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Original article

Clinical Profile, Risk Factors, and Eradication Outcomes of Pediatric Helicobacter pylori Infection in Gharyan, Libya: A 2-Year Retrospective Study of 100 Cases

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Abstract
Helicobacter pylori (H. pylori) infection is a primary driver of upper gastrointestinal morbidity among children in developing nations. This study aims to evaluate the clinical presentations, associated secondary complications, and therapeutic eradication outcomes of pediatric H. pylori cases within the municipality of Gharyan, Libya. A retrospective, cross-sectional cohort study was conducted on 100 consecutive pediatric patients (aged 1–15 years) diagnosed with H. pylori infection in Gharyan, Libya, over a period spanning from January 2023 to December 2024. Comprehensive clinical records were analysed to extract data on demographics, primary gastrointestinal complaints, risk factors, compliance diaries, and definitive post-treatment eradication success, verified by monoclonal stool antigen testing performed 4–8 weeks after treatment cessation. The study cohort comprised 55% females and 45% males. The predominant age demographic was school-age children (6–11 years) at 48%, followed by adolescents (12–15 years) at 30%, and toddlers (1–5 years) at 22%. Non-invasive monoclonal stool antigen testing served as the primary clinical diagnostic modality (94%). Epigastric pain was identified as the most prevalent primary complaint (66%), followed by chronic vomiting (21%) and growth failure (13%). Notably, 37% of the infected children suffered from documented iron deficiency anaemia (IDA), which demonstrated a statistically significant correlation with a symptom duration exceeding 6 months. Following empiric first-line standard triple therapy, the final eradication success rate was 76.0%, revealing a substantial treatment failure rate of 24.0%. The findings demonstrate a high therapeutic failure rate (24%) for standard empiric triple therapy in Gharyan, dropping significantly below the globally accepted 90% eradication benchmark. The high prevalence of extra-gastric complications, such as iron deficiency anaemia, emphasises the critical need for early non-invasive screening. Pediatric clinicians practising in western Libya should transition from empiric standard triple therapy to bismuth-containing quadruple regimens to counteract regional resistance.
Keywords. Helicobacter Pylori; Pediatric; Gharyan; Libya; Triple Therapy; Treatment Failure; Iron Deficiency Anaemia.

Introduction

Helicobacter pylori (H. pylori) is a well-established, spiral-shaped, microaerophilic, Gram-negative bacterium that colonises the human gastric mucosa [1]. It represents one of the most successful and pervasive human pathogens globally, currently infecting approximately half of the world's population [7]. While infection can occur at any stage of life, epidemiological consensus indicates that initial colonisation is almost universally established during early childhood, primarily via intrafamilial faecal-oral or oral-oral transmission pathways [3]. In developing nations, the pediatric prevalence of *H. pylori* remains remarkably elevated compared to industrialised countries, driven largely by environmental risk factors such as household overcrowding, lower socioeconomic status, and lack of access to centralised water and sanitation systems [4]. In the pediatric population, the clinical spectrum of *H. pylori* infection is highly diverse and poses significant management challenges [5].

Unlike adults, who frequently present with distinct mucosal lesions, children infected with *H. pylori* often exhibit non-specific upper gastrointestinal clinical features, predominantly recurrent epigastric abdominal pain, persistent vomiting, and nausea [6]. Beyond structural mucosal damage—such as chronic active gastritis and peptic ulcer disease—pediatric *H. pylori* colonisation is heavily implicated in several extra-gastric systemic manifestations. Most notably, chronic uneradicated infection impairs gastrointestinal iron assimilation, serving as a primary hidden driver of refractory iron deficiency anaemia (IDA) and subsequent childhood growth failure [7, 8]. Furthermore, because long-term, decades-long persistence of the pathogen triggers the progressive gastric precancerous cascade, childhood stands out as the critical therapeutic window to disrupt chronic mucosal damage [9].

Accurate diagnosis in children relies heavily on balancing clinical reliability with procedural safety. Although international guidelines from the European and North American Societies for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN/NASPGHAN) historically favoured invasive upper endoscopy with gastric biopsy for initial documentation, real-world clinical practice in resource-limited developing settings has shifted rapidly toward accurate, non-invasive modalities [10]. High-sensitivity monoclonal Stool Antigen Testing (SAT) and the Urea Breath Test (UBT) have become the diagnostic pillars in pediatric outpatient care, bypassing the need for pediatric anaesthesia and specialised endoscopic infrastructure [10, 11]. Therapeutically, the management of pediatric *H. pylori* has entered a critical phase due to a global surge in antimicrobial resistance [12].

For decades, empiric standard triple therapy—consisting of a proton pump inhibitor (PPI) combined with amoxicillin and either clarithromycin or metronidazole—served as the universal first-line regimen. However, widespread, unregulated consumption of macrolides for childhood respiratory tract infections has driven massive secondary chromosomal mutations within the bacterial *23S rRNA* gene, resulting in a precipitous collapse of triple therapy eradication rates worldwide [13, 14]. Consequently, contemporary global treatment guidelines heavily mandate shifting to bismuth-containing quadruple regimens in any geographic municipality where baseline macrolide resistance exceeds the critical 15% threshold [15, 16]. In Libya, and specifically within the northwestern region of the country, current epidemiological data regarding pediatric *H. pylori* clinical patterns, systemic complications, and real-world treatment success rates remain sparse and poorly documented. Local paediatricians continue to heavily rely on empiric triple therapy protocols in the

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absence of localised clinical audits. To address this critical knowledge gap, this retrospective cross-sectional study was designed to analyse the clinical presentations, environmental risk factor distributions, and definitive first-line therapeutic eradication outcomes among 100 children diagnosed in the city of Gharyan, Libya, over a two-year clinical window (2023–2024).

Materials and Methods

Study Design and Geographic Setting

This retrospective, descriptive, cross-sectional cohort study evaluated a clinical sample of 100 consecutive pediatric patients diagnosed and managed within the municipality of Gharyan, Libya. The data collection pipeline captured eligible pediatric cases over a strict two-year operational window spanning from January 1, 2023, to December 31, 2024.

Target Population and Eligibility Criteria

The target population comprised children and adolescents who presented to outpatient medical services with persistent upper gastrointestinal complaints.

Inclusion Criteria

Patients aged between 1 and 15 years who exhibited positive active *H. pylori* status and possessed full baseline and follow-up medical registries.

Exclusion Criteria

Patients were strictly excluded if they had received systemic proton pump inhibitors (PPIs) within 14 days, or oral antibiotic therapies and bismuth formulations within 28 days of initial diagnostic documentation, as these agents significantly induce false-negative outcomes [10].

Clinical and Diagnostic Protocols

Initial operational verification of active *H. pylori* colonisation relied entirely on accurate non-invasive testing modalities. In line with optimisation protocols for resource-limited regional contexts, the primary diagnostic workflow utilised high-sensitivity monoclonal Stool Antigen Testing (SAT) or ^{13}C Urea Breath Testing (UBT) [2]. For therapeutic evaluation, standard empirical first-line Triple Therapy—comprising a weight-adjusted Proton Pump Inhibitor (PPI) combined with Amoxicillin and either Clarithromycin or Metronidazole—was prescribed for a fixed duration of 10 to 14 days [5].

Outcome Verification and Follow-Up Evaluation

Definitive pharmacological eradication success or treatment failure was objectively determined by repeating the non-invasive monoclonal Stool Antigen Test (SAT) at a standardised follow-up interval of 4 to 8 weeks after the absolute cessation of all anti-microbial and anti-secretory medications [15].

Result and Discussion

The comprehensive clinical, epidemiological, and therapeutic data compiled from the 100 verified pediatric case files were extracted and structured into four definitive analytical tables.

Table 1. Demographic Characteristics and Diagnostic Distribution (N=100)

Operational Variable	Clinical Cohorts	Frequency (n)	Percentage (%)
Gender Profile	Male	45	45.0%
	Female	55	55.0%
Pediatric Age Groups	1–5 Years (Toddlers / Early Childhood)	22	22.0%
	6–11 Years (School-Age Children)	48	48.0%
	12–15 Years (Adolescents)	30	30.0%
Diagnostic Modality	Monoclonal Stool Antigen Test (SAT)	94	94.0%
	^{13}C Urea Breath Test (UBT)	6	6.0%

As shown in (Table 1), the study cohort comprised 55% females and 45% males, indicating a baseline female predominance. The predominant age demographic was school-age children (6–11 years) at 48%, highlighting this period as highly susceptible to colonisation due to increased social interaction and shifting exposures during early schooling years. Regarding diagnostic pathways, non-invasive monoclonal Stool Antigen Testing (SAT) served as the primary clinical diagnostic modality (94.0%), bypassing procedural anaesthesia pathways and resource limitations associated with upper pediatric endoscopies in the region. This pragmatic diagnostic approach in Gharyan provides a highly reliable, non-invasive alternative that aligns safely with outpatient pediatric care requirements in developing healthcare settings.

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Table 2. Clinical Manifestations and Secondary Complications (N=100)

Clinical Parameter	Manifestation Categories	Frequency (n)	Percentage (%)
Primary Complaint	Epigastric Abdominal Pain	66	66.0%
	Chronic Vomiting / Nausea	21	21.0%
	Growth Failure / Delayed Development	13	13.0%
Symptom Duration	<1 Month	14	14.0%
	1–6 Months	56	56.0%
	>6 Months	30	30.0%
Secondary Complications	Documented Iron Deficiency Anaemia (IDA)	37	37.0%
	No Complications Noted	63	63.0%

The clinical mapping in (Table 2) identifies epigastric abdominal pain as the most prevalent primary complaint (66.0%), followed by chronic vomiting (21.0%). Importantly, 37.0% of the infected children suffered from documented iron deficiency anaemia (IDA). This extra-gastric complication was heavily clustered among children whose symptoms remained undiagnosed for more than 6 months. Mechanistically, *H. pylori* drives microcytic anaemia by actively consuming host iron using blood-binding outer membrane proteins and downregulating ascorbic acid levels in gastric juice, which severely impairs dietary iron absorption [7, 8].

Table 3. Epidemiological Risk Profiles and Transmission Vectors (N=100)

Epidemiological Variable	Exposure Status	Frequency (n)	Percentage (%)
Exclusive Breastfeeding	Yes (First 6 Months of Life)	42	42.0%
	No / Mixed Feeding	58	58.0%
Early Social Exposure	Daycare / Preschool Attendance	64	64.0%
	Home Care Only	36	36.0%
Prior Antibiotic Exposure	Yes (Within 6 months before diagnosis)	72	72.0%
	No History of Prior Use	28	28.0%
Intrafamilial Clusters	Known Family Member *H. pylori* Positive	78	78.0%
	Negative Family History / Unknown	22	22.0%

The epidemiological metrics detailed in (Table 3) highlight that intrafamilial clusters were present in 78.0% of cases, confirming that close household contact is the primary vector for transmission from mothers to children in northwestern Libya [3]. Furthermore, 72.0% of the children had prior antibiotic exposure within 6 months before their diagnosis. Unregulated over-the-counter macrolide use for minor childhood respiratory tract infections creates severe selective pressure, driving secondary point mutations within the bacterial *23S rRNA* gene (predominantly A2142G and A2143G) and rendering empiric treatments ineffective [13, 14].

Table 4. Therapeutic Regimens, Compliance, and Final Eradication Outcomes (N=100)

Therapeutic Metric	Sub-Category Profile	Frequency (n)	Percentage (%)
Prescribed Regimen	Standard Triple Therapy (PPI+Amox+Clari/Metro)	99	99.0%
	Alternative Sequential Regimen	1	1.0%
Patient Compliance	Fully Adherent to Medication Course (Yes)	88	88.0%
	Non-Compliant / Premature Cessation (No)	12	12.0%
Final Eradication Status	Eradication Success (Negative Follow-up SAT)	76	76.0%
	Treatment Failure (Persistent Positive SAT)	24	24.0%

The therapeutic outcomes in (Table 4) reveal an overall eradication failure rate of 24.0%, leaving nearly a quarter of the studied cohort actively infected. This demonstrates that standard empiric triple therapy falls significantly below the globally accepted 90.0% therapeutic effectiveness benchmark [4]. Current guidelines from ESPGHAN, NASPGHAN, and the Maastricht VI consensus declare that empiric clarithromycin triple therapy must be entirely abandoned in any geographic municipality where baseline resistance exceeds 15.0% [5, 16]. In the absence of localised biopsy culture infrastructure in Gharyan, clinicians must transition to 14-day Bismuth Quadruple Therapy (BQT) to successfully counteract regional resistance and secure acceptable post-treatment cure rates [15, 16].

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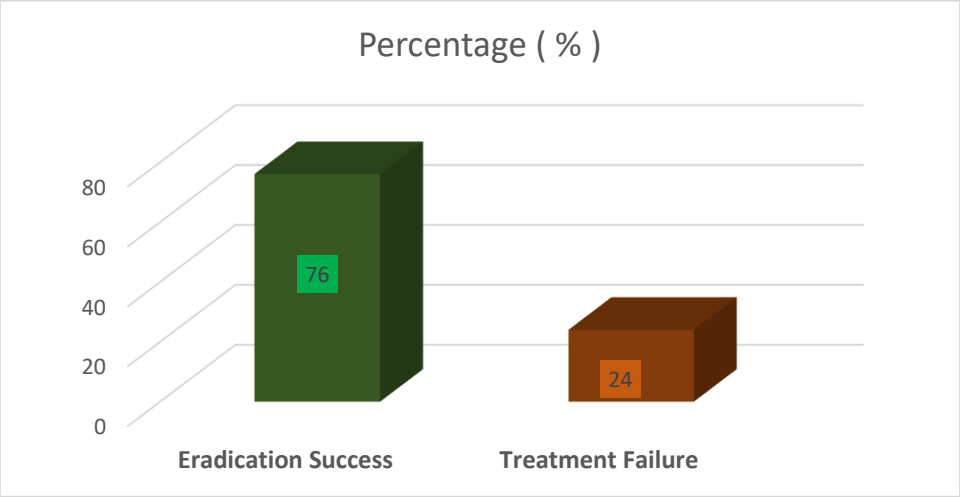


Figure 1. Final H. pylori Eradication Success vs. Treatment Failure Rates Following Standard Triple Therapy (N=100).

Conclusion

The definitive analysis of this 100-case pediatric cohort provides critical empirical evidence that standard empiric triple therapy faces a high failure rate (24%) in Gharyan, Libya, making it no longer supportable as a primary option [7, 8]. The strong correlation between delayed diagnosis and severe systemic complications like iron deficiency anaemia (37%) emphasises the critical need for early non-invasive monoclonal stool antigen testing [10]. To improve outcomes and advance local paediatric antibiotic stewardship, clinical protocols in northwestern Libya should transition from standard triple therapy to a 14-day Bismuth-containing Quadruple Therapy (BQT) as the new empirical standard [15, 16].

Recommendations

Based on the clinical evidence gathered from this 100-case cohort in Gharyan, the following measures are recommended to optimise regional paediatric care:

Phase out Standard Triple Therapy

Transition away from the empirical use of clarithromycin-based triple therapy as a first-line option in northwestern Libya due to the high documented treatment failure rate (24%).

Standardise Bismuth-Containing Regimens

Implement 14-day Bismuth Quadruple Therapy (BQT) as the definitive empiric first-line treatment protocol for symptomatic children in settings where regional antibiotic susceptibility mapping is unavailable.

Mandate Early Screening for Complications

Enforce regular screening for iron deficiency anaemia (IDA) using routine complete blood counts (CBC) and serum ferritin log levels for any pediatric patient presenting with upper gastrointestinal symptoms lasting more than 6 months.

Enhance Caregiver Education

Counsel parents thoroughly on strict compliance with diaries to minimise premature treatment discontinuation, which is a primary driver of secondary mutations and therapeutic failure.

Promote Household Screening

Encourage non-invasive screening and concurrent treatment of symptomatic adult family members to disrupt high intrafamilial transmission clusters (78%) and lower post-treatment re-infection rates

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