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# Lessons From a Quality Improvement Project to Standardize the Process of Gastric Biopsy Culture for *Helicobacter pylori*

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**ABSTRACT**

**Background:** Despite expert recommendations, clinician's adherence to pediatric societal clinical practice guidelines is variable, particularly with respect to the use of gastric biopsy culture in the initial diagnosis of *Helicobacter pylori* infection. In addition, the implementation of routine use of gastric biopsy culture has been challenging with several factors affecting the rate of successful primary *H pylori* culture.

**Methods:** We conducted a quality improvement (QI) project with the aims of increasing the rate of successful primary culture. The QI project involved educational efforts among our gastroenterologists, endoscopy suite personnel, and laboratory personnel. We compared the frequency of gastric biopsy culture sent in patients with international classification of diseases 9th revision code 041.86, and 10th revision codes B96.81 evaluated by pediatric gastroenterologists at Boston Children's Hospital during the 9 months before the QI intervention (February 1, 2019 to October 31, 2019) and 9 months after the QI intervention (November 1 2019 to July 31 2020). We also compared the rate of culture growth in patients with positive histology (culture positivity), and antimicrobial susceptibilities before and after November 1, 2019.

**Results:** We observed an increased frequency of gastric biopsy acquisition by any gastroenterologist, obtained in 39% (28 of 71) preintervention patients compared with 67% (36 of 54) intervention patients ($P = 0.004$). There was an increase in the percentage of culture positivity across study periods from 21% (3 of 14) preintervention to 45% (5 of 11) postintervention ($P = 0.39$; 95% confidence interval, 0.64-7.00).

**Conclusion:** Educational initiatives and collaborative work with staff physicians, endoscopy personnel, and hospital laboratory appear to be effective tools to increase usage of gastric biopsy culture as a diagnostic tool for *H pylori* infection and to increase culture positivity. Improving the surveillance of local resistance rates will improve the selection of the most effective primary treatment in specific geographic areas.

**Key Words:** clarithromycin resistance, gastric biopsy culture, *Helicobacter pylori*, quadruple therapy

**What Is Known?**

- Diagnostic approach to *Helicobacter pylori* infection has not significantly changed in spite of current 2016 revised guidelines with overall low use of gastric biopsy culture for microbial susceptibility testing.
- Implementation of routine use of gastric biopsy culture is challenging as it requires technical expertise and may be affected by several factors.

**What Is New?**

- Educational interventions involving endoscopy nursing staff training, laboratory staff, and physicians significantly improved the frequency of cultures sent by pediatric gastroenterologists at our center.
- Improvement of specimen handling procedures by endoscopy and laboratory personnel may contribute to increase rate of culture growth in patients with presence of *H pylori* on gastric biopsies.

## INTRODUCTION

*Helicobacter pylori* infection continues to represent a significant global health problem (1). Approximately one-third of children are affected by the infection worldwide with an increased prevalence of the infection in developing countries (2–4). *H pylori* infection has been associated with several gastrointestinal conditions including chronic gastritis, peptic ulcer disease, and gastric cancer (5). Chronic gastritis is common in the pediatric population whereas ulcer disease occurs at a lower rate than in the adult population (6, 7). Extragastrointestinal conditions have also been linked to *H pylori* infection although not conclusively, with the most definitive evidence of association shown in idiopathic thrombocytopenic purpura as well as iron deficiency and iron-deficient anemia (8–13).

The approach to the diagnosis and management of *H pylori* infection in children and adolescents has evolved over the past decade (14, 15). The 2016 updated North American and European pediatric gastroenterology societal guidelines continue to discourage the use of noninvasive tests to diagnose *H pylori* infection as well as a test and treat strategy (15). Instead, upper gastrointestinal endoscopy (EGD) is recommended when a valid clinical indication for the procedure is present. During endoscopy, obtaining gastric biopsy for primary *H pylori* culture and assessing antimicrobial susceptibility prior to treatment is strongly encouraged. Current data suggest a high prevalence of antimicrobial resistance in *H pylori*, particularly to clarithromycin and metronidazole with negative impact on success rates of eradication therapy. Therefore, previously recommended pediatric first-line therapies for *H pylori* infection such as triple therapy (proton pump inhibitor and two antibiotics: amoxicillin and clarithromycin, or metronidazole) are no longer endorsed. Instead, it is recommended by

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experts that the clinician treat for eradication on the basis of antimicrobial susceptibility from the gastric biopsy culture. If this information is not available, quadruple therapy (bismuth subsalicylate, proton-pump inhibitor (PPI), metronidazole, and amoxicillin or tetracycline according to age below or above 8 years, respectively), high dose amoxicillin (PPI, amoxicillin, and metronidazole) or concomitant therapy (PPI, amoxicillin, clarithromycin, and metronidazole) can be utilized (15). However, this empiric approach frequently adds more drugs to the treatment regimen, thereby decreasing adherence, increasing the cost of therapy, and potentially contributing to further resistance particularly in treatment failures (16).

Despite expert recommendations (first guidelines were published in 1999 in Canada and 2000 in the United States), we noticed that the clinicians in our large clinical practice (over 50 gastroenterologists) had not been adhering to the recommendations (particularly with respect to gastric biopsy culture) (17). Furthermore, the rate of *H pylori* culture positivity (defined as positive culture growth in a patient with a gastric biopsy that demonstrated *H pylori* organisms on pathology) was low. Therefore, we conducted a quality improvement (QI) project with the aims of increasing the rate of successful primary culture and antimicrobial susceptibility testing which will ultimately lead to an increase in the numbers of *H pylori*–infected children who receive appropriate eradication therapy.

## METHODS

Our QI initiative involved our physicians, endoscopy staff, and laboratory staff. To provide a contextual picture, our hospital-based gastroenterology practice is comprised of 60 pediatric gastroenterologists. From this group, 48 doctors perform endoscopic procedures in our endoscopy unit. Each procedural room is staffed by an anesthesia-provider and endoscopy staff (1 nurse and 1 technician) dedicated to assisting the physician with different tasks including specimen collection. The endoscopy unit is located on the fourth floor of the hospital while the laboratory is located on the seventh floor of the same building. Culture specimens are usually hand delivered, or transported through the pneumatic tube system by endoscopy staff. The large number of physicians involved and variability in practice made this population a suitable group to perform a QI initiative.

We hypothesized the following: (1) raising awareness of the diagnostic upper endoscopy process for obtaining *H pylori* culture through education and review of the updated European Society for Pediatric Gastroenterology, Hepatology & Nutrition (ESPGHAN)-North American Society For Pediatric Gastroenterology, Hepatology & Nutrition (NASPGHAN) guidelines for management of *H pylori* in children and adolescents would lead to an increase in the percentage of successful primary cultures sent, (2) implementing interventions to correct the deficiencies identified in the diagnostic upper endoscopy process for obtaining *H pylori* culture at our institution would lead to an increase in our rate of culture positivity. The specific interventions included use of correct media culture for *H Pylori*, collection of 2 gastric biopsies (1 from antrum and 1 from corpus), placement of the culture media with specimen on ice immediately after being collected, and prompt transportation from endoscopy suite to hospital laboratory.

To address our first aim of increasing the percentage of successful primary cultures sent, we conducted educational efforts among our gastroenterologists. First, we gave a presentation at our hospital-based Pediatric Gastroenterology Grand Rounds on the clinical management of *H pylori* infection, incorporating recommendations from the 2016 NASPGHAN/ESPGHAN guidelines. Second, we prepared a division-wide e-mail notification with these recommendations. Third, we summarized the recommendations on a large television monitor that is located at the entrance of our gastroenterology division's main office.

To address our second aim of improving the rate of culture positivity, we met with our endoscopy suite leaders, nursing staff, and hospital laboratory staff in an effort to standardize the process of gastric biopsy culture. Specific interventions in our endoscopy suite included (1) an oral presentation describing the QI project to endoscopy suite personnel at their morning meeting, and (2) creation of a QI form (Fig. 1) addressing the deficiencies identified to be filled by endoscopy nurses (Table 1). Specific interventions in our hospital laboratory included (1) an oral presentation describing the QI project to laboratory personnel stressing the importance of promptness of sample refrigeration after reception and immediate transportation to the off-site specialty laboratory (ARUP Laboratories) for culture (Fig. 2) (18).

Briefly, once ARUP Laboratories receives the specimen from our laboratory, tissue is grinded in 1 mL tryptic soy broth to homogenize and subsequently inoculated on 2 Brucella agar plates. The plates are incubated at 33°C-37°C, in microaerophilic conditions. Plates are examined at 3, 5, and 7 days looking for characteristic colonies. Identification is performed by matrix assisted laser desorption ionization-time of flight mass spectrometry or 16S sequencing. If positive growth, susceptibility testing is added. The sample then is sent to Mayo Clinical Lab (test code: ZMMLS/8073) (19) which conducts antimicrobial susceptibilities by means of agar dilution method. The susceptibility breakpoint values for *H pylori* isolates used in assessing resistance to a given antibiotic are as follows (μg/mL): amoxicillin >0.25, clarithromycin >1, metronidazole >8, levofloxacin >1, tetracycline >4 (20–22).

We compared the frequency of gastric biopsy culture sent in patients with International classification of diseases, 9th revision (ICD-9) code 041.86 (*Helicobacter pylori*) and ICD-10 codes B96.81 (*Helicobacter pylori* as the cause of diseases classified elsewhere), A04.8 (other specified bacterial intestinal infections), K29.70 (gastritis, unspecified, without bleeding), and K29.71 (gastritis, unspecified, with bleeding) evaluated by pediatric gastroenterologists at Boston Children's Hospital during the 9 months before the QI intervention (February 1, 2019 to October 31, 2019) and 9 months after the QI intervention (November 1 2019 to July 31 2020). We also compared the rate of culture positivity, and antimicrobial susceptibilities before and after November 1, 2019. Finally, we collected information regarding *H pylori* treatment within the 6 months before EGD, PPI use at the time of EGD, histologic findings, and presence of characteristic *H pylori* endoscopic findings in all patients. Treatment regimen if offered, eradication data if treated, and clinical symptoms posttreatment were also collected. The QI initiative was exempt from review by the hospital Institutional Review Board.

### Statistical Analysis

Age at the time of upper endoscopy is summarized as mean ± standard deviation and compared across study periods by Student's *t* test. All other variables are categorical and summarized by frequency (numerator/denominator) and percentage. Comparison of categorical variables was evaluated by a 2-sided Fisher exact test with $P < 0.05$ considered statistically significant. For the comparison of culture positivity across study periods, the relative risk is reported with a 95% confidence interval. All statistical analysis was performed with SAS version 9.4 (Cary, NC).

## RESULTS

We identified a total of 126 patients with ICD-9/10 codes as described earlier, who were evaluated by pediatric gastroenterologists at Boston Children's Hospital and underwent upper endoscopy during the study period (February 1, 2019 to July 31, 2020). The 126 patients represented 3% of overall endoscopies during that time-period (2612 EGDs preintervention and 1730 EGDs postintervention

**CULTURE MEDIA PARA-PAK C&S (H Pylori Culture)**

**TO IMPROVE CULTURE SENSITIVITY:**

1) Obtain 2 gastric biopsies, 1 from ANTRUM and 1 from the CORPUS.
2) Place 2 biopsies on culture media.
3) Place the culture media on ice as soon as it is collected; keep media on ice during upper gastrointestinal endoscopy
4) Please transport directly to laboratory in a timely fashion to be refrigerated.

Place patient sticker here:

Time taken out of Fridge: _____

Time Sent to Lab Control: _____

Was the sample on ice the entire time? (Circle one) YES NO

**FIGURE 1.** QI form addressing the deficiencies identified, to be completed and sent to the hospital laboratory with every gastric biopsy culture by endoscopy suite personnel. QI = quality improvement.

for a total of 4342). One patient was excluded from the analysis due to age (34 years old), resulting in 125 eligible patients: 71 patients underwent endoscopy before our culture QI initiative (preintervention) and 54 underwent endoscopy after our QI intervention. Sixty-four of the 125 eligible patients (51%) had a gastric biopsy sent for culture, and are the focus of this analysis.

The 64 patients who had gastric biopsy culture were 58% (n = 37) female with a mean age of 13.6 ± 5.0 years. The most common race was Caucasian (76%, n = 49), followed by Asian (19%, n = 12) and African American (6%, n = 3); 26% (n = 17) of patients were Hispanic. There were more Hispanic patients during the preintervention period compared with the after intervention period (43% versus 14%, respectively; $P = 0.01$), with all Hispanics being of Caucasian race. Otherwise, all demographic characteristics were similar across study periods and are summarized in Table 2.

There was a significant increase across study periods in the frequency of gastric biopsy acquisition for culture by the gastroenterologist, obtained in 39% (28 of 71) preintervention patients, compared with 67% (36 of 54) postintervention patients ($P = 0.004$). Twenty-eight doctors in total scoped during the entire study period. In the preintervention period, 23 physicians performed the endoscopies. In the postintervention period, 19 physicians performed the endoscopies, of which 10 were the same physicians that did endoscopy in the preintervention period. *H pylori* treatment within the 6 months before EGD (13%, 8 of 64), PPI use at the time of EGD (30%, 19 of 64), histologic findings (61%, 39 of 64), and the presence of characteristic *H pylori* endoscopic findings (58%, 37 of 64: antral nodularity, gastric erosion or ulcer, duodenal erosion or ulcer) were similar across study periods and are summarized in Table 3.

Among the 64 patients that had a gastric biopsy culture, 25 patients had *H pylori* demonstrated histology; of these, 14 (50%) demonstrated *H pylori* organisms on histology during the preintervention period and 11 (31%) demonstrated *H pylori* organisms on histology after the intervention ($P = 0.13$). Of the 25 patients that demonstrated *H pylori* on histology, only 8 had *H pylori* grow out on culture. There was an increase in the percentage of culture positivity across study periods (Fig. 3), from 21% (3 of 14) preintervention to 45% (5 of 11) postintervention, representing a 2.12-fold increase in culture positivity ($P = 0.39$; 95% confidence interval, 0.64-7.00). Disappointingly, 68%

**TABLE 1.** Specific interventions to address deficiencies on process of gastric biopsy culture

| |
|---|
| Confirm correct culture media and adequate temperature |
| Record time the culture media was taken out of the refrigerator |
| Place culture media on ice |
| Confirm adequate number of biopsies in culture media (2 biopsies) |
| Confirm adequate stomach sites were biopsied (1 biopsy from antrum and 1 biopsy from corpus) |
| Transportation of culture media with specimen to hospital laboratory |

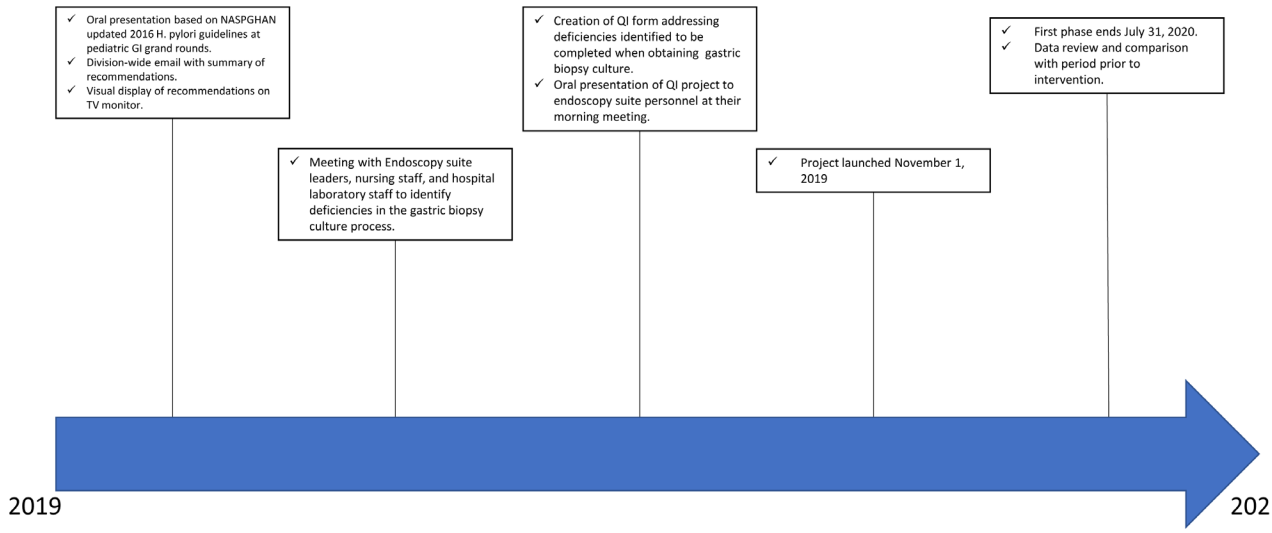


**FIGURE 2.** PDSA QI project timeline. GI = gastroenterology; NASPGHAN = North American Society For Pediatric Gastroenterology, Hepatology & Nutrition; PDSA = Plan-Do-Study-Act; QI = quality improvement.

(17 of 25) of patients with biopsies demonstrating *H pylori* organisms on pathology had negative culture. None of the 39 patients in which *H pylori* was not seen on histology had positive cultures.

Antimicrobial susceptibilities from positive cultures were available in 100% (3 of 3) of the preintervention and 80% (4 of 5) of the intervention specimens. Clarithromycin resistance was observed in 33% (1 of 3) of the preintervention specimens, whereas 50% (2 of 4) of the specimens were clarithromycin resistant during the intervention period. Overall clarithromycin resistance was 43% (3 of 7). Resistance to other antimicrobial agents including amoxicillin, metronidazole, and ciprofloxacin was not identified.

Eradication rate was 67% (14 patients, 2 not treated, 8 eradicated, 4 failures) preintervention, and 70% (11 patients, 1 missing eradication confirmation, 7 eradicated, 3 failures) postintervention. The most common regimen preintervention was clarithromycin-based triple therapy (amoxicillin, clarithromycin, PPI). The most common regimen postintervention was bismuth quadruple (bismuth, metronidazole, amoxicillin, PPI) with only 1 patient receiving rifabutin-based triple therapy (amoxicillin, rifabutin, PPI). All the regimens were prescribed for 14 days. Patients with proven successful eradication preintervention (7 of 14) experienced resolution of initial symptoms with only 1 patient with mild intermittent symptoms after eradication. Similarly, all patients with proven eradication postintervention experienced substantial clinical improvement or resolution of symptoms (7 of 11).

## DISCUSSION

Our study demonstrates that educational interventions (including endoscopy nursing staff training, laboratory staff training, and physician education) to raise awareness of the importance of sending gastric biopsy culture in patients with suspected *H pylori* infection, significantly improved the frequency of cultures sent by pediatric gastroenterologists at our center. In addition, improvement of specimen handling procedures by our endoscopy personnel and hospital laboratory contributed to an increase in our rate of culture positivity.

**TABLE 2.** Patient characteristics overall and by study period*

| | Total (n = 64) | Preintervention (n = 28) | Postintervention (n = 36) | *P*† |
|---|---|---|---|---|
| Male sex | 27 (42%) | 13 (46%) | 14 (39%) | 0.61 |
| Age at procedure (y), mean ± SD | 13.6 ± 5.0 | 13.1 ± 5.1 | 14.0 ± 4.9 | 0.50 |
| 1–3 | 1 (2%) | 1 (4%) | 0 (0%) | |
| 3–6 | 8 (12%) | 3 (11%) | 5 (14%) | |
| 7–11 | 12 (19%) | 6 (21%) | 6 (17%) | |
| 12–17 | 32 (50%) | 14 (50%) | 18 (50%) | |
| 18–22 | 11 (17%) | 4 (14%) | 7 (19%) | |
| Race | | | | 1.00 |
| Caucasian | 49 (77%) | 22 (78%) | 27 (75%) | |
| Black or African American | 3 (5%) | 1 (4%) | 2 (6%) | |
| Asian | 12 (19%) | 5 (18%) | 7 (19%) | |
| Hispanic or Latino | 17 (27%) | 12 (43%) | 5 (14%) | 0.01 |

SD = standard deviation.
*Preintervention (February 1, 2019 to October 31, 2019); postintervention (November 1, 2019 to July 31, 2020).
†*P* value from Student's *t* test or Fisher exact test.

**TABLE 3.** Treatment and findings before and at the time of upper endoscopic procedure (EGD), overall and by study period*

| | Total (n = 64) (%) | Preintervention (n = 28) (%) | Postintervention (n = 36) (%) | *P*† |
|---|---|---|---|---|
| *Helicobacter pylori* treatment before EGD | 8 (13) | 3 (11) | 5 (14) | 1.00 |
| PPI use at the time of EGD | 19 (30) | 9 (32) | 10 (28) | 0.79 |
| Histologic findings‡ | 39 (61) | 19 (68) | 20 (56) | 0.44 |
| Endoscopic findings§ | 37 (58) | 15 (54) | 22 (61) | 0.61 |

EGD = gastrointestinal endoscopy.
*Preintervention (February 1, 2019 to October 31, 2019); postintervention (November 1, 2019 to July 31, 2020).
†*P* value from Student's *t* test or Fisher exact test.
‡Chronic gastritis (active or inactive); chronic duodenitis.
§Nodularity antrum or duodenum; antral or duodenal erosions; gastric or duodenal ulcers.

The topic of our study is of utmost importance in light of the alarming decrease in eradication rates of first line therapies, which are largely attributed to clarithromycin antibiotic resistance. The 2016 pediatric guidelines for Europe and North America have been instrumental in emphasizing the importance of gastric biopsy culture not only as a diagnostic tool for active infection, but most importantly to obtain antimicrobial susceptibilities to optimize treatment regimens (15). The guidelines represent an excellent review of available pediatric data and provide recommendations that guide the clinician's management, the reason why we used them as the basis of the educational efforts for our QI project. Unfortunately, lack of awareness is one of the main drivers of physician nonadherence to guidelines in general. Our study showed that with appropriately directed education, we can change clinician attitudes and in turn quality of care can be improved.

The implementation of routine use of gastric biopsy culture has been challenging. General reasons include that it requires invasive diagnostic upper endoscopic procedure, potential complications associated with anesthesia and/or endoscopy, and greater healthcare costs (23). Our study interventions addressed deficiencies in specimen handling (number of biopsies, gastric biopsy sites, appropriate media culture, adequate temperature, and transportation times) by education of endoscopy suite personnel and by the completion of a check list QI form with each culture. Similar challenges of the culture process have been reported in cohorts of adult patients with previous treatment failure in large tertiary care institutions (24, 25). However data are limited in the United States because culture use is uncommon in clinical practice (26). Current available data comes from research settings. For example, a recent multicenter clinical trial comparing antibiotic regimens in refractory *H pylori* infection had a culture positivity rate above 90% (27). In addition, the culture positivity rate varies greatly among laboratories. Adult guidelines continue to evolve their recommendations in light of the increasing *H pylori* antibiotic resistance rates and decreased effectiveness of first-line therapies worldwide (28). Recent 2021 American Gastroenterological Association guidelines on treatment of refractory *H pylori* infection are now formally recommending obtaining antibiotic susceptibilities via different methods including gastric biopsy culture, after 2 failed therapies with confirmed patient adherence (26). We expect more information to be available as these guidelines are implemented in clinical practice.

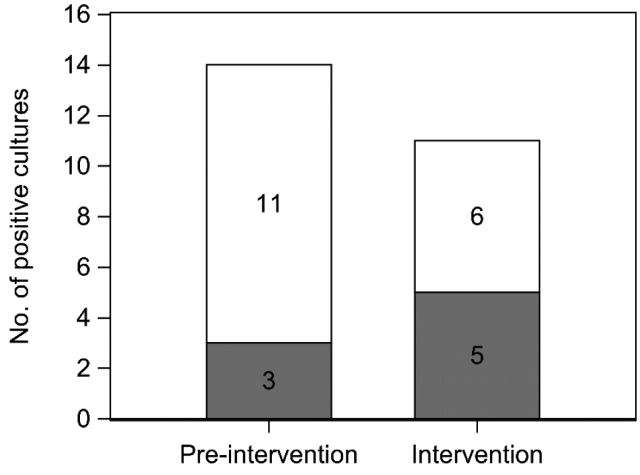


**FIGURE 3.** Rate of culture positivity (defined as positive culture growth in a patient with a gastric biopsy that demonstrated *Helicobacter pylori* organisms on pathology). The number of positive cultures identified by the off-site lab was 3 of 14 (21%) preintervention and 5 of 11 (45%) during the intervention. This represents a 2.12-fold increase over the preintervention rate (*P* = 0.39; 95% confidence interval, 0.64-7.00).

We observed an improvement in our culture positivity from 21% to 45.5% though this difference did not achieve statistical significance. Despite this improvement, our culture positivity remains lower than the accepted standard of 90%. Multiple factors influence successful isolation and cultivation of *H pylori*. We do not know precisely which if any of the steps addressed by our intervention contributed to the low culture positivity, or if the lack of growth in 68% (17 of 25) of patients with biopsies demonstrating *H pylori* organisms on pathology occurred because of the processes at the off-site laboratories. Since our QI process addressed the factors pertaining to the handling of the specimens by our endoscopy personnel and laboratory, we speculate handling of specimen by off-site laboratories may be largely contributing to the lack of culture growth. It is well known that *H pylori* does not survive transport well (29). Exposure to PPI and antibiotics are also recognized factors influencing culture growth, though only a small number of patients in our cohort with positive histology and negative culture were exposed to either or both when undergoing culture. It is also possible that the low culture positivity reflects the fastidiousness of the organism to grow under real world conditions.

We observed an overall high clarithromycin resistance rate of 43% (33% preintervention versus 50% postintervention period) which is concerning. The United States pooled prevalence of *H pylori* antibiotic resistance for clarithromycin, metronidazole, and levofloxacin has been reported as 22%, 20%, and 37%, respectively (28), making the resistance rate in our population one of the highest reported in the US pediatric population. This may be explained in part by the complex population seen at our tertiary care center, most of which have a history of previous exposure to multiple antibiotics. Previous exposure to macrolides commonly prescribed for

respiratory tract infections is an essential risk factor for clarithromycin resistance. *H pylori* antibiotic resistance is one of the highest contributors to treatment failures, driving an increase in the overall resistance prevalence in many populations and thereby a greater burden of infection and associated disease. Clarithromycin resistance has been recognized as the main culprit of first-line treatment failure and it was the focus of the updated NASPGHAN-ESPGHAN guidelines (15, 30). Knowledge of antibiotic susceptibilities is key for antibiotic stewardship in the midst of rising antibiotic resistance. Furthermore, it provides us with the necessary information to offer appropriate treatment with the ultimate goal to improve eradication rates thus improving clinical outcomes (31). All patients with proven eradication pre and postintervention experienced substantial clinical improvement or resolution of symptoms. Interestingly, our eradication rate did not change drastically after our intervention (67% pre and 70% post). We hypothesize the main reason why we did not appreciate a larger improvement in eradication rate was the small sample size. Poor eradication preintervention is likely due to the use of clarithromycin-based triple therapy on a population with high clarithromycin resistance. An important factor on the patients with failure of eradication postintervention was poor adherence to treatment regimen, which next to antibiotic resistance, is a well-recognized factor for failure of eradication. We speculate that the increased number of drugs in bismuth quadruple therapy, which was the most common treatment in the postintervention period, may have contributed to the decreased adherence. Pediatric societal guidelines have emphasized this point urging clinicians to explain to the family the importance of adherence to the therapy, and when possible provide leaflets with detailed instructions to enhance successful eradication.

Limitations of our study include the variability of clinical approaches within our large practice, the unique tertiary care center population, and the relatively low number of cases that may affect the generalizability of our results. Exposure to PPI in a subset of patients may have affected culture growth. In addition, we were unable to control for the factors deriving from the handling of the specimen by offsite laboratories, which may have largely contributed to the decrease yield of positive cultures. This factor was one of the main reasons why we initiated our QI project. The results of this QI project have been instrumental for our division to make our case to our hospital laboratory.

In conclusion, educational initiatives and collaborative work with staff physicians, endoscopy personnel, and hospital laboratory appear to be effective tools to increase usage of gastric biopsy culture as a diagnostic tool for *H pylori* infection and to increase culture positivity. Future efforts should be directed to working with off-site specialty laboratories to identify areas of potential improvement, consolidation of testing to a single laboratory with capabilities to perform both culture and antibiotic sensitivity, or ideally to develop the capability to do the test in house. Improving the process of gastric biopsy culture will increase the availability of antibiotic susceptibility data, which has been highly advocated by expert guidelines. Most importantly, it will lead to the selection of the most effective primary treatment for children and adolescents with *H pylori* infection. Due to their simplicity (can be done in stool or fixed specimens), timely availability and high sensitivity and specificity, molecular methods represent a viable option for obtaining antibiotic susceptibilities when faced with low culture positivity.

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