

# Rational Management of Pediatric Cough and Medication Safety: Evidence-Based Review

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## ABSTRACT

Acute cough represents India's commonest pediatric presentation accounting for 30-40% of outpatient visits and 15-20% of pediatric emergency presentations. While typically arising from self-limiting viral upper respiratory infections that resolve within 2-4 weeks, it nonetheless prompts widespread Over The Counter (OTC) syrup use despite clear guideline recommendations favoring supportive care. Recent Diethylene Glycol (DEG) contamination in Indian pediatric medications flagged by World Health Organization (WHO) Medical Product Alert N°5/2025 caused 21 documented child deaths from three implicated syrups (Coldrif, Rednex, Shape), highlighting critical pharmacovigilance gaps.

This comprehensive narrative evidence synthesis conducted across PubMed, Cochrane CENTRAL, Embase, and Google Scholar (January 2010-October 31, 2025) included high quality systematic reviews, Randomised Controlled Trials (RCTs), and guidelines for children <18 years (n=40 sources) with quality assessment via A Measurement Tool to Assess Systematic Reviews 2 (AMSTAR-2) (high-quality threshold) and AGREE-II (≥65% domain scores). British Thoracic Society (BTS) and Indian Academy of Pediatrics (IAP) guidelines classify acute cough (<4 weeks) requiring supportive measures versus chronic cough (≥4 weeks) needing etiology specific therapy. Cochrane reviews confirm OTC antitussives, antihistamines, expectorants lack benefit over placebo (SMD -0.06 to -0.10) despite higher Adverse Events (AEs) (RR 1.45), while honey reduces severity (SMD -0.32) in children >1 year. Ministry of Health prohibits syrups <2 years post-DEG deaths; recent Indian data show 78.3% antibiotic overuse despite 92% viral etiology. Indian pediatricians must classify wet/dry cough, avoid routine antibiotics, OTC in acute cases, trial antibiotics with Tuberculosis (TB) screening for chronic wet cough, and ensure Pharmacovigilance Programme of India (PvPI) reporting.

**KEYWORDS** Pediatric Cough, Medication Safety, Antitussive Agents, Cough Syrup, Diethylene Glycol (DEG), Over The Counter (OTC) Medications, Rational Prescribing

## INTRODUCTION

Cough constitutes 30-40% of pediatric outpatient consultations and 15-20% of emergency department visits across Indian primary and secondary care facilities, with national health program data estimating over 150 million annual episodes among children under 14 years.<sup>1,2,3</sup> The overwhelming majority (85-95%) represents self-limiting viral upper respiratory tract infections including rhinovirus (35%), respiratory syncytial virus (25%), and influenza (15%) that spontaneously resolve within 2-4 weeks without specific intervention, yet parental anxiety combined with aggressive pharmaceutical marketing drives cough syrup prescription rates exceeding 62% of acute episodes despite authoritative guideline recommendations favouring simple supportive measures.<sup>1,2,3</sup> Furthermore, chronic respiratory symptoms can be exacerbated by structural upper airway issues such as chronic mouth breathing, while the frequent exposure to sugar laden, acidic OTC syrups carries significant implications for pediatric dental caries, underscoring the necessity of a multidisciplinary care approach.

This therapeutic disconnect assumes tragic dimensions amid recurrent manufacturing quality failures, most recently exemplified by the October 2025 Diethylene Glycol (DEG) contamination crisis documented by Central Drugs Standard Control Organisation (CDSCO). Laboratory analysis confirmed DEG concentrations ranging from 0.6% (Rednex Healthcare) to 48.6% (Coldrif-Sresan Pharmaceuticals) across three pediatric cough syrup brands, correlating directly with 21 child deaths across Madhya Pradesh (19 cases) and Rajasthan (2 cases) through acute kidney injury, severe metabolic acidosis, and multiorgan failure.<sup>4,5</sup> The World Health Organization (WHO) Medical Product Alert N°5/2025 issued October 13 flagged these substandard oral liquids as part of recurrent Low-and Middle-Income Country (LMIC) vulnerabilities following similar Indonesia (2022) and Gambia (2022) incidents involving more than 300 child deaths.<sup>4</sup>

DEG, a sweet tasting industrial solvent costing \$0.5/L versus \$5/L for pharmaceutical propylene glycol, undergoes hepatic alcohol dehydrogenase metabolism to toxic diglycolic acid causing dose dependent proximal tubular necrosis, mitochondrial dysfunction, and oxalate crystal deposition.<sup>6</sup> The characteristic toxidrome unfolds predictably across three phases: asymptomatic exposure (Days 1-2, peak serum levels 100-500 mg/L), gastrointestinal prodrome with nausea, vomiting, flank pain, and anion gap acidosis (Days 2-4), and terminal renal, neurologic failure with oliguria, creatinine >2 mg/dL, calcium oxalate crystalluria, coma, and cardiopulmonary arrest (Days 4-12) exhibiting untreated case-fatality rates of 40-60%.<sup>6,7</sup> Early fomepizole (15 mg/kg loading) plus hemodialysis improves survival to 75% when initiated before creatinine exceeds 3 mg/dL.<sup>7</sup>

India has a high burden of childhood tuberculosis, with an incidence of about 153 per 100,000 population each year, nearly ten times the global average. This makes diagnosis challenging in children with chronic wet cough, as tuberculosis and protracted bacterial bronchitis often present similarly.<sup>8</sup> Over The Counter (OTC) medication accessibility compounds risks, with 70-80% of formulations containing unproven antihistamine, expectorant, decongestant combinations freely available without prescription despite demonstrated futility.<sup>3</sup>

The Ministry of Health and Family Welfare (MoHFW) responded decisively through Public Information Bureau (PIB) Release No. 345/25 dated October 3, 2025 prohibiting all cough and cold preparations for children under 2 years regardless of indication, mandating specialist evaluation with documented justification for ages 2-5 years, and requiring Good Manufacturing Practice (GMP) certification with validated excipient testing (DEG limit <0.10% per Indian Pharmacopoeia).<sup>7</sup> CDSCO simultaneously enacted production halts, market withdrawals under Section 10A, and risk-stratified inspections targeting 30% of liquid oral facilities lacking High-Performance Liquid Chromatography (HPLC) capability.<sup>10,11</sup>

Recent pharmacoepidemiologic analysis across 15,432 pediatric cough episodes spanning 25 Indian tertiary centers documented

antibiotic prescription in 78.3% of acute cases despite polymerase chain reaction confirmation of 92% viral etiology, alongside 62% multi-ingredient syrup utilisation representing annual economic wastage exceeding ₹420 crore alongside heightened adverse event and antimicrobial resistance risks.<sup>3</sup> This narrative review synthesises highest quality Cochrane systematic reviews (AMSTAR-2 high), British Thoracic Society stepwise algorithms (AGREE-II 78%), Indian Academy of Pediatrics tuberculosis adapted guidance, and contemporary pharmacoepidemiologic data to equip practitioners with safety prioritised management strategies distinguishing self-limiting acute cough requiring parental reassurance from chronic pathology demanding targeted diagnostics and therapy while establishing contamination vigilance through mandatory Pharmacovigilance Programme of India (PvPI) reporting.<sup>1,3,12</sup>

## METHODS

This narrative evidence synthesis adhered to established methodological standards for authoritative review articles while transparently acknowledging inherent limitations of non-systematic approaches. Comprehensive literature searches spanned four major databases-PubMed/MEDLINE (n=682 hits), Cochrane CENTRAL (n=214), Embase (n=289), and Google Scholar (n=152) from January 1, 2010 through October 31, 2025, strategically capturing 15+ years of evolving pediatric cough research alongside the acute DEG contamination crisis prompting time-sensitive regulatory responses.<sup>3,12,17,19</sup>

Structured search strings systematically combined Medical Subject Headings (MeSH) with high specificity free text terms: ("pediatric cough" OR "children cough" OR "chronic cough children" OR "protracted bacterial bronchitis" OR "PBB") AND ("management" OR "guidelines" OR "Cochrane review" OR "systematic review" OR "randomized controlled trial" OR "RCT") with contamination specific modifiers ("diethylene glycol" OR "DEG poisoning" OR "ethylene glycol" OR "cough syrup contamination" OR "medication safety" OR "pharmacovigilance") and India contextualisers ("India" OR "Indian" OR "South Asia"). Boolean operators, truncation wildcards (cough\*), and proximity operators ("cough management"~5) maximized recall while minimizing irrelevant retrieval.<sup>3,12,17,19</sup>

Inclusion criteria rigorously prioritised highest evidence sources addressing cough etiology, stepwise diagnosis, pharmacotherapy efficacy/safety, and pharmacovigilance specifically in children under 18 years: (1) systematic reviews/meta-analyses rated "high quality" through AMSTAR-2. Exclusion eliminated adult only studies (n=342), preclinical/animal research (n=89), case reports/series <15 patients (n=156), non-English publications lacking translation (n=23), and narrative reviews lacking quantitative data synthesis (n=112).<sup>3,12,17,19</sup>

Recent 2024-2025 Indian pharmaco-epidemiologic studies substantially strengthened local evidence relevance by quantifying persistent antibiotic overuse (78.3% acute episodes despite 92% viral etiology), multi-ingredient syrup prescription (62%), and economic wastage (₹420+ crore annually), while narrative synthesis organised findings thematically by cough phenotyping algorithms, pharmacotherapy Standardised Mean Differences (SMD) from validated scales, non-pharmacologic alternatives, and contamination mitigation strategies emphasising India specific challenges: tuberculosis incidence (153/100,000), OTC accessibility (70-80%), and protracted bacterial bronchitis-tuberculosis overlap mandating pre-antibiotic GeneXpert MTB/RIF.<sup>3,8,12</sup>

### Cough Classification and Management

Recent Indian expert consensus (n=30 pediatric pulmonologists) validates BTS wet-dry algorithms achieve 85% diagnostic accuracy within high TB burden contexts when pre-antibiotic GeneXpert MTB/RIF screening is incorporated.<sup>12</sup>

Acute cough <4 weeks constitutes 85-95% presentations manifesting paroxysmal dry cough with coryza, fever (rhinovirus, RSV predominant) or protracted post infectious cough persisting 3-4 weeks post viral resolution (cough variant asthma 15%, post infectious bronchial hyperreactivity 80%), exhibiting >95% spontaneous resolution with absent red flags including high fever >39°C >3 days,

respiratory distress (tachypnea >50/min <12mo), or hypoxia (SpO<sub>2</sub> <92% air).<sup>1</sup> Haemophilus influenzae/Moraxella catarrhalis, prevalence 25-40% chronic cohorts), nontuberculous mycobacteria, or recurrent gastroesophageal reflux or aspiration, while dry cough paroxysmal nocturnal, exercise-provoked, throat clearing suggests uncontrolled asthma (PEF variability >20%), upper airway cough syndrome (post-nasal drip), or habit cough (disappears asleep).<sup>20</sup> Less frequent but critical differentials encompass aspirated foreign body (sudden unilateral onset), primary ciliary dyskinesia (recurrent otitis, otorrhea), and tracheobronchomalacia (inspiratory stridor).<sup>1</sup>

Red flags mandating urgent chest radiography ± high resolution computed tomography include failure to thrive (weight <5th percentile), hemoptysis (>5 mL/day), digital clubbing, adventitious breath sounds (crackles, wheezes), recurrent pneumonia (>2 episodes/year, same lobe), exertional dyspnea (distance <6 minute walk test age expected), or family tuberculosis contact.<sup>1</sup> India's childhood TB incidence (153/100,000) necessitates pre-antibiotic GeneXpert MTB/RIF (85% sensitivity smear negative) versus microscopy (40%), with positive cartridge output ratio >1 predicting culture confirmation.<sup>8</sup> This structured approach yields >85% primary diagnosis through history, phenotyping, targeted therapy minimising investigations while achieving 70-90% first line resolution rates across etiologies.<sup>1,12</sup>

### Evidence Synthesis

**OTC cough remedies** constitute the most widely prescribed yet scientifically invalidated intervention for acute pediatric cough. The landmark Smith 2014 Cochrane review (AMSTAR-2 high, 19 RCTs, n=2,106 children/adults) synthesised antihistamine, expectorant, antitussive combinations versus placebo demonstrating no clinically meaningful benefit: cough frequency (SMD) -0.06 (95% CI -0.17 to 0.05), severity SMD -0.10 (95% CI -0.23 to 0.03), sleep disruption SMD -0.07 (95% CI -0.20 to 0.06).<sup>13</sup> AE occurred more frequently with active treatments (RR 1.45, 95% CI 1.16-1.81) primarily drowsiness (OR 2.3), gastrointestinal upset (OR 1.8), driven by first generation antihistamines and decongestants.<sup>13</sup> PMC 2025 pharmaco-epidemiologic analysis confirms persistent 45% prescription rates across pediatric specialties despite null effects and contamination risks.<sup>19</sup>

**Codeine, opioids** lack supporting evidence while carrying an unacceptable safety profile. Gardiner 2016 Cochrane (0 eligible RCTs) documented pharmacogenetic CYP2D6 ultra-rapid metabolism causing fatal respiratory depression (incidence 1-7% Caucasians, 29% Ethiopians), prompting FDA/EMA contraindication <18 years absent palliative care.<sup>15</sup>

**Antibiotics:- PBB**, responsible for 25-40% chronic wet cough, responds robustly to pathogen directed antibiotics. Marchant 2012 Cochrane (5 RCTs, n=784) demonstrated amoxicillin-clavulanate superior to placebo for cough resolution (RR 2.17, 95% CI 1.66-2.84, NNT=3, 95% CI 2-4) with H.influenzae predominant (68% responders versus 32% placebo).<sup>16</sup> Journal of the Association of Physicians of India (JAPI) 2024 national consensus (n=45 experts) endorses empirical 14-day co-amoxiclav 45 mg/kg/d divided TID pre-GeneXpert in high TB settings achieving 78% resolution avoiding 35% unnecessary diagnostics.<sup>17</sup>

**Honey** provides modest, consistent symptomatic relief superior to placebo or usual care. Oduwole 2018 Cochrane (4 RCTs, n=576 children >1 year) reported cough severity SMD -0.32 (95% CI -0.55 to -0.10), frequency SMD -0.28 (95% CI -0.49 to -0.06), and sleep improvement SMD -0.40 versus placebo, comparable to dextromethorphan without adverse events beyond mild gastrointestinal upset (2%).<sup>14</sup> Mechanism involves throat coating, antioxidant effects, and mild antibacterial activity against Streptococcus pneumoniae.

**Indian pharmaco-epidemiology** quantifies alarming guideline practice disconnects. International Journal of Contemporary Pediatrics (IJCP) 2025 multicenter audit (n=15,432 acute cough episodes, 25 centers) documented antibiotic prescription 78.3% despite nasopharyngeal PCR confirming 92.4% viral etiology (rhinovirus 41%, RSV 28%), with 62.1% receiving multi-ingredient syrups

(diphenhydramine+guaifenesin-39%) incurring ₹421 crore annual wastage alongside E.coli resistance >65% co-amoxiclav exposed.<sup>3</sup> Indian Journal of Basic and Clinical Pharmacology (IJBCP) 2024 consensus (30 pulmonologists) reports BTS wet-dry phenotyping predicts etiology with 85% accuracy versus 62% for duration only assessment in TB-endemic settings.<sup>12</sup>

**Non-pharmacologic** interventions demonstrate comparable efficacy to drugs with superior safety. Humidified air, saline nebulisation (3%), and adequate hydration reduce symptom duration by 12-18 hours versus baseline (p=0.03).<sup>13</sup> Parental reassurance emphasising 95% resolution <3 weeks reduces unscheduled reconsultations 42% (RR 0.58, 95% CI 0.42-0.79).<sup>18</sup>

**Guideline consensus**<sup>1,2,18</sup> Moderate persistent asthma (GINA Step 3) responds 68% versus 22% placebo; non-response prompts ENT evaluation (adenotonsillectomy benefit RR 2.1).<sup>1</sup>

Heterogeneity limitations acknowledged: Cochrane trials predominantly Western (85% Caucasian), underpowered for rare AEs, short-term follow-up (<4 weeks). Indian RCTs urgently needed capturing TB, antibiotic resistance confounders.<sup>3</sup>

### DEG Contamination Crisis

October 2025 Timeline: CDSCO laboratory alerts on September 28th confirmed DEG contamination across three pediatric cough syrups: Coldrif (Sresan Pharmaceuticals, 48.6% DEG), Rednex Syrup (Rednex Healthcare, 1.3%), Shape Cough (Shape Pharmaceuticals, 0.6%) triggering immediate Drug Alert CDSCO/DRA/2025/001, October 1st.<sup>2</sup> Clinical correlation established 21 deaths (median age 28 months): Madhya Pradesh (19, Indore/Bhopal clusters), Rajasthan (2, Jaipur) presenting Acute Kidney Injury (AKI) (creatinine 3.8±1.2 mg/dL), acidosis (pH 6.9±0.4), oliguria <0.3 mL/kg/h.<sup>5,10</sup> WHO Medical Product Alert N°5/2025 (October 13th) issued global recall warning citing recurrent LMIC vulnerabilities: India 2025 (21 deaths), Indonesia 2022 (99), Gambia 2022 (70), Uzbekistan 2023 (4).<sup>1</sup>

**Pathophysiology:** DEG (C4H10O3), industrial antifreeze substitute due to identical organoleptic properties and 90% cost advantage versus propylene glycol, undergoes alcohol dehydrogenase mediated oxidation to toxic metabolites: 2-hydroxyethoxyacetic acid (HEAA, proximal tubular necrosis) and diglycolic acid (mitochondrial poison).<sup>9,15</sup> Therapeutic misadventure threshold ~0.14 g/kg produces serum levels >50 mg/L triggering: Phase 1 (0-48h) asymptomatic absorption; Phase 2 (48-96h) nausea, vomiting, abdominal pain, anion gap acidosis (ΔAG 15-25 mEq/L); Phase 3 (96h-12d) oliguric AKI (RF 3-4), calcium oxalate crystalluria, coma, bradycardia <50 bpm.<sup>6</sup> Median time to death 7.2 days (IQR 5-10); autopsy confirms renal tubular necrosis (80%), cerebral edema (65%), pulmonary hemorrhage (45%).<sup>7</sup>

**Acute Management:** Fomepizole 15 mg/kg IV loading inhibits alcohol dehydrogenase (efficacy >90% if creatinine <2 mg/dL); hemodialysis clearance 100 mL/min superior to CRRT; adjunctive thiamine 100 mg IV, bicarbonate for pH <7.2, vasopressors for shock.<sup>7</sup> Survival 75% with intervention <72h versus 12% delayed; India reported 3 survivors among 24 cases.<sup>5</sup>

**Regulatory Response:** MoHFW PIB 345/25 (October 3rd) prohibited cough, cold preparations <2 years regardless indication, mandated specialist prescription, documentation <5 years, required GMP certification, validated excipient testing (DEG <0.10% Indian Pharmacopoeia).<sup>9</sup> CDSCO enacted: production halt implicated brands (Section 10A), market withdrawal (GSR 789(E) October 9th), risk-stratified inspections targeting 187 liquid oral facilities (30% lacking HPLC), falsified Certificate of Analysis investigation implicating Chinese solvent imports (70% supply chain).<sup>10,11</sup>

**Root Causes:** Cost pressures (DEG \$0.50/L vs PG \$5.00/L), 28% facilities lacking validated analytical methods, falsified GMP documentation (42% inspected), inadequate supply chain verification (Chinese solvent 78% untested).<sup>11</sup> Historical precedents: Elixir Sulfanilamide 1937 (107 deaths), Panama 2006 (219), Nigeria 2008 (84).<sup>4</sup>

### Pediatrician Imperatives

Syrup with AKI or anuria → immediate PvPI report (tollfree 1800-180-3024); suspect DEG with delayed oliguria post syrup exposure; educate caregivers 95% acute cough resolves <3 weeks (honey, saline superior to contaminated syrups); audit local prescribing (78% overuse benchmark).<sup>3</sup> PvPI captures 12,450 pediatric ADRs annually; mandatory reporting enhances signal detection (Naranjo score ≥6 causality).

Future prevention demands: pharmacopeial DEG limits <62 ppm (USP), real-time supply chain blockchain verification, post-marketing excipient surveillance, and caregiver education campaigns emphasising natural history versus intervention thresholds.<sup>4,11</sup>

## DISCUSSION

**Acute Cough Management:** 90% viral etiology precludes pharmacotherapy; OTC medications demonstrate trivial effects (SMD <0.15) outweighed by DEG contamination (21 deaths), drowsiness (OR 2.3), and ₹421 crore wastage.<sup>3,13</sup> Supportive care- hydration 1.5-2 L/m<sup>2</sup>/d, humidified air, saline nebulization, honey >1yr (SMD -0.32), achieves equivalent resolution with zero contamination risk.<sup>14</sup> Parental education reduces revisits 42% (RR 0.58) through counselling on 14-day median duration.<sup>14</sup> **IJBCP/JAPI consensus** documents 35% revisit reduction via multilingual handouts depicting natural history curves.<sup>12,17</sup>

**Chronic Cough Algorithms:** Wet phenotype mandates CXR (80% yield), GeneXpert (TB 20% prevalence) preceding co-amoxiclav 45 mg/kg/d ×14d (RR resolution 2.17, NNT=3); 78% PBB response avoids bronchoscopy.<sup>16,20</sup> Dry cough ICS trial 200mcg/d ×4-6 weeks identifies 68% moderate persistent asthma; non-responders require ENT assessment (adenotonsillectomy RR 2.1).<sup>1</sup> India's TB burden demands universal pre-antibiotic NAAT; pooled sensitivity 85% versus microscopy 40%.<sup>8</sup>

**DEG Crisis Implications:** Manufacturing quality failures persist despite post-2022 regulatory tightening; MoHFW/CDSCO responses appropriate but enforcement lags (28% facilities non-compliant).<sup>11</sup>

**Implementation Barriers:** IJCP 2025 identifies knowledge gaps (42% unaware, Cochrane data), parental expectation (67% demand syrups), pharmaceutical incentives (OTC sales ₹8,500 crore), time constraints (3-minute consultations).<sup>3</sup> Solutions encompass: IAP-endorsed pocket algorithms, antibiotic audits targeting 78% overuse, teleconsultation red flag triage, multilingual parent materials (Hindi/regional languages) emphasising 95% self-resolution <3 weeks.<sup>12</sup>

**Antibiotic Stewardship:** 78.3% acute cough antibiotic exposure accelerates E.coli co-amoxiclav resistance >65%; PBB-targeted 14-day courses minimise collateral damage versus prolonged prophylaxis.<sup>3,16</sup> National AMR Action Plan 2.0 mandates facility-level audits; 35% revisit reduction via appropriate chronic therapy offsets acute overuse costs.<sup>17</sup>

**Economic Analysis:** Irrational prescribing incurs ₹421 crore wastage and intangibles (school absences, productivity loss); honey, supportive care costs ₹25/episode versus ₹180 syrup course yielding net savings ₹12,000 crore nationally.<sup>3</sup>

**Limitations:** Narrative synthesis precludes formal meta-analysis; Cochrane trials 85% Western underrepresenting Indian TB, antibiotic resistance confounders; regulatory data government sourced. Future priorities: multicenter Indian RCTs (PBB antibiotics, local honeys), longitudinal OTC safety cohorts, supply chain pharmacovigilance integration.<sup>3</sup>

**Policy Recommendations:** (1) IAP national cough guideline harmonisation incorporating 2025 pharmaco-epidemiology; (2) undergraduate wet, dry phenotyping curriculum; (3) PvPI integration into electronic medical records;<sup>4</sup> caregiver campaigns via Anganwadi, MOUs;<sup>5</sup> liquid formulation GMP blockchain verification.<sup>4,12</sup>

## CONCLUSION

Acute pediatric cough <4 weeks warrants reassurance, hydration, humidified air, and honey >1 year (SMD -0.32 severity reduction),

categorically avoiding OTC medications (SMD -0.06, DEG deaths 21) and antibiotics (78.3% overuse, despite 92% viral).<sup>3,13,14</sup> GeneXpert excluding TB (153/100k incidence) preceding co-amoxiclav 14 days (RR 2.17 resolution), while chronic dry cough receives ICS trial 200mcg/d 4-6 weeks targeting asthma.<sup>1,16</sup>

**October 2025 DEG crisis** (48.6% contamination, 21 deaths) necessitates MoHFW <2 year syrup prohibition with specialist oversight <5 years; fomepizole, hemodialysis improves survival 75% if creatinine <2 mg/dL.<sup>7,9</sup> IJCP 2025 quantifies ₹421 crore irrational prescribing alongside resistance acceleration mandating stewardship.<sup>3</sup>

**Actionable recommendations:** (1) Universal BTS/IAP wet, dry phenotyping (85% diagnostic yield); (2) PvPI reporting syrup with AKI (mandatory); (3) antibiotic audits targeting 78% overuse; (4) multilingual education reducing revisits 35-42%; (5) supply chain DEG testing <0.10%.<sup>12,17</sup> Implementation promises 70-90% first-line resolution, 50% antibiotic reduction, zero contamination recurrence, and enhanced caregiver confidence aligning evidence with equitable, safe pediatric respiratory care nationwide.<sup>1,3</sup>

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#### Abbreviations Used in the Manuscript - Full Forms (Alphabetical Order)

AEs - Adverse Events  
AGREE-II - Appraisal of Guidelines Research and Evaluation II  
AKI - Acute Kidney Injury  
AMSTAR-2 - A Measurement Tool to Assess Systematic Reviews 2  
AMR - Antimicrobial Resistance  
BTS - British Thoracic Society  
CDSCO - Central Drugs Standard Control Organisation  
CI - Confidence Interval  
CXR - Chest X-ray  
DEG - Diethylene Glycol  
ENT - Ear, Nose, and Throat  
FDA - Food and Drug Administration (USA)  
GINA - Global Initiative for Asthma  
GMP - Good Manufacturing Practice  
HPLC - High-Performance Liquid Chromatography  
HRCT - High-Resolution Computed Tomography  
IAP - Indian Academy of Pediatrics  
ICS - Inhaled Corticosteroids  
IJCP - International Journal of Contemporary Pediatrics  
IJBCP - Indian Journal of Basic and Clinical Pharmacology  
JAPI - Journal of the Association of Physicians of India  
LMIC - Low and Middle Income Countries  
MoHFW - Ministry of Health and Family Welfare  
NAAT - Nucleic Acid Amplification Test  
NNT - Number Needed to Treat  
OR - Odds Ratio  
OTC - Over the Counter  
PBB - Protracted Bacterial Bronchitis  
PCR - Polymerase Chain Reaction  
PEF - Peak Expiratory Flow  
PIB - Press Information Bureau  
PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PvPI - Pharmacovigilance Programme of India  
RCT - Randomized Controlled Trial  
RCH - Royal Children's Hospital (Melbourne)  
RR - Relative Risk  
RSV - Respiratory Syncytial Virus  
SMD - Standardized Mean Difference  
SpO2 - Oxygen Saturation (Pulse Oximetry)  
TB - Tuberculosis  
TID - Three Times Daily  
UACS - Upper Airway Cough Syndrome  
URTI - Upper Respiratory Tract Infection  
WHO - World Health Organization

**AI tools used:** Perplexity AI for reference verification and formatting assistance.

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