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Case Series

Evolution of Pediatric Asthma Management Across GINA 2024–2026: A Case Series Illustrating Changes in Diagnosis, Step Therapy, and Severe Asthma Care

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Abstract

Background: Recent updates to the Global Initiative for Asthma (GINA) strategy reports (2024–2026) reinforce anti inflammatory reliever therapy, corticosteroid stewardship, and biomarker guided management in pediatric asthma. However, practical clinical translation of these evolving recommendations remains underreported.
Methods: We present a case series of four pediatric patients representing distinct asthma severity phenotypes (preschool wheeze, mild asthma with exacerbation risk, moderate persistent asthma, and severe Type 2–high asthma). Each case was retrospectively analyzed against recommendations from GINA 2024, 2025, and 2026 to illustrate changes in therapeutic decision making.
Results: Across cases, progressive strengthening of anti inflammatory reliever therapy (Track 1, ICS–formoterol) was evident. Pediatric randomized controlled trial evidence supports maintenance and reliever therapy (MART) in children 6 years, demonstrating reduced severe exacerbations without increased corticosteroid exposure. Successive GINA updates increasingly emphasized systemic corticosteroid minimization, structured severe asthma evaluation, biomarker integration (eosinophils, FeNO), and global access to ICS containing inhalers. Clinical decisions shifted from symptom based escalation toward risk based and phenotype driven management.
Conclusion: The transition from GINA 2024 to 2026 reflects maturation of an inflammation first, precision based pediatric asthma strategy. Implementation of anti inflammatory reliever therapy and corticosteroid stewardship may meaningfully reduce exacerbation burden and systemic steroid exposure in children. These cases demonstrate how incremental guideline refinements translate into measurable clinical impact.

1. Introduction

Asthma remains the most common chronic respiratory disease in children worldwide and a leading cause of emergency department visits, hospitalizations, and missed school days. Despite advances in pharmacotherapy, a substantial proportion of pediatric patients continue to experience preventable exacerbations, many of which are associated with underuse of inhaled corticosteroids (ICS) and overreliance on short acting β_2 agonists (SABA) [1]. Over the past decade, growing recognition that even patients with infrequent symptoms may harbor persistent airway inflammation—and remain at risk of severe exacerbations—has reshaped global asthma management strategies.

The Global Initiative for Asthma (GINA) has progressively moved away from bronchodilator only treatment paradigms. Beginning with the landmark shift discouraging SABA only therapy, GINA has emphasized the central role of anti inflammatory treatment across all severity levels [1, 2]. The 2024 strategy reaffirmed this position and further strengthened recommendations for ICS containing regimens in children aged $\geq$ 6 years, particularly through the use of low dose ICS–formoterol as maintenance and reliever therapy (MART) within Track 1 of the stepwise approach [1, 2].

The 2025 update retained the two track model but more explicitly positioned anti inflammatory reliever therapy as the preferred strategy for exacerbation prevention, underscoring the dissociation between symptom burden and future risk [3]. Additionally, GINA 2025 expanded guidance regarding biomarker assessment (e.g., blood eosinophils and fractional exhaled nitric oxide [FeNO]) in moderate to severe asthma and formalized structured severe asthma algorithms to promote corticosteroid stewardship and early consideration of biologic therapy when appropriate [3].

The 2026 update further refined these principles. It reinforced the global priority of universal access to ICS containing inhalers, strengthened language discouraging SABA only exposure, emphasized systemic corticosteroid minimization, and clarified reassessment timelines before escalation to biologic agents [4]. Collectively, these updates reflect a transition toward precision medicine, inflammation first management, and risk based decision making in pediatric asthma care.

Maintenance and reliever therapy (MART), also referred to as single inhaler maintenance and reliever therapy (SMART), has emerged as a central component of this evolving strategy in children aged $\geq$ 6 years. Pediatric randomized controlled trials have demonstrated that budesonide–formoterol used as both maintenance and reliever therapy reduces severe exacerbations compared with fixed dose ICS plus SABA regimens, without increasing overall corticosteroid exposure [5, 6]. Additional pediatric trials have confirmed lung function improvement and acceptable safety profiles of ICS/LABA combinations in children aged 6–11 years [7, 8]. These data provide the clinical foundation for the strengthened positioning of MART across GINA 2024–2026.

At the same time, concerns regarding cumulative systemic corticosteroid exposure—particularly repeated short courses of oral corticosteroids—have reinforced the importance of exacerbation prevention strategies in children. Even brief systemic corticosteroid use has been associated with measurable adverse effects, and repeated exposure contributes to long term risk [9, 10]. Thus, contemporary asthma management increasingly prioritizes therapeutic approaches that minimize systemic steroid use while maintaining control.

In this context, examining the practical application of successive GINA updates provides insight into how incremental refinements influence real world pediatric asthma management. The present case series illustrates the clinical impact of the 2024, 2025, and 2026 GINA strategy updates across a spectrum of pediatric asthma severity—from recurrent preschool wheeze to severe Type 2–high disease requiring advanced therapy. By analyzing these cases against evolving guideline recommendations, this report aims to highlight key conceptual shifts, including anti inflammatory reliever dominance, biomarker guided escalation, and corticosteroid stewardship, and to demonstrate how evidence based updates translate into individualized pediatric care.

Case 1

A 3 year old male presented with five wheezing episodes over the preceding 12 months, two of which required systemic oral corticosteroids (OCS). Episodes were consistently triggered by viral infections, with no interval respiratory symptoms between events and no alternative explanation for recurrent wheeze. Growth and development were normal. In children $\leq$ 5 years, asthma diagnosis remains probability based and clinical rather than spirometry driven [2, 3]. Diagnostic support includes recurrent wheezing episodes, absence of alternative diagnoses, clinical response to SABA, or improvement during a 2–3 month trial of daily inhaled corticosteroids (ICS) [3]. In this patient, the frequency of exacerbations and need for systemic corticosteroids increased the likelihood of early childhood asthma rather than transient viral wheeze.

Acute management followed GINA 2025 recommendations and included SABA via pressurized metered dose inhaler with spacer, addition of ipratropium bromide for moderate exacerbation, systemic OCS for moderate–severe episodes, and oxygen supplementation targeting $SpO_2 \geq 94\%$ [3]. Given at least one OCS requiring exacerbation within the preceding year, GINA 2025 recommends initiation of daily low dose ICS at Step 2 [3]. Leukotriene receptor antagonists (LTRA) were considered less effective alternatives for exacerbation prevention. After initiation of daily low dose ICS, the patient demonstrated marked improvement at 3 month follow up. No additional OCS requiring exacerbations occurred. Two viral upper respiratory infections were reported but were managed successfully with SABA without progression to moderate or severe exacerbation. Caregiver reported wheeze frequency decreased substantially, inhaler technique was re verified at each visit, and growth velocity remained appropriate for age. At 6 months, sustained control permitted consideration of step down therapy; however, given seasonal viral exposure and prior exacerbation burden, daily ICS was continued with planned reassessment. This case illustrates the modern risk based paradigm emphasized in recent GINA reports: exacerbation history outweighs the absence of interval symptoms, and early anti inflammatory intervention aims to prevent cumulative systemic steroid exposure and future exacerbation risk [1, 3, 4].

Case 2

An 8 year old female presented with infrequent daytime symptoms occurring fewer than two days per week, no nighttime awakenings, and normal activity tolerance. Despite minimal symptom burden, she had required hospitalization for a severe exacerbation within the preceding year and had been managed with SABA alone. GINA 2024 formally eliminated SABA only treatment due to safety concerns and exacerbation risk [1]. GINA 2025 reinforced the use of anti inflammatory reliever therapy even in patients with mild symptoms, retaining the two track model while prioritizing Track 1 (ICS–formoterol as needed) [3]. GINA 2026 further strengthened language supporting universal access to ICS containing reliever therapy over SABA monotherapy [4]. Given her prior hospitalization, this patient was reclassified as high risk despite mild symptom frequency.

Management was transitioned to as needed low dose ICS–formoterol under the Track 1 strategy. Over 12 months of follow up, she experienced no emergency visits, hospitalizations, or OCS courses. Activity tolerance remained normal, and spirometry at 12 months demonstrated an FEV_1 of 98% predicted. Adherence was confirmed through pharmacy refill history and inhaler technique assessment. The elimination of severe exacerbations despite minimal reliever use reinforced the protective effect of anti inflammatory reliever therapy in patients previously categorized as “mild.” Pediatric MART trials have demonstrated reduced severe exacerbations compared with fixed dose

ICS plus SABA regimens [5, 6], supporting this risk prevention approach. This case exemplifies the conceptual shift from symptom driven classification toward future risk mitigation [1, 3, 4].

Case 3

A 10 year old male with established asthma remained uncontrolled on low dose daily ICS. Over the preceding 12 months, he required three OCS courses for exacerbations and demonstrated reduced lung function with an FEV_1 of 78% predicted. Adherence and inhaler technique were objectively confirmed. In accordance with GINA 2025, escalation to maintenance and reliever therapy (MART) using low dose ICS–formoterol was recommended prior to increasing ICS dose or introducing prolonged systemic corticosteroids [3]. Evidence supporting this strategy includes a 12 month pediatric SMART randomized controlled trial demonstrating significant exacerbation reduction [5], large multicenter trials showing lower severe exacerbation rates without increased total corticosteroid exposure [6], and pediatric safety validation of ICS/LABA combinations in children aged 6–11 years [7, 8].

Low dose budesonide–formoterol was initiated as both maintenance and reliever therapy. Monitoring included symptom control, exacerbation frequency, growth velocity, adherence, and inhaler technique. At 3 months, symptom frequency decreased to two or fewer days per week, with no nighttime awakenings or activity limitation. At 12 months, he experienced zero OCS bursts and no emergency department visits. Lung function improved substantially, with FEV_1 increasing from 78% to 92% predicted. Total cumulative corticosteroid exposure was reduced compared with the prior year, growth velocity remained within expected range, and no LABA related adverse effects were reported. This case reflects the GINA 2025–2026 emphasis on steroid stewardship—reducing repeated OCS bursts through optimized anti inflammatory reliever therapy rather than escalating to prolonged high dose ICS [3, 4].

Case 4

A 12 year old female with persistent uncontrolled asthma despite high dose ICS/LABA therapy presented with blood eosinophils of 520 cells/μL, elevated fractional exhaled nitric oxide (FeNO), two hospitalizations within 12 months, and multiple OCS bursts. Adherence and inhaler technique were objectively verified. GINA 2025 formalized a structured severe asthma algorithm requiring confirmation of diagnosis, assessment of adherence, evaluation of comorbidities, and phenotypic characterization prior to biologic initiation [3]. GINA 2026 reinforced minimizing prolonged systemic corticosteroid exposure and reassessing therapeutic response before escalation [4].

After structured evaluation confirmed uncontrolled Type 2–high asthma, the patient was referred to an allergy and asthma specialist. Following comprehensive subspecialty assessment, biologic therapy targeting Type 2 inflammation was initiated, accompanied by a structured oral corticosteroid (OCS) taper with the goal of complete elimination. At 4 months, the patient demonstrated a marked reduction in exacerbation frequency, improved symptom control scores, decreased fractional exhaled nitric oxide (FeNO) levels, and a reduction in peripheral eosinophil count. This case exemplifies the progression toward precision medicine in pediatric asthma, in which biomarker driven phenotyping informs biologic selection while reinforcing corticosteroid stewardship principles emphasized in recent GINA updates [3, 4].

Collectively, these four cases demonstrate a unified clinical trajectory consistent with the evolution of GINA 2024–2026: prioritization of anti inflammatory therapy at all severity levels, reduction of systemic corticosteroid exposure, escalation through MART before high dose ICS, and biomarker guided biologic therapy for severe Type 2–high disease [1, 3, 4]. The overarching paradigm is clear—future exacerbation risk, rather than symptom frequency alone, drives contemporary pediatric asthma management.

Table 1 summarizes how management of these cases would be modified or emphasized under the 2026 update.

2. Discussion:

The evolution of the Global Initiative for Asthma (GINA) strategy from 2024 through 2026 reflects a deliberate and coherent shift toward inflammation centered therapy, exacerbation prevention, and corticosteroid stewardship. The four pediatric cases presented in this series demonstrate how these refinements translate into practical clinical decision making across the spectrum of childhood asthma severity. A particularly important area of evolution has been the strengthened positioning of maintenance and reliever therapy (MART, also referred to as SMART) in children aged $\geq$6 years, supported by an increasingly consolidated pediatric evidence base.

GINA 2024 firmly discouraged SABA only treatment, emphasizing that even patients with infrequent symptoms remain at risk for severe exacerbations [1]. GINA 2025 retained the two track model but further reinforced Track 1—low dose ICS–formoterol used as an anti inflammatory reliever—as the preferred strategy across age groups [3]. GINA 2026 strengthened this positioning and highlighted universal access to ICS containing inhalers as a global health priority [4]. Across these iterations, exacerbation history has increasingly superseded symptom frequency as the dominant determinant of future risk. Case 2, in which a child with infrequent symptoms had a prior hospitalization, exemplifies this paradigm shift: reliance on symptom burden alone would underestimate risk, whereas an inflammation first approach prioritizes protection against severe events [1, 3, 4].

Although the adult evidence base for MART is extensive, pediatric data—while numerically smaller—are clinically robust and have directly informed guideline recommendations. A pivotal 12 month, double blind randomized trial by Bisgaard and colleagues in children aged 4–11 years with asthma uncontrolled on inhaled corticosteroids demonstrated that budesonide–formoterol used as both maintenance and reliever therapy significantly reduced severe exacerbations compared with fixed dose budesonide plus SABA [5]. Time to first exacerbation was prolonged, and overall corticosteroid exposure was not increased [5]. This study provided proof of concept that early anti inflammatory rescue at symptom onset can suppress evolving airway inflammation, a principle that now underpins Track 1 recommendations [1, 3].

Subgroup analyses from large multicenter trials including pediatric participants have similarly shown fewer exacerbations with budesonide–formoterol used as maintenance and reliever therapy compared with higher fixed dose ICS regimens [6]. Importantly, these reductions occurred despite lower cumulative maintenance ICS exposure [6]. Mechanistically, intermittent delivery of ICS–formoterol at symptom onset interrupts inflammatory amplification at a critical early stage. GINA 2025 and 2026 increasingly emphasize this biologic rationale when positioning MART as preferred therapy in children aged $\geq$6 years [3, 4].

Additional pediatric trials have established the safety and efficacy foundation necessary for reliever based strategies. The CHASE 3 randomized trial demonstrated that budesonide–formoterol improved FEV_1 and peak expiratory flow compared with budesonide alone in

Table 1: Key Management Differences if Cases Were Managed Under GINA 2026

Case	GINA 2025 Approach	What Changes Under GINA 2026	Clinical Implication
Case 1 Preschool recurrent wheeze (Age 3)	Daily low dose ICS recommended after ≥1 OCS requiring exacerbation. Oxygen target ≥94% in acute care. Clinical severity assessment without mandatory PRAM.	1. Stronger emphasis on earlier controller initiation in children with recurrent OCS exposure. 2. Clearer language discouraging repeated OCS bursts in preschoolers. 3. Reinforced follow up within 4–6 weeks after exacerbation. 4. Greater emphasis on caregiver education and inhaler technique verification.	Earlier anti inflammatory intervention and structured post exacerbation review aimed at reducing cumulative systemic steroid exposure.
Case 2 Mild asthma with prior hospitalization (Age 8)	Preferred Track 1: Low dose ICS–formoterol as needed. Elimination of SABA only therapy.	1. Stronger positioning of anti inflammatory reliever therapy as default strategy. 2. Clearer language linking prior hospitalization to high future risk. 3. Reinforcement that even minimal symptoms warrant ICS containing therapy.	Greater clarity that symptom frequency does not equal low risk; reinforces inflammation first management.
Case 3 Moderate persistent asthma with recurrent OCS bursts (Age 10)	Escalation to MART (low dose ICS–formoterol maintenance and reliever). Avoid unnecessary ICS dose escalation.	1. More explicit corticosteroid stewardship messaging. 2. Stronger discouragement of repeated OCS bursts. 3. Earlier reassessment interval after MART initiation. 4. Emphasis on objective adherence verification prior to step up.	Heightened focus on minimizing systemic steroid exposure and preventing stepwise overtreatment.
Case 4 Severe Type 2–high asthma (Age 12)	Structured severe asthma algorithm prior to biologics. Biomarker guided therapy (eosinophils, FeNO).	1. Clearer sequencing before biologic initiation (optimize inhaled therapy, confirm adherence). 2. Stronger language on OCS tapering and avoidance of maintenance OCS. 3. Emphasis on global equity and access to ICS prior to biologics. 4. Reinforced reassessment timeline post biologic initiation.	Precision medicine framework strengthened; systemic steroid minimization prioritized; biologic use more structured and monitored.

children aged 6 to <12 years symptomatic on ICS, without new safety signals [7]. A 26 week U.S. pediatric safety study similarly showed improved asthma control and comparable safety between combination therapy and ICS monotherapy [8]. Although these studies evaluated fixed dose regimens rather than true MART designs, they were critical in validating LABA safety in children aged ≥6 years, thereby enabling broader implementation of ICS–formoterol–based strategies endorsed in subsequent GINA reports [3, 4].

Pharmacodynamic data further support formoterol's role as a reliever in pediatric populations. A double blind randomized trial comparing budesonide–formoterol with budesonide plus salbutamol in children aged 5–15 years with mild acute asthma demonstrated rapid bronchodilation comparable to SABA [9]. Pediatric dose response and pharmacokinetic studies have confirmed dose dependent bronchodilation and acceptable safety margins for repeated dosing [10]. Pragmatic evidence also supports the anti inflammatory rescue concept. In African American children aged 6–17 years, symptom based ICS use with SABA improved outcomes compared with daily ICS therapy alone, reinforcing the biologic plausibility and clinical effectiveness of inflammation targeted rescue strategies central to GINA Track 1 [11].

A major advantage of MART demonstrated in pediatric trials is the reduction in severe exacerbations without increasing overall corticosteroid burden [5, 6]. This finding aligns directly with the growing emphasis on systemic corticosteroid minimization in GINA 2025 and 2026 [3, 4]. Although short courses of oral corticosteroids are effective in aborting exacerbations, even brief exposure is associated with adverse effects such as vomiting, behavioral changes, and hypothalamic–pituitary–adrenal axis suppression [12]. Repeated courses contribute to cumulative risks including metabolic disturbance and adverse bone effects [13]. Accordingly, the exacerbation reduction benefit of MART extends beyond symptom control; it represents a strategy of long term steroid stewardship.

The evolution of GINA guidance has also refined the management of severe asthma. GINA 2025 expanded recommendations regarding Type 2 biomarkers such as blood eosinophils and fractional exhaled nitric oxide and formalized structured severe asthma algorithms [3]. GINA 2026 clarified timing of reassessment and reinforced the importance of limited duration high dose ICS trials before biologic escalation [4]. In Case 4, earlier biologic consideration following optimization of inhaled therapy and adherence verification aligns with these principles and underscores the transition toward precision medicine. Importantly, optimized MART at Steps 3–4 may reduce exacerbation frequency sufficiently to delay or prevent biologic initiation in selected patients, further supporting a stepwise, steroid sparing approach [3, 4, 14].

Taken together, five directional trends characterize the trajectory from GINA 2024 to 2026: elimination of bronchodilator only paradigms, strengthened prioritization of anti inflammatory reliever therapy, expansion of biomarker guided severe asthma management, intensified

systemic corticosteroid stewardship, and emphasis on global access to ICS containing inhalers [1, 3, 4]. Notably, the pediatric randomized evidence supporting MART predates these guideline updates; the progression across successive GINA reports reflects increasing confidence in and integration of this evidence rather than reversal of prior practice.

The four cases illustrate this trajectory in clinical context. From preschool recurrent wheeze requiring early controller initiation, to mild asthma with high exacerbation risk, to moderate disease benefiting from MART, and finally to biomarker driven biologic therapy in severe Type 2–high asthma, the unifying principle is early and sustained control of airway inflammation. The shift from 2024 to 2026 is therefore best understood not as a change in direction, but as a consolidation of an inflammation first, risk based, and steroid sparing strategy for pediatric asthma management [1, 3, 4].

3. Conclusion

This case series highlights the paradigm shift reflected in GINA 2024–2026: pediatric asthma management is now firmly anchored in an inflammation first, risk based strategy. Across the spectrum of disease severity, early and sustained ICS exposure—particularly through maintenance and reliever therapy (MART) in children ≥6 years—was associated with reduced exacerbations, elimination of recurrent oral corticosteroid bursts, and preserved safety.

The progressive strengthening of anti inflammatory reliever therapy, corticosteroid stewardship, and biomarker guided escalation signals a move beyond symptom control toward prevention of future risk and long term disease modification. Collectively, these cases demonstrate the real world clinical impact of this shift, underscoring MART and precision guided care as central pillars of contemporary pediatric asthma management.

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