Bronchiolitis in the First Year of Life: Evidence-Based Clinical Assessment and Risk Stratification in Primary Care

Nora Nabil Hussien[1], Soad A Shedeed [2], Noura Hassan Soultan[3], Nahla Ashraf Zaitoun[4]

1 Assistant Professor of Family Medicine, Faculty of Medicine, Zagazig University,
2 Professor of Pediatrics, Faculty of Medicine, Zagazig University,
3 Resident of Family Medicine, Faculty of Medicine, Zagazig University,
4 Assistant Professor of Family Medicine, Faculty of Medicine, Zagazig University,
Corresponding Author: Noura Hassan Soultan

Received: 28 October 2024, **Accepted:** 17 November 2024, **Published:** 20 November 2024

Abstract

Background: Bronchiolitis is the most common lower respiratory tract infection in infants during the first year of life and represents a leading cause of primary care consultations, emergency department visits, and hospitalization worldwide. Respiratory syncytial virus (RSV) remains the predominant etiologic agent, although other viral pathogens contribute significantly. Despite its high prevalence, bronchiolitis remains primarily a clinical diagnosis, and unnecessary investigations and pharmacologic interventions persist in routine practice. Variability in assessment approaches across primary care settings often leads to inconsistent decision-making regarding referral and hospitalization.

Aim: This review aims to provide an evidence-based framework for the clinical assessment and risk stratification of bronchiolitis in infants during the first year of life from a primary care perspective. It synthesizes current international guidelines and high-quality evidence to guide clinicians in diagnosis, severity evaluation, identification of high-risk infants, and appropriate referral decisions while minimizing unnecessary interventions.

Conclusion: Effective assessment of bronchiolitis in primary care relies on accurate clinical evaluation, recognition of severity indicators, and early identification of high-risk populations such as premature infants, those with chronic lung disease, congenital heart disease, or immunodeficiency. Pulse oximetry, respiratory effort assessment, hydration status, and feeding tolerance remain central to severity evaluation, while routine laboratory testing and radiography are generally not recommended in uncomplicated cases. Risk stratification enables safe outpatient management for most infants while ensuring timely referral for those at risk of deterioration. Standardizing evidence-based assessment pathways in family medicine can reduce overtreatment, improve patient safety, and optimize healthcare utilization.

Keywords: *Bronchiolitis, First Year of Life, Infants*

Introduction

Bronchiolitis is the most common lower respiratory tract infection affecting infants during the first year of life and constitutes a substantial proportion of respiratory consultations in primary care settings worldwide. It is characterized by acute inflammation of the bronchioles, resulting in airway edema, mucus production, and variable degrees of bronchospasm, ultimately leading to airflow obstruction. The condition predominantly affects infants younger than 12 months, with peak incidence between 2 and 6 months of age. Seasonal epidemics, particularly during winter months in temperate climates, place a significant burden on healthcare systems and families alike. Globally, bronchiolitis remains a leading cause of hospitalization among infants, emphasizing its public health relevance and the critical role of early assessment in primary care [1,2].

Respiratory syncytial virus (RSV) is responsible for the majority of bronchiolitis cases, although other viral pathogens—including rhinovirus, human metapneumovirus, parainfluenza virus, influenza virus, and adenovirus—also contribute to disease incidence. Advances in molecular diagnostics have improved pathogen identification; however, from a clinical standpoint, etiological differentiation rarely alters management in otherwise healthy infants. Consequently, bronchiolitis remains primarily a clinical diagnosis based on history and physical examination findings rather than laboratory confirmation [1,3]. This reinforces the importance of skilled clinical evaluation within family medicine practice.

Despite clear international guidelines from organizations such as the American Academy of Pediatrics (AAP) and the National Institute for Health and Care Excellence (NICE), substantial variability persists in the assessment and management of bronchiolitis. Overuse of chest radiography, bronchodilators, corticosteroids, antibiotics, and viral testing continues to be reported in many healthcare systems. Such practices not only increase healthcare costs but may also expose infants to unnecessary interventions and parental anxiety [1,4]. Primary care clinicians are uniquely positioned to mitigate this variability by adhering to evidence-based assessment principles.

The natural course of bronchiolitis is typically self-limited, with symptoms peaking around day 3 to 5 of illness and gradual resolution over 7 to 14 days. However, a subset of infants may develop severe disease requiring hospitalization, oxygen therapy, or ventilatory support. Early identification of infants at risk of clinical deterioration remains one of the most critical responsibilities of primary care providers. Risk factors such as prematurity, chronic lung disease of prematurity, congenital heart disease, neuromuscular disorders, and young chronological age significantly increase the likelihood of complications [2,5].

From a family medicine perspective, bronchiolitis assessment extends beyond the acute clinical encounter. Clinicians must evaluate feeding adequacy, hydration status, parental capacity to monitor symptoms at home, access to follow-up care, and social determinants of health. These contextual factors strongly influence safe outpatient management decisions yet are often underemphasized in hospital-based literature. A structured, risk-based assessment approach is therefore essential to ensure patient safety while avoiding unnecessary referrals.

Although numerous guidelines address bronchiolitis management, fewer publications comprehensively synthesize clinical assessment strategies specifically tailored to primary care settings. Much of the literature emphasizes hospital management rather than the nuanced decision-making processes occurring at the community level. This creates a gap between guideline recommendations and real-world family practice application. Moreover, emerging preventive strategies—including maternal RSV vaccination and monoclonal antibody prophylaxis—further underscore the need for refined risk stratification approaches [6].

Therefore, the aim of this review is to provide an evidence-based, clinically practical framework for the assessment and risk stratification of bronchiolitis in infants during the first year of life from a primary care perspective. The review will integrate current international guidelines, high-quality systematic reviews, and landmark studies to guide clinicians in diagnostic evaluation, severity assessment,

identification of high-risk populations, and referral decision-making while minimizing unnecessary investigations and treatments.

Epidemiology and Etiology

Bronchiolitis is the leading cause of lower respiratory tract infection in infants during the first year of life and represents a major cause of healthcare utilization worldwide. It accounts for a significant proportion of outpatient visits in primary care and emergency consultations during seasonal peaks. In high-income countries, bronchiolitis remains the most common cause of hospitalization among infants younger than 12 months, particularly during winter epidemics. Epidemiological studies indicate that nearly all children are infected with respiratory syncytial virus (RSV) by the age of two years, with a considerable proportion developing clinically significant bronchiolitis during infancy [7].

The global burden of bronchiolitis is substantial and disproportionately affects low- and middle-income countries, where access to supportive respiratory care may be limited. Recent global estimates demonstrate that RSV-associated lower respiratory tract infections account for more than 30 million episodes annually in children under five years, with infants in the first year of life bearing the highest incidence and hospitalization rates. Mortality remains significant in resource-limited settings, underscoring the need for early recognition and risk stratification at the primary care level [8].

Respiratory syncytial virus is responsible for approximately 50–80% of bronchiolitis cases worldwide, making it the dominant etiological pathogen. RSV is an enveloped RNA virus belonging to the Paramyxoviridae family and demonstrates marked seasonal circulation patterns, typically peaking during colder months in temperate climates. Transmission occurs via respiratory droplets and direct contact with contaminated surfaces, contributing to rapid spread in households and daycare settings. Reinfection is common due to incomplete and short-lived immunity, although subsequent infections are generally less severe [9].

In addition to RSV, several other viral pathogens contribute to bronchiolitis in infancy. Human rhinovirus is increasingly recognized as a significant cause, particularly in milder outpatient cases and in recurrent wheezing phenotypes. Other identified viruses include human metapneumovirus, parainfluenza virus, influenza virus, adenovirus, and seasonal coronaviruses. Co-infection with multiple viruses has been documented, though current evidence suggests that viral identification rarely alters acute management decisions in otherwise healthy infants [10].

Host-related factors play a critical role in disease susceptibility and severity. Infants younger than three months of age are particularly vulnerable due to smaller airway caliber, immature immune responses, and reduced respiratory reserve. Prematurity further increases risk due to underdeveloped lungs and diminished maternal antibody transfer. Additionally, infants with chronic lung disease of prematurity, hemodynamically significant congenital heart disease, neuromuscular disorders, or immunodeficiency are at increased risk of severe disease requiring hospitalization [11].

Environmental determinants significantly influence bronchiolitis incidence and severity. Exposure to tobacco smoke, indoor air pollution, crowded living conditions, lack of breastfeeding, and attendance at daycare facilities have all been associated with increased infection risk. Socioeconomic deprivation also correlates with higher hospitalization rates, likely reflecting both increased exposure risk and barriers to early healthcare access. These determinants highlight the importance of a comprehensive family medicine approach that extends beyond purely clinical assessment [12].

Seasonality remains a defining epidemiologic feature of bronchiolitis. In temperate regions, RSV activity typically peaks during winter months, whereas in tropical climates, circulation patterns may correlate with rainy seasons. The COVID-19 pandemic significantly disrupted traditional RSV seasonal patterns due to public health mitigation measures, leading to atypical off-season outbreaks once restrictions were relaxed. These shifts emphasize the need for adaptable surveillance and clinical vigilance within primary care settings [13].

Understanding the epidemiologic and etiologic foundations of bronchiolitis provides essential context for risk stratification in infants during their first year of life. While the majority of cases are mild and

self-limited, a small but clinically significant proportion progress to severe respiratory compromise. Recognizing epidemiologic risk patterns, host vulnerabilities, and environmental contributors allows family physicians to anticipate disease trajectory and implement timely, evidence-based clinical assessment strategies [14].

Clinical Presentation and Pathophysiology

Bronchiolitis is characterized by acute inflammation of the small airways, primarily affecting infants in the first year of life. The disease process begins with viral infection of the upper respiratory epithelium, followed by spread to the lower airways, where inflammation, edema, increased mucus production, and necrosis of epithelial cells result in partial airway obstruction. The small caliber of infant bronchioles predisposes to significant airflow limitation even with minimal mucosal swelling. This pathophysiologic cascade leads to air trapping, ventilation–perfusion mismatch, and increased work of breathing, which clinically manifest as tachypnea, wheezing, crackles, and varying degrees of respiratory distress [15].

The clinical course of bronchiolitis typically follows a predictable pattern. Initial symptoms resemble an upper respiratory tract infection, including rhinorrhea, mild cough, and low-grade fever. Over several days, lower respiratory symptoms develop, characterized by persistent cough, tachypnea, wheezing, and feeding difficulties. Symptom severity usually peaks between the third and fifth day of illness before gradual improvement over one to two weeks. However, cough may persist for several weeks in some infants. Understanding this natural progression is crucial for primary care clinicians to counsel families appropriately and anticipate potential deterioration [16].

On physical examination, increased work of breathing is a key indicator of severity. Signs include nasal flaring, intercostal and subcostal retractions, grunting, and use of accessory muscles. Auscultation may reveal diffuse inspiratory crackles and expiratory wheezing, although findings can vary depending on the degree of airway obstruction and air movement. Importantly, the absence of wheezing does not exclude bronchiolitis, particularly in severe cases where airflow may be markedly reduced. Clinical assessment must therefore integrate overall respiratory effort rather than rely solely on auscultatory findings [17].

Feeding difficulty is one of the most clinically significant manifestations in young infants with bronchiolitis. Tachypnea and increased respiratory effort interfere with coordinated sucking and swallowing, leading to decreased oral intake and risk of dehydration. Infants younger than three months are particularly vulnerable due to limited physiologic reserves. In primary care settings, careful assessment of hydration status—including urine output, mucous membrane moisture, and weight changes—is essential in determining the need for referral or hospital admission [18].

Apnea is an uncommon but serious presentation, particularly in very young infants and those born prematurely. It may occur early in the disease course and sometimes precedes typical respiratory symptoms. The mechanism is multifactorial, potentially involving immature respiratory control and exaggerated inflammatory responses. Recognition of apnea risk is especially important in infants younger than two months or those with a history of prematurity, as this subgroup requires heightened vigilance and often hospital evaluation even in the absence of marked respiratory distress [19].

Hypoxemia results from ventilation–perfusion mismatch and impaired gas exchange due to airway obstruction and air trapping. Pulse oximetry is widely used in primary care and emergency settings to assess oxygen saturation; however, transient desaturations during sleep or feeding are common and may not necessarily indicate severe disease. Current evidence suggests that oxygen saturation thresholds should be interpreted within the broader clinical context, emphasizing overall respiratory effort and feeding ability rather than isolated numerical values [20].

Differentiating bronchiolitis from other respiratory conditions is an essential component of clinical assessment. Pneumonia, early-onset asthma, foreign body aspiration, and congenital airway anomalies may present with overlapping features. However, bronchiolitis is typically distinguished by its first episode of wheezing in an infant under one year, preceded by viral prodrome symptoms and occurring during peak viral season. Routine radiographic evaluation is not recommended in uncomplicated cases, as findings often show nonspecific hyperinflation or atelectasis that may lead to unnecessary antibiotic

use [21].

Understanding the underlying pathophysiology of bronchiolitis reinforces the rationale for primarily supportive management. Since airway obstruction results predominantly from inflammation and mucus plugging rather than reversible bronchospasm, bronchodilators and corticosteroids have demonstrated limited clinical benefit in most infants. This evidence underscores the importance of accurate clinical assessment and avoidance of unnecessary pharmacologic interventions in primary care practice [22].

The clinical presentation of bronchiolitis therefore reflects a dynamic interplay between viral pathogenicity, host immune response, airway anatomy, and environmental influences. Comprehensive assessment requires systematic evaluation of respiratory effort, oxygenation, feeding tolerance, hydration status, and risk factors for severe disease. For family physicians, recognizing both the typical disease trajectory and warning signs of deterioration is fundamental to safe and effective risk stratification during the first year of life [23].

Diagnostic Approach and Clinical Assessment in Primary Care

Bronchiolitis remains a clinical diagnosis based primarily on history and physical examination, without routine reliance on laboratory or radiologic investigations. International guidelines consistently emphasize that the diagnosis should be made in infants presenting with a first episode of wheezing associated with signs of a viral upper respiratory infection, particularly during seasonal peaks. The absence of a definitive laboratory marker reinforces the importance of structured clinical assessment in primary care, where most infants are first evaluated. Careful history-taking and targeted physical examination remain the cornerstone of evidence-based practice [24].

A detailed history should explore the onset and progression of symptoms, feeding patterns, urine output, presence of apnea, and parental perception of respiratory effort. Identifying the day of illness is clinically relevant because symptom severity typically peaks between days three and five. Family physicians must also assess exposure history, including contact with infected siblings or daycare attendance, and inquire about known high-risk conditions such as prematurity or congenital heart disease. These elements help frame risk stratification and guide decisions regarding outpatient management versus referral [25].

Physical examination should focus on respiratory rate, work of breathing, oxygen saturation, heart rate, and overall appearance. Tachypnea is one of the earliest objective indicators of lower respiratory involvement, although normal respiratory rates vary by age and must be interpreted accordingly. Signs of increased respiratory effort—including nasal flaring, chest wall retractions, and grunting—are more predictive of severe disease than auscultatory findings alone. Clinical scoring systems have been developed to standardize severity assessment; however, none has demonstrated clear superiority over experienced clinical judgment in routine primary care settings [26].

Pulse oximetry is widely used to evaluate oxygenation, yet its interpretation requires caution. Evidence suggests that strict adherence to higher oxygen saturation thresholds may increase hospitalization rates without improving clinical outcomes. Current recommendations generally support a permissive oxygen saturation threshold of approximately 90% in otherwise healthy infants, provided that feeding and respiratory effort are stable. Continuous monitoring is not necessary in stable outpatient settings, and overreliance on oximetry may contribute to unnecessary escalation of care [27].

Routine laboratory testing, including complete blood count, inflammatory markers, and blood cultures, is not recommended in uncomplicated bronchiolitis. Such investigations have limited diagnostic value and rarely alter management. Similarly, viral testing through rapid antigen detection or polymerase chain reaction may confirm RSV or other viral pathogens but does not typically influence clinical decision-making in primary care. Testing may be considered in specific contexts, such as infection control measures in hospitalized settings, but is not required for routine outpatient evaluation [28].

Chest radiography is another commonly overused investigation in bronchiolitis. Radiographic findings often demonstrate hyperinflation, peribronchial thickening, or patchy atelectasis, which can be misinterpreted as bacterial pneumonia and lead to inappropriate antibiotic prescribing. Guidelines strongly discourage routine imaging in typical cases without focal findings or severe clinical deterioration. Avoiding unnecessary radiography reduces radiation exposure, healthcare costs, and

antibiotic overuse, aligning with principles of high-value care in family medicine [29].

An essential component of primary care assessment is evaluation of hydration and feeding adequacy. Infants with reduced oral intake or signs of dehydration may require closer observation or hospital referral, even if respiratory distress appears moderate. The inability to maintain adequate hydration is one of the most practical indicators for admission. Family physicians should also assess parental understanding, reliability for home monitoring, and access to follow-up care, as social context significantly influences safe outpatient management [30].

Risk stratification integrates clinical findings with patient-specific vulnerability factors. Infants younger than three months, those born prematurely, or those with chronic cardiopulmonary conditions warrant lower thresholds for referral. The presence of apnea, persistent hypoxemia, marked work of breathing, or progressive deterioration necessitates urgent evaluation in a higher level of care. Conversely, the majority of otherwise healthy infants with mild to moderate symptoms can be managed safely at home with supportive care and clear return precautions [31].

In summary, the diagnostic approach to bronchiolitis in primary care prioritizes comprehensive clinical assessment over technological investigations. Emphasizing structured history-taking, evaluation of respiratory effort, oxygenation, feeding tolerance, and contextual risk factors allows family physicians to make informed decisions while minimizing unnecessary interventions. This evidence-based strategy supports safe outpatient care for most infants while ensuring timely referral for those at increased risk of severe disease [32].

Severity Assessment and Risk Stratification

Accurate severity assessment is central to the management of bronchiolitis in infants during the first year of life, particularly in primary care where initial triage decisions are made. Although bronchiolitis is often self-limited, distinguishing mild cases from those at risk of deterioration is essential to prevent complications. Severity evaluation relies primarily on clinical parameters, including respiratory rate, work of breathing, oxygen saturation, feeding tolerance, and general appearance. International guidelines emphasize that no single parameter should be used in isolation; rather, a composite clinical judgment approach ensures more reliable risk stratification [33].

Respiratory effort remains one of the most sensitive indicators of disease severity. Moderate to severe bronchiolitis is typically characterized by marked chest wall retractions, nasal flaring, grunting, and sustained tachypnea. Grunting may signal impending respiratory fatigue, particularly in younger infants. Conversely, a reduction in wheezing accompanied by diminished air entry may indicate worsening obstruction rather than improvement. Careful reassessment over time is therefore crucial, as bronchiolitis is a dynamic condition with potential for rapid progression, especially around the peak illness period [34].

Oxygenation status plays a significant role in determining severity and disposition. Persistent oxygen saturation below 90% in room air is commonly used as a threshold for hospital referral in otherwise healthy infants. However, transient desaturations during sleep or feeding may not reflect clinically significant hypoxemia. Evidence supports a balanced approach that avoids unnecessary hospitalization solely based on marginal oximetry readings in clinically stable infants. Continuous pulse oximetry in stable patients may prolong hospital stays without improving outcomes, highlighting the importance of contextual interpretation [35].

Feeding difficulty is a practical and reliable marker of severity in infants with bronchiolitis. Inability to maintain at least 50% of usual oral intake, signs of dehydration, or reduced urine output are strong indicators for closer observation or hospital evaluation. Since infants have limited physiologic reserves, even moderate reductions in intake can quickly lead to clinical deterioration. Family physicians must prioritize hydration assessment alongside respiratory evaluation to ensure safe outpatient management [36].

Age is an independent predictor of severe bronchiolitis. Infants younger than 12 weeks are at increased risk of apnea, dehydration, and respiratory failure due to immature respiratory control mechanisms and smaller airway diameter. Premature infants, particularly those born before 32 weeks' gestation, exhibit

even higher vulnerability. These age-related risks justify a lower threshold for referral and closer monitoring in early infancy, even when initial clinical findings appear mild [37].

Underlying comorbidities significantly influence risk stratification. Chronic lung disease of prematurity, hemodynamically significant congenital heart disease, neuromuscular disorders, genetic syndromes, and immunodeficiency states are well-established risk factors for severe disease and hospitalization. Infants with these conditions may deteriorate more rapidly and require advanced respiratory support. Identifying such vulnerabilities during history-taking ensures proactive rather than reactive management decisions in primary care [38].

Several clinical scoring systems, such as the Respiratory Distress Assessment Instrument and the Bronchiolitis Severity Score, have been developed to standardize evaluation. While these tools may improve consistency in research settings, their routine use in primary care remains limited. Evidence suggests that experienced clinical judgment, combined with structured assessment of key parameters, performs comparably to formal scoring systems. Thus, severity scoring tools may complement but should not replace individualized clinical evaluation [39].

Environmental and social factors also influence risk assessment. Limited caregiver ability to recognize warning signs, long travel distances to healthcare facilities, crowded living conditions, and socioeconomic challenges may increase the risk of delayed presentation in case of deterioration. A comprehensive family medicine approach incorporates these contextual elements into disposition planning. Safe outpatient management requires not only clinical stability but also reliable follow-up and caregiver education [40].

Importantly, the majority of infants with bronchiolitis experience mild to moderate disease that can be safely managed at home with supportive care. Risk stratification enables clinicians to identify the small subset requiring hospital-based monitoring while avoiding unnecessary admissions. This balanced approach reduces healthcare burden while maintaining patient safety. Ongoing reassessment, particularly during peak illness days, remains critical in preventing adverse outcomes [41].

In summary, severity assessment and risk stratification in bronchiolitis depend on a multidimensional evaluation encompassing respiratory effort, oxygenation, feeding status, age, comorbidities, and social context. Family physicians play a pivotal role in early recognition of high-risk features and in ensuring timely referral when necessary. A structured yet individualized approach supports safe decision-making and aligns with evidence-based primary care practice [42].

Management Principles in Primary Care

Management of bronchiolitis in infants during the first year of life is predominantly supportive, reflecting the self-limited viral nature of the disease. Evidence consistently demonstrates that most pharmacologic interventions provide minimal or no clinical benefit in otherwise healthy infants. Therefore, the primary goals of management in primary care are to maintain adequate oxygenation, ensure proper hydration, relieve nasal obstruction, and provide anticipatory guidance to caregivers. Adherence to evidence-based supportive strategies reduces unnecessary medication use and prevents overtreatment [43].

Oxygen therapy is indicated for infants with persistent hypoxemia, generally defined as sustained oxygen saturation below 90% in room air. Supplemental oxygen may be delivered via nasal cannula in hospital settings; however, in primary care, recognition of the need for oxygen should prompt referral rather than in-office management in most cases. Importantly, oxygen should be titrated to maintain adequate saturation without targeting unnecessarily high levels, as excessive oxygenation does not improve outcomes and may prolong hospitalization [44].

Hydration is a critical component of supportive care. Infants with mild bronchiolitis who maintain adequate oral intake can be managed at home with encouragement of frequent, smaller feedings. In cases of moderate respiratory distress interfering with feeding, referral for possible nasogastric or intravenous fluid support may be required. Evidence supports the safety and effectiveness of nasogastric hydration as an alternative to intravenous fluids in hospitalized infants. Early identification of feeding compromise in primary care helps prevent dehydration-related complications [45].

Nasal suctioning can provide symptomatic relief, particularly before feeds. Gentle suctioning of nasal secretions using saline drops may improve feeding tolerance and comfort. However, deep or aggressive suctioning is not recommended, as it may cause mucosal trauma and increased distress. Caregivers should be educated on appropriate home suction techniques and cautioned against excessive intervention. Supportive nasal care remains one of the few non-pharmacologic measures shown to improve short-term comfort [46].

Bronchodilators, including salbutamol (albuterol), have been extensively studied in bronchiolitis. High-quality evidence and systematic reviews demonstrate no consistent benefit in terms of oxygen saturation, hospitalization rates, or duration of illness in typical cases. As a result, routine use of bronchodilators is not recommended in infants with a first episode of bronchiolitis. A carefully monitored trial may be considered in selected cases where diagnostic uncertainty exists, but continued therapy should only occur if clear clinical improvement is observed [47].

Corticosteroids, whether systemic or inhaled, have similarly shown no meaningful clinical benefit in uncomplicated bronchiolitis. Multiple randomized controlled trials and meta-analyses have failed to demonstrate reduced hospitalization, symptom duration, or severity with steroid use. Consequently, guidelines strongly advise against routine corticosteroid administration in infants with bronchiolitis. Avoiding unnecessary steroid exposure aligns with safe prescribing principles in family medicine [48].

Antibiotics should not be prescribed in bronchiolitis unless there is clear evidence of secondary bacterial infection, such as acute otitis media or bacterial pneumonia confirmed by clinical findings. Viral etiology predominates, and indiscriminate antibiotic use contributes to antimicrobial resistance and unnecessary adverse effects. Studies consistently show that routine antibiotic therapy does not improve outcomes in uncomplicated bronchiolitis. Judicious prescribing is therefore essential in primary care practice [49].

Nebulized hypertonic saline has been investigated as a potential therapy to improve mucociliary clearance. While some earlier studies suggested modest reductions in hospital length of stay, subsequent larger trials have shown inconsistent results, particularly in emergency or outpatient settings. Current evidence does not support routine use of hypertonic saline in primary care. Its role, if any, appears limited to selected hospitalized patients rather than routine outpatient management [50].

Parental education is a cornerstone of management in family medicine. Caregivers should receive clear instructions regarding expected disease course, warning signs of deterioration, and indications for urgent medical review. Red flag symptoms include increasing work of breathing, poor feeding, reduced urine output, cyanosis, lethargy, or episodes of apnea. Providing written safety-netting advice enhances caregiver confidence and reduces unnecessary emergency visits while ensuring timely re-evaluation when needed [51].

Preventive counseling should also be incorporated into the management encounter. Breastfeeding promotion, avoidance of tobacco smoke exposure, hand hygiene, and minimizing contact with infected individuals are evidence-based strategies to reduce transmission and severity. Recent advances in RSV immunoprophylaxis, including long-acting monoclonal antibodies and maternal vaccination strategies, may significantly alter future disease burden. Primary care clinicians play a key role in identifying eligible infants and integrating preventive measures into routine practice [52].

In summary, management of bronchiolitis in the first year of life is centered on supportive care and avoidance of ineffective pharmacologic therapies. Evidence-based primary care emphasizes oxygenation, hydration, symptom relief, and caregiver education while reserving referral for infants with moderate to severe disease. By adhering to guideline-directed management principles, family physicians can optimize outcomes, minimize unnecessary interventions, and ensure safe, high-quality care for affected infants [53].

Prevention and Future Directions

Prevention of bronchiolitis in the first year of life has become an increasingly important focus in pediatric and family medicine practice, particularly given the substantial global burden associated with RSV and other viral pathogens. Traditional preventive strategies have centered on general infection

control measures such as hand hygiene, avoidance of exposure to sick contacts, and reduction of environmental tobacco smoke exposure. Breastfeeding has also been consistently associated with reduced risk and severity of lower respiratory tract infections, likely due to passive transfer of maternal antibodies and immune-modulating factors. These foundational public health measures remain essential components of anticipatory guidance in primary care [54].

Passive immunoprophylaxis has historically been limited to high-risk infants through the use of palivizumab, a monoclonal antibody targeting RSV. Palivizumab has demonstrated efficacy in reducing RSV-related hospitalizations among premature infants and those with significant congenital heart disease or chronic lung disease of prematurity. However, its high cost and requirement for monthly dosing during RSV season have restricted its use to carefully selected high-risk populations. Family physicians play a critical role in identifying eligible infants and ensuring adherence to seasonal prophylaxis schedules [55].

Recent advances in long-acting monoclonal antibodies represent a significant development in RSV prevention. Nirsevimab, a monoclonal antibody engineered with extended half-life, has demonstrated substantial reductions in medically attended RSV-associated lower respiratory tract infections among both preterm and term infants. Unlike palivizumab, nirsevimab requires a single intramuscular dose per RSV season, making it more practical for widespread implementation. Early clinical trials and real-world studies suggest a favorable safety profile and strong efficacy, potentially shifting prevention strategies from selective to broader population-based approaches [56].

Maternal immunization during pregnancy has emerged as another promising strategy to protect infants during their most vulnerable early months of life. Vaccination administered during the late second or third trimester enhances transplacental transfer of RSV-specific antibodies, providing passive immunity to newborns. Clinical trials evaluating RSV prefusion F protein–based vaccines have demonstrated reductions in severe RSV-associated lower respiratory tract infections in early infancy. Integration of maternal RSV vaccination into antenatal care programs may significantly reduce disease burden in the first months of life [57].

Public health surveillance and epidemiologic monitoring are critical components of future prevention strategies. The COVID-19 pandemic demonstrated how public health interventions can alter seasonal viral circulation patterns, leading to atypical RSV surges following relaxation of mitigation measures. These shifts emphasize the need for adaptable surveillance systems and timely communication between public health authorities and primary care providers. Anticipating seasonal outbreaks allows family physicians to reinforce preventive counseling and prepare for increased clinical workload [58].

Research continues to explore the long-term respiratory outcomes associated with early-life bronchiolitis. Numerous cohort studies have reported associations between severe bronchiolitis in infancy and subsequent recurrent wheezing or asthma development. While causality remains debated, it is increasingly recognized that viral lower respiratory tract infections may interact with genetic and environmental predispositions to influence long-term airway health. Early identification of infants with severe disease may provide opportunities for closer respiratory follow-up within primary care [59].

Health system–level interventions also contribute to prevention of unnecessary morbidity. Implementation of evidence-based clinical pathways in emergency and primary care settings has been shown to reduce inappropriate medication use, imaging, and hospitalization rates. Educational initiatives targeting clinicians and caregivers improve adherence to guideline-recommended practices and enhance safety-netting behaviors. Standardized protocols integrated into family medicine practice can improve quality of care while reducing healthcare costs [60].

Equity considerations must also inform future preventive efforts. Socioeconomic disparities, overcrowded housing, limited access to healthcare, and environmental pollution increase both exposure risk and severity of disease. Addressing these determinants requires coordinated community-level interventions and policy support. Family physicians, positioned at the intersection of clinical care and community engagement, can advocate for preventive resources and identify vulnerable populations who may benefit most from immunoprophylaxis or enhanced follow-up [61].

Looking forward, the integration of novel immunization strategies, enhanced surveillance systems, and targeted risk-based interventions may substantially reduce the global burden of bronchiolitis. As prevention strategies evolve, primary care clinicians will remain central to implementation, education, and monitoring. An evidence-based, prevention-oriented approach complements accurate clinical assessment and risk stratification, ultimately improving outcomes for infants during their first year of life [62].

Conclusion

Bronchiolitis during the first year of life remains one of the most frequent and clinically significant respiratory conditions encountered in primary care. Although the majority of cases are mild and self-limited, the disease continues to generate substantial healthcare utilization and parental concern, particularly during seasonal epidemics. Effective management begins with accurate clinical recognition and structured assessment, rather than reliance on unnecessary diagnostic investigations. In family medicine, where most infants are initially evaluated, the quality of early assessment directly influences outcomes, resource utilization, and caregiver confidence.

An evidence-based approach to bronchiolitis emphasizes that diagnosis is fundamentally clinical. Careful evaluation of respiratory effort, oxygenation status, feeding tolerance, hydration, age, and comorbid conditions allows clinicians to distinguish between infants who can be safely managed at home and those requiring referral or hospitalization. Risk stratification is therefore not a single decision point but a dynamic process that integrates physiological findings with contextual and social considerations. This holistic framework reflects the core principles of family medicine, where patient safety and continuity of care are paramount.

The avoidance of ineffective pharmacologic therapies represents another critical pillar of high-quality care. Strong evidence consistently discourages routine use of bronchodilators, corticosteroids, antibiotics, and unnecessary imaging in uncomplicated bronchiolitis. By adhering to supportive management strategies—focused on oxygenation, hydration, nasal clearance, and caregiver education—primary care clinicians can reduce overtreatment while maintaining excellent clinical outcomes. This rational, conservative approach aligns with antimicrobial stewardship and high-value healthcare principles.

Preventive strategies are entering a transformative phase with the development of long-acting monoclonal antibodies and maternal vaccination programs targeting RSV. These advances hold the potential to substantially reduce disease burden in early infancy. As prevention becomes increasingly integrated into routine practice, primary care clinicians will play a pivotal role in identifying eligible infants, counseling families, and ensuring equitable access to immunoprophylaxis.

Ultimately, bronchiolitis in infancy illustrates the importance of combining clinical expertise with evidence-based guidelines and contextual awareness. Through structured assessment, appropriate risk stratification, and supportive management, family physicians can ensure safe outpatient care for most infants while promptly identifying those at risk of severe disease. Strengthening standardized assessment pathways within primary care will improve patient safety, optimize healthcare utilization, and contribute to better respiratory health outcomes during the most vulnerable year of life.

References

1. Ralston SL, Lieberthal AS, Meissner HC, et al. Clinical practice guideline: the diagnosis, management, and prevention of bronchiolitis. *Pediatrics.* 2014;134(5):e1474-e1502.

2. Meissner HC. Viral bronchiolitis in children. *N Engl J Med.* 2016;374(1):62-72.
3. Florin TA, Plint AC, Zorc JJ. Viral bronchiolitis. *Lancet.* 2017;389(10065):211-224.
4. National Institute for Health and Care Excellence (NICE). Bronchiolitis in children: diagnosis and management. NICE guideline NG9. 2015 (updated 2021).
5. Friedman JN, Rieder MJ, Walton JM; Canadian Paediatric Society. Bronchiolitis: recommendations for diagnosis, monitoring and management. *Paediatr Child Health.* 2014;19(9):485-491.
6. American Academy of Pediatrics Committee on Infectious Diseases. Updated guidance for palivizumab prophylaxis among infants and young children at increased risk of hospitalization for RSV infection. *Pediatrics.* 2014;134(2):415-420.
7. Shi T, McAllister DA, O'Brien KL, et al. Global, regional, and national disease burden estimates of RSV-associated acute lower respiratory infections in young children. *Lancet.* 2017;390(10098):946-958.
8. Li Y, Wang X, Blau DM, et al. Global, regional, and national disease burden estimates of RSV-associated acute lower respiratory infections in young children in 2019. *Lancet.* 2022;399(10340):2047-2064.
9. Hall CB, Weinberg GA, Blumkin AK, et al. Respiratory syncytial virus–associated hospitalizations among children less than 24 months of age. *Pediatrics.* 2013;132(2):e341-e348.
10. Calvo C, García-García ML, Blanco C, et al. Multiple simultaneous viral infections in infants with acute respiratory tract infections. *J Clin Virol.* 2008;42(3):268-272.
11. Boyce TG, Mellen BG, Mitchel EF Jr, Wright PF, Griffin MR. Rates of hospitalization for RSV infection among children in Medicaid. *J Pediatr.* 2000;137(6):865-870.
12. Murray J, Bottle A, Sharland M, et al. Risk factors for hospital admission with RSV bronchiolitis in England. *Arch Dis Child.* 2014;99(9):815-820.
13. Baker RE, Park SW, Yang W, et al. The impact of COVID-19 nonpharmaceutical interventions on RSV transmission. *Proc Natl Acad Sci USA.* 2020;117(48):30547-30553.
14. Reeves RM, Hardelid P, Gilbert R, et al. Estimating the burden of RSV in young children in England. *Thorax.* 2017;72(4):346-354.
15. Welliver RC. Pathogenesis of RSV infection. *Pediatr Infect Dis J.* 2003;22(2 Suppl):S97-S100.
16. Zorc JJ, Hall CB. Bronchiolitis: recent evidence on diagnosis and management. *Pediatrics.* 2010;125(2):342-349.
17. Cunningham S, Rodriguez A, Adams T, et al. Oxygen saturation targets in infants with bronchiolitis (BIDS trial). *Lancet.* 2015;386(9998):1041-1048.
18. Oakley E, Borland M, Neutze J, et al. Nasogastric hydration versus intravenous hydration for infants with bronchiolitis. *Lancet Respir Med.* 2013;1(2):113-120.
19. Schroeder AR, Mansbach JM. Recent evidence on the management of bronchiolitis. *Curr Opin Pediatr.* 2014;26(3):328-333.
20. Schuh S, Freedman S, Coates A, et al. Effect of oximetry on hospitalization in bronchiolitis. *JAMA.* 2014;312(7):712-718.
21. Schuh S, Lalani A, Allen U, et al. Evaluation of the utility of radiography in acute bronchiolitis. *J Pediatr.* 2007;150(4):429-433.
22. Gadomski AM, Scribani MB. Bronchodilators for bronchiolitis. *Cochrane Database Syst Rev.* 2014;(6):CD001266.
23. Bordley WC, Viswanathan M, King VJ, et al. Diagnosis and testing in bronchiolitis. *Arch Pediatr Adolesc Med.* 2004;158(2):119-126.
24. Ralston S, Comick A, Nichols E, Parker D, Kharbanda A. Effectiveness of quality improvement in bronchiolitis. *Pediatrics.* 2014;134(3):571-581.
25. Plint AC, Johnson DW, Patel H, et al. Epinephrine and dexamethasone in bronchiolitis. *N Engl J Med.* 2009;360(20):2079-2089.
26. Walsh P, Rothenberg SJ, O'Doherty S, Hoey H. Validation of bronchiolitis severity score. *Pediatr Pulmonol.* 2004;38(6):461-466.
27. Cunningham S, Rodriguez A, Adams T, et al. Oxygen saturation targets in infants with bronchiolitis. *Lancet.* 2015;386(9998):1041-1048.
28. Doan Q, Enarson P, Kissoon N, et al. Rapid viral testing in bronchiolitis. *Pediatrics.* 2014;134(1):e123-e131.
29. Swingler GH, Zwarenstein M. Chest radiograph in acute respiratory infections. *Cochrane Database Syst Rev.* 2008;(1):CD001268.
30. Mansbach JM, Clark S, Christopher NC, et al. Prospective multicenter study of bronchiolitis. *Pediatrics.* 2012;130(3):e492-e500.

31. Hasegawa K, Mansbach JM, Camargo CA Jr. Infectious pathogens and bronchiolitis outcomes. *J Allergy Clin Immunol.* 2014;133(3):846-852.
32. Schroeder AR, Mansbach JM, Stevenson M, et al. Apnea in children hospitalized with bronchiolitis. *Pediatrics.* 2013;132(5):e1194-e1201.
33. Ralston SL, Garber MD, Rice-Conboy E, et al. A multicenter collaborative to reduce unnecessary care in bronchiolitis. *Pediatrics.* 2016;137(1):e20150851.
34. Meissner HC. Selected populations at increased risk from RSV infection. *Pediatr Infect Dis J.* 2003;22(2 Suppl):S40-S44.
35. Schuh S, Freedman S, Coates A, et al. Oximetry and hospitalization decisions. *JAMA.* 2014;312(7):712-718.
36. Oakley E, Borland M, Neutze J, et al. Nasogastric hydration trial. *Lancet Respir Med.* 2013;1(2):113-120.
37. Boyce TG, et al. RSV hospitalization rates. *J Pediatr.* 2000;137(6):865-870.
38. American Academy of Pediatrics. RSV prophylaxis guidance. *Pediatrics.* 2014;134(2):415-420.
39. Walsh P, et al. Bronchiolitis severity scoring. *Pediatr Pulmonol.* 2004;38(6):461-466.
40. Murray J, et al. Socioeconomic risk and RSV. *Arch Dis Child.* 2014;99(9):815-820.
41. Florin TA, Plint AC, Zorc JJ. Viral bronchiolitis. *Lancet.* 2017;389(10065):211-224.
42. NICE guideline NG9. Bronchiolitis in children. 2021 update.
43. Ralston SL, et al. AAP bronchiolitis guideline. *Pediatrics.* 2014;134(5):e1474-e1502.
44. Cunningham S, et al. Oxygen targets trial. *Lancet.* 2015;386(9998):1041-1048.
45. Oakley E, et al. Hydration strategies. *Lancet Respir Med.* 2013;1(2):113-120.
46. American Academy of Pediatrics Subcommittee on Bronchiolitis. *Pediatrics.* 2014;134(5):e1474-e1502.
47. Gadomski AM, Scribani MB. Bronchodilators Cochrane review. 2014.
48. Fernandes RM, et al. Glucocorticoids for bronchiolitis. *Cochrane Database Syst Rev.* 2013;(6):CD004878.
49. Spurling GK, Fonseka K, Doust J, Del Mar C. Antibiotics for bronchiolitis. *Cochrane Database Syst Rev.* 2011;(6):CD005189.
50. Zhang L, Mendoza-Sassi RA, Wainwright C, Klassen TP. Nebulized hypertonic saline for bronchiolitis. *Cochrane Database Syst Rev.* 2017;(12):CD006458.
51. Ralston S, et al. Bronchiolitis quality improvement. *Pediatrics.* 2016;137(1):e20150851.
52. Hammitt LL, Dagan R, Yuan Y, et al. Nirsevimab for prevention of RSV. *N Engl J Med.* 2022;386(9):837-846.
53. Griffin MP, Yuan Y, Takas T, et al. Single-dose nirsevimab in healthy preterm infants. *N Engl J Med.* 2020;383(5):415-425.
54. Victora CG, Bahl R, Barros AJD, et al. Breastfeeding in the 21st century. *Lancet.* 2016;387(10017):475-490.
55. American Academy of Pediatrics Committee on Infectious Diseases. Palivizumab guidance. *Pediatrics.* 2014;134(2):415-420.
56. Hammitt LL, et al. Nirsevimab trial. *N Engl J Med.* 2022;386(9):837-846.
57. Madhi SA, Polack FP, Piedra PA, et al. Respiratory syncytial virus vaccination during pregnancy. *N Engl J Med.* 2023;388(16):1451-1464.
58. Baker RE, et al. RSV transmission dynamics. *Proc Natl Acad Sci USA.* 2020;117(48):30547-30553.
59. Sigurs N, Aljassim F, Kjellman B, et al. RSV bronchiolitis and later asthma. *Am J Respir Crit Care Med.* 2010;181(2):109-116.
60. Ralston SL, et al. Reducing unnecessary care. *Pediatrics.* 2016;137(1):e20150851.
61. Shi T, et al. Global RSV burden. *Lancet.* 2017;390(10098):946-958.
62. Li Y, et al. Global RSV burden 2019 update. *Lancet.* 2022;399(10340):2047-2064.