians continue to advocate for a therapeutic trial of bronchodilators, but notes that the observed response is often no better than expected placebo effect and that continuing bronchodilators in apparent responders exposes infants to medication side effects without proven benefit.

5.2 Epinephrine

Nebulized epinephrine has theoretical advantages over selective beta-2 agonists due to its alpha-adrenergic vasoconstrictor effects, which might reduce mucosal edema [76]. Early studies suggested possible benefit, and epinephrine has been more commonly used in some countries, particularly for outpatients.

However, systematic reviews have not demonstrated clinically meaningful benefit from nebulized epinephrine [77]. A Cochrane review found that epinephrine reduced hospital admissions compared to placebo on the day of the emergency department visit, but this effect was transient and did not persist when overall admission rates were analyzed [78]. Given epinephrine's short duration of action and the impracticality of home administration, discharging an infant after observing a response raises concerns about subsequent clinical deterioration.

Current guidelines recommend against routine use of epinephrine for bronchiolitis [10]. The 2014 AAP guideline states that the evidence does not support a routine role for epinephrine, either as monotherapy or in combination with other agents.

5.3 Hypertonic Saline

Nebulized hypertonic saline (typically 3%) was introduced based on the hypothesis that it might improve mucociliary clearance and reduce airway edema by drawing fluid from the mucosa [79]. Initial studies, primarily from settings with prolonged hospital stays, showed promising results, leading to enthusiasm and widespread adoption in many institutions.

However, subsequent larger trials and meta-analyses have tempered this enthusiasm considerably [80]. A Cochrane review found modest reduction in length of stay for hospitalized infants, but this effect was most pronounced in settings with baseline stays exceeding three days, which is atypical of North American practice [81]. For emergency department use, hypertonic saline has not been shown to reduce admission rates or improve clinical outcomes. The AAP guideline specifically recommends against hypertonic saline in the emergency department setting and provides only weak support for optional use in hospitalized infants [10].

A large multicenter trial (the SABRE study) found no benefit of hypertonic saline compared to normal saline for hospitalized infants with bronchiolitis in a typical U.S. setting where baseline length of stay averaged 2.4 days [82]. Current evidence does not support routine use of hypertonic saline in most clinical settings.

5.4 Corticosteroids

Corticosteroids are highly effective in asthma, reducing airway inflammation and improving outcomes. Their apparent similarities to bronchiolitis led to widespread use despite fundamental differences in pathophysiology [83]. Unlike asthma, where eosinophilic inflammation and airway hyperresponsiveness respond to corticosteroids, bronchiolitis involves neutrophilic inflammation and structural obstruction that are not steroid-responsive [84].

The evidence against corticosteroids in bronchiolitis is remarkably consistent. A Cochrane review of 17 randomized controlled trials involving nearly 2,600 children found no benefit of systemic or

inhaled corticosteroids on admission rates, length of hospitalization, clinical scores, or any other clinically relevant outcome [85]. Two large multicenter trials, including the 600-patient PECARN trial and the 800-patient Canadian CanBEST trial, confirmed the absence of benefit [86,87]. The CanBEST trial did find a possible benefit from combined epinephrine plus dexamethasone, but this exploratory finding has not been replicated and current guidelines do not recommend this combination [10]. Despite this evidence, corticosteroid use in bronchiolitis persists. Studies show that 25% to 45% of hospitalized infants with bronchiolitis receive systemic corticosteroids in some institutions [12]. This practice exposes infants to medication side effects without benefit and represents a clear deviation from evidence-based care.

5.5 Antibiotics

Bronchiolitis is a viral illness, and antibiotics have no role in its treatment unless there is documented bacterial co-infection [10]. Secondary bacterial infection is uncommon in bronchiolitis; studies consistently show that the rate of concurrent serious bacterial infection in infants with documented RSV infection is less than 1% to 2%, except in very young infants where urinary tract infection rates remain elevated [88].

Despite this, antibiotic prescription rates in bronchiolitis range from 14% to 45% depending on the setting [89]. Chest radiograph abnormalities, fever, and elevated inflammatory markers are commonly cited reasons for antibiotic use, yet none of these findings reliably indicate bacterial infection in the context of bronchiolitis [50]. Inappropriate antibiotic use contributes to antimicrobial resistance, exposes infants to adverse drug effects, and increases healthcare costs [90].

Antibiotics should be prescribed only when there is clear evidence of bacterial co-infection, such as acute otitis media or documented bacteremia. The presence of fever, radiographic infiltrates, or elevated white blood cell count in a child with typical bronchiolitis does not warrant antibiotics [10].

5.6 Chest Physiotherapy

Chest physiotherapy, including percussion, vibration, and postural drainage, was historically used in bronchiolitis on the theory that it might help clear airway secretions [91]. However, randomized controlled trials have failed to demonstrate benefit, and there is concern for potential harm.

A Cochrane review of nine trials found no improvement in length of hospital stay, oxygen requirement, or clinical severity scores with chest physiotherapy [92]. Some studies suggested increased respiratory distress during and immediately after treatment. Current guidelines explicitly recommend against chest physiotherapy in bronchiolitis [10]. The intervention is uncomfortable for infants, time-consuming, and diverts resources from beneficial supportive care.

Table 1. Summary of Evidence for Bronchiolitis Interventions

Intervention	Recommendation	Evidence Summary
Supplemental oxygen	Yes, if SpO ₂ <90-92%	Essential supportive care; target lower thresholds (90%) reasonable
Hydration support	Yes	Oral > nasogastric > IV; maintain adequate intake
Superficial nasal suction	Yes, as needed	Helpful for feeding; avoid deep suctioning
High-flow nasal cannula	Consider for failure of standard O ₂	Reduces treatment escalation; does not reduce LOS or intubation
Bronchodilators	No	No benefit on any clinically meaningful outcome; multiple meta-analyses

Nebulized epinephrine	No	Transient effect only; no sustained benefit
Hypertonic saline	No (ED); Optional (inpatient)	No benefit in ED; limited benefit in prolonged hospitalizations
Corticosteroids	No	Consistent evidence of no benefit; multiple large RCTs
Antibiotics	No (unless bacterial co-infection)	Viral illness; bacterial co-infection rare
Chest physiotherapy	No	No benefit; potential for harm

ED = emergency department; LOS = length of stay; RCT = randomized controlled trial

6. Admission Decisions And Risk Stratification

Determining which infants require hospitalization is a critical clinical decision that balances ensuring safety for high-risk patients against avoiding unnecessary admissions for those who can be safely managed at home [93].

6.1 Indications for Hospitalization

Hospitalization should be considered for infants with persistent oxygen requirement (SpO₂ consistently below 90-92% on room air), marked respiratory distress with significant retractions or tachypnea, inadequate oral intake raising concerns for dehydration, young age (particularly infants under 4-6 weeks or under 48 weeks post-conceptual age for preterm infants) given apnea risk, history of apnea or observed apneic episodes, and high-risk underlying conditions including prematurity, hemodynamically significant congenital heart disease, chronic lung disease, or immunodeficiency [10,94].

Social factors should also be considered, including caregiver ability to monitor the infant and recognize deterioration, access to follow-up care, ability to return promptly if symptoms worsen, and availability of transportation [95]. The decision should integrate clinical severity, risk factors, trajectory of illness, and family circumstances.

6.2 High-Risk Groups

Certain populations are at substantially increased risk for severe bronchiolitis requiring hospitalization, intensive care, or mechanical ventilation [96]. Premature infants, particularly those born before 32 weeks gestation, have smaller airways, immature immune systems, and may have residual chronic lung disease. Infants with hemodynamically significant congenital heart disease are at risk due to limited cardiopulmonary reserve. Infants with chronic lung disease from any cause, including bronchopulmonary dysplasia, cystic fibrosis, or congenital anomalies, have reduced baseline pulmonary function. Immunocompromised infants, including those with primary immunodeficiencies, HIV infection, or receiving immunosuppressive therapy, may have prolonged viral shedding and more severe illness [97].

Importantly, most severe bronchiolitis cases occur in previously healthy infants without identifiable risk factors, simply because healthy infants comprise the vast majority of the population [98]. Risk factors identify infants at increased probability of severe disease but do not identify all severe cases.

6.3 Safe Discharge Criteria

Infants may be considered for discharge when respiratory distress has improved to mild or resolved, oxygen saturation is stable at or above 90% on room air, oral intake is adequate to maintain hydration, caregivers demonstrate understanding of the expected disease course and warning signs for return, follow-up is arranged, and the home environment is safe with accessible care if needed [10]. Discharge

should not be delayed solely to complete a prescribed course of ineffective therapies or to observe for a specific duration after the last intervention.

6.4 Criteria for Intensive Care

Admission to a pediatric intensive care unit should be considered for infants with impending respiratory failure evidenced by severe distress, exhaustion, or rising PaCO₂; persistent hypoxemia despite supplemental oxygen; need for respiratory support beyond the capabilities of the general ward (CPAP, BiPAP, mechanical ventilation); recurrent or prolonged apnea; and hemodynamic instability [99]. Early consultation with critical care specialists is advisable for infants showing signs of deterioration.

7. Prevention Strategies

Given the absence of effective treatments for bronchiolitis, prevention represents the most promising strategy for reducing disease burden. Recent advances have dramatically expanded prevention options [100].

7.1 Palivizumab

Palivizumab (Synagis), a humanized monoclonal antibody against the RSV F protein, was approved in 1998 and represented the first specific prevention strategy for RSV disease [101]. Administered as monthly intramuscular injections during RSV season, palivizumab reduces RSV hospitalization by approximately 50% in high-risk infants. Due to its high cost and requirement for monthly dosing, use has been limited to specific high-risk populations: infants born before 29 weeks gestation, infants with hemodynamically significant congenital heart disease, and infants with chronic lung disease of prematurity requiring medical therapy within six months of RSV season onset [102].

The restricted indications for palivizumab mean that most infants who develop severe bronchiolitis are not eligible for prophylaxis. This limitation has driven development of broader prevention strategies applicable to all infants.

7.2 Nirsevimab and Maternal RSV Vaccination

Nirsevimab (Beyfortus), a long-acting monoclonal antibody approved in 2023, represents a transformative advance in RSV prevention [103]. Unlike palivizumab, nirsevimab provides protection for an entire RSV season with a single intramuscular injection due to its extended half-life. Clinical trials demonstrated 77-80% efficacy against RSV-associated hospitalization and similar protection against medically attended lower respiratory tract infection [104,105].

The CDC Advisory Committee on Immunization Practices recommends nirsevimab for all infants younger than 8 months born during or entering their first RSV season, and for children aged 8-19 months at increased risk for severe RSV disease entering their second RSV season [106]. Real-world effectiveness data from the 2023-2024 season have confirmed high effectiveness, with estimates of 77% effectiveness against RSV-associated emergency department visits and 90% or greater effectiveness against RSV-associated hospitalization [107].

Maternal RSV vaccination with RSVpreF (Abrysvo), approved in 2023, provides an alternative prevention strategy through transplacental transfer of maternal antibodies [108]. Administered to pregnant women at 32-36 weeks gestation during RSV season, maternal vaccination protects newborns during their most vulnerable first months of life. Clinical trials demonstrated approximately 70-80% efficacy against RSV-associated lower respiratory tract infection in infants through six months of age [109]. Either nirsevimab or maternal vaccination is recommended for infant protection, but not both in most circumstances.

7.3 Infection Control and Parental Education

Complementary prevention measures include hand hygiene, which remains the most important intervention for reducing RSV transmission in healthcare settings and homes [110]. Alcohol-based hand sanitizers are effective against RSV. Limiting exposure of young infants to individuals with respiratory illness and avoiding crowded indoor settings during RSV season may reduce infection risk. Tobacco smoke avoidance is important, as environmental smoke exposure increases both risk and severity of bronchiolitis [111]. Breastfeeding provides partial protection against respiratory infections and should be encouraged [112].

8. Challenges In Implementation

Despite decades of consistent evidence and clear guideline recommendations, ineffective treatments for bronchiolitis persist in clinical practice. Understanding the barriers to evidence-based care is essential for improving implementation [113].

8.1 Why Ineffective Treatments Persist

Multiple factors contribute to continued use of bronchodilators, corticosteroids, and other ineffective interventions. Clinical uncertainty regarding diagnosis leads some clinicians to treat empirically in case the infant has early asthma rather than bronchiolitis [114]. Desire to do something active in the face of a distressed infant and anxious parents creates pressure to intervene beyond supportive care. Perceived improvement after administering treatments may be attributed to the intervention rather than natural disease fluctuation or placebo effect [115]. Entrenched practice patterns and institutional culture perpetuate ineffective treatments even when individual clinicians are aware of the evidence. Parental expectations also play a role. Families often expect prescription medications for sick children and may be disappointed by a plan that consists solely of supportive care. Fear of missing a diagnosis or failing to treat adequately leads to defensive medicine practices [116].

8.2 Strategies for De-Implementation

De-implementation of low-value care requires deliberate strategies beyond simply publishing guidelines. Multi-faceted approaches combining education, audit and feedback, clinical decision support, and changes to default order sets have shown success [117]. Standardized clinical pathways that explicitly exclude ineffective treatments while outlining appropriate supportive care reduce variation and improve adherence to evidence-based practice [118]. Choosing Wisely campaigns that highlight bronchiolitis as an exemplar of overtreatment have raised awareness [119].

8.3 Communication with Families

Effective communication with families is essential when the treatment plan consists primarily of supportive care and watchful waiting. Key messages should include explanation that bronchiolitis is caused by a virus and does not respond to antibiotics or asthma medications; acknowledgment that the illness can be concerning and distressing; clear description of supportive measures including hydration, nasal suctioning, fever management, and positioning; realistic expectation setting regarding the typical 10-14 day duration; specific guidance on warning signs that warrant return for evaluation; and validation that parents are providing appropriate care by keeping the infant comfortable, hydrated, and monitored [120].

Framing supportive care positively, rather than as nothing we can do helps families understand that observation and support constitute appropriate medical management, not absence of treatment [121].

9. Special Populations

9.1 Premature Infants

Premature infants face multiple vulnerabilities to severe bronchiolitis, including smaller airways, immature immune function, possible residual chronic lung disease, and decreased respiratory reserve

[122]. Management principles remain the same as for term infants, with emphasis on supportive care. Premature infants may require hospitalization at lower thresholds of respiratory distress or oxygen requirement. Apnea risk is increased in preterm infants, particularly those with corrected gestational age below 48 weeks, warranting close monitoring [123]. Current prevention recommendations include nirsevimab for all preterm infants entering their first RSV season.

9.2 Infants with Comorbidities

Infants with hemodynamically significant congenital heart disease, chronic lung disease, neuromuscular disorders affecting respiratory function, or immunodeficiency require individualized management with lower thresholds for hospitalization and closer monitoring [97]. These infants have limited physiological reserve and may deteriorate rapidly. Early involvement of relevant subspecialists is advisable. Prevention with nirsevimab is particularly important for these high-risk populations.

9.3 Recurrent Wheezers: Bronchiolitis vs. Early Asthma

A common clinical dilemma involves older infants with recurrent wheezing episodes, where the distinction between bronchiolitis and early asthma becomes unclear [124]. True bronchiolitis is generally considered a first or second wheezing episode triggered by viral infection in an infant younger than 24 months. Recurrent wheezing beyond this, particularly in infants with atopic features (eczema, allergic rhinitis, family history of asthma), may represent early-onset asthma rather than repeated bronchiolitis.

This distinction matters because asthma may respond to bronchodilators and corticosteroids while bronchiolitis does not. The AAP guideline suggests that a trial of bronchodilators may be considered in older infants (beyond 12 months), those with multiple prior wheezing episodes, personal history of atopy, or strong family history of asthma [10]. If a bronchodilator trial is undertaken, objective response assessment should guide continuation or discontinuation.

10. Conclusion

Bronchiolitis remains the most common lower respiratory tract infection in infancy and a leading cause of hospitalization in young children worldwide. Despite substantial research investment, no pharmacological treatment has been shown to meaningfully alter the disease course. Management is fundamentally supportive, focusing on maintaining adequate oxygenation and hydration while the self-limited illness resolves.

The evidence is clear and consistent: bronchodilators, corticosteroids, nebulized epinephrine, hypertonic saline (in the ED), antibiotics, and chest physiotherapy do not work and should not be routinely used. Supportive care supplemental oxygen when needed, hydration through the most appropriate route, and gentle nasal suctioning remains the cornerstone of management. High-flow nasal cannula offers a reasonable option for escalating respiratory support in infants failing standard oxygen therapy.

Recent advances in prevention represent the most promising development in decades. Nirsevimab and maternal RSV vaccination now offer the potential to substantially reduce RSV disease burden across the entire infant population, not just high-risk groups. Implementation of these preventive strategies should be a priority.

The key message for clinicians is that avoiding unnecessary interventions is as important as providing appropriate supportive care. In bronchiolitis, less is often more. Adherence to evidence-based guidelines, de-implementation of ineffective treatments, and clear communication with families about the rationale for supportive care will improve outcomes while reducing costs, adverse effects, and antibiotic resistance. The challenge for clinicians is not discovering new treatments but rather

implementing what the evidence has consistently shown: supportive care works, and most everything else does not.

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