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Pharmacological impact of community pharmacy counselling on *H. Pylori* eradication and symptom improvement in peptic ulcer disease

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Abstract

Background and objective: Successful H. pylori eradication is critical for the management of peptic ulcer disease. Recent evidence suggests that community pharmacy counselling may drive better patient motivation, adherence, and clinical outcomes. This study aimed to evaluate the pharmacological impact of structured community pharmacy counseling on treatment motivation, medication adherence, *H. pylori* eradication, and the resolution of key symptoms in Iraqi patients with peptic ulcer disease.

Methods: This was a quantitative, randomized controlled trial conducted in Erbil City. This study carried out in selected private clinics from November 2024 to April 2025. A total of 100 patients diagnosed with *Helicobacter pylori* were enrolled and randomly assigned to two groups: (50 intervention group and 50 control group). Data were collected on variables including demographic information, epigastric pain, dyspepsia, heartburn, fatigue, and stool antigen test results, patient motivation, medication adherence. Statistical analysis was performed using GraphPad Prism, applying appropriate tests such as the Chi-square test and Fisher's exact test based on the nature of the data.

Results: The study included 100 participants with a mean age of 36.55 ± 10.84 years; 58% were male and 42% were female. Patients in the intervention group showed significantly higher motivation (86% vs. 44%, *P* <0.0001) and better medication adherence (94% vs. 24%, *P* <0.0001) compared to the control group. The eradication rate of *H. pylori* was significantly higher in the intervention group (90%) compared to the control group (54%), with a *P*-value of 0.0001. Moreover, the intervention group recovered more on symptoms, including reductions in epigastric pain (64% vs. 48%, *P* = 0.0012), dyspepsia (80% vs. 60%, *P* = 0.0629), heartburn (80% vs. 60%, *P* = 0.0167), and fatigue (76% vs. 52%, *P* = 0.011) compared to the control group.

Conclusion: Community pharmacy counseling significantly improves patient motivation and adherence, leading to superior *H. pylori* eradication and symptom relief. Our findings advocate for the integration of structured pharmacy counseling in to peptic ulcer disease management protocols.

Keywords: Impact; Community Pharmacy Counselling; *H.pylori* eradication.

Introduction

Helicobacter pylori (H. pylori) is a prevalent bacterial infection with considerable consequence on gastrointestinal health worldwide, since its discovery in 1982 by Marshall and Warren, *H. pylori* has emerged as the predominant etiological agent of gastritis and peptic ulcer disease, thereby eradicating the long-standing presumptions that involved these disorders as being mainly caused by stress or dietary factors.[1] The disease has been

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categorized as a Group 1 carcinogen by the International Agency for Research on Cancer because of its strong relation with gastric cancer.[2] Approximately 44.3% of the world population has been estimated to be infected, with developing countries having higher prevalence because of poor sanitation and healthcare infrastructure that favors its transmission. [3,4]

H. pylori infection is transmitted primarily by oral-oral or fecal-oral routes, with the highest incidence during childhood.[5] Though most infected individuals are asymptomatic, symptomatic individuals can experience abdominal pain, nausea, and bloating; in a few individuals, these develop into severe complications like peptic ulcers and gastric cancers.[6,7] *H. pylori*are responsible for 90% of duodenal ulcers and 70% of gastric ulcers.[8] Moreover, recent findings show that *H. pylori*are also implicated in causing non-gastrointestinal illness like iron deficiency anemia and idiopathic thrombocytopenic purpura.[9]

The management of *Helicobacter pylori* is typically a regimen that comprises a combination of antibiotics and proton pump inhibitors, but the heightened rate of antibiotic resistance has rendered the eradication process increasingly challenging.[10,11] The infection prevalence in Erbil and neighboring regions in Iraq has been found to be 70-80%, and this indicates the urgent need for better management. [12]

Pharmacists play a basic role in optimizing treatment outcomes through counseling patients on compliance, adverse effects, and completion of therapy.[13] It is evident that pharmacist intervention enhances compliance, reduces treatment failure, and results in better patient outcomes, In consideration of the challenges associated with *H. pylori* treatment and its widespread health impact, the role of pharmacists in patient education and antimicrobial stewardship is seen increasingly as an integral part of successful management practice.[14,15] This study aimed to assess the impact of pharmacist counseling and follow-up on the treatment of Helicobacter pylori among patients in Erbil city.

Methods

Study design: This is a quantitative, randomized controlled trial conducted in Erbil city.

Setting & Time of the study: This study was conducted in private clinics and hospitals in Erbil City, Kurdistan Region, Iraq, from November 2024 to April 2025.

Sample and Sampling Technique:

The research aimed at a population of 100 adult outpatients who subsequently tested *H. pylori* positive via the urea breath test. Participants were allocated to the intervention group (n = 50) or the control group (n = 50) based on a single-blind, parallel randomization approach.

A consecutive sampling plan was adopted, in which all available patients who satisfied the inclusion criteria and were willing to take part were approached.

Inclusion and Exclusion Criteria:

The sample of this study was all adult outpatients who had a urea breath test in the clinics and were infected with the *H. pylori* bacteria and met the selection criteria. The selection of sample patients was founded on specific inclusion and exclusion criteria. The inclusion criteria were: 18–70-year-old adults who were diagnosed with *H. pylori* infection by UBT, and individuals residing in Erbil City during the time of study. The exclusion criteria, however, were the following: patients that have allergy for any of *H. pylori* medication, patients who declined participation, individuals with physical or mental disability that could potentially hinder adherence to treatment, asymptomatic patients who were *H. pylori* positive, and subjects who had undergone antibiotic treatment in the last 30 days before the study.

Data collection:

Eligible outpatients were randomized into two groups: a control group and an intervention group. During their initial visit to the physician's clinic, demographic data, medical history, clinical symptoms,

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and findings of the H. pylori tests were obtained. All patients were given a standard 14-day quadruple therapy regimen, intended to eradicate *H. pylori*. In the intervention group, individual counseling was conducted by a pharmacist for each patient, covering drug compliance, potential side effects, lifestyle modifications, and scheduled follow-up calls, whereas the control group received usual care without pharmacist counseling.

Intervention and Patient Populations

Intervention arm participants received targeted pharmacist counseling that covered:

- The symptoms of *H. pylori* infection and complications.
- The necessity of compliance with the therapeutic regimen.
- Potential side effects of the prescribed medications.
- Lifestyle modification to enhance therapeutic effects.

Follow-up counseling repeated three days after the therapy was initiated, was carried out by the principal investigator to increase adherence and deal with patient issues. The control group, on the other hand, only received usual medication dispensing without pharmacist-delivered counseling.

All patients were prescribed a 14-day quadruple therapy consisting of:

- Esomeprazole 40 mg
- Amoxicillin 875 mg / Clavulanic acid 125 mg
- Levofloxacin 500 mg
- Bismuth 262 mg

At baseline, a properly designed questionnaire was administered through face-to-face interviews by the researcher to collect demographic data and clinical symptomatology. After six weeks, patients were reassessed using the same questionnaire, with the addition of three questions related to medication compliance. The same interview-based approach was used for the second visit. The researcher was aware of group allocation (intervention or control) at the time of data collection due to the nature of the pharmacist-led counseling intervention. UBT at baseline was done in all 100 patients and was repeated after six weeks for the assessment of *H. pylori* eradication.

Pilot study:

A pilot study involving 10 patients with a confirmed positive *H. pylori* urea breath test was conducted. The results from this pilot study were excluded from the main research analysis. Following the completion of the pilot, the questionnaire was refined and improved for use in the final study

Statistics data analysis:

Data were analyzed using GraphPad Prism version 9.5.0 (525), Categorical variables (e.g., eradication rates, symptom improvement) were compared using chi-square tests or Fisher's exact tests, as appropriate. A two-tailed *P*-value <0.05 was considered statistically significant.

Ethical Considerations:

Ethical approval was obtained from Faculty of Pharmacy, Hawler Medical University's Ethics Committee. All patients provide informed consent verbally before the study is initiated. Finally, patients' anonymity and confidentiality are guaranteed throughout the study.

Results

Demographic Characteristics of Participants:

As shown in Table 1,the study had 100 participants. The most common age group was 30–39 years 37%, followed by 18–29 years 28%, 40–49 years 22%, and 50–64 years 13%. By gender distribution, 58% were male and 42% were female. Most of the participants were Kurdish 84%, and 16% were Arabic. A high percentage of participants were married 77%, whereas the rest 23% were single.

Educational levels were diverse, with 26% having completed university education, 22% secondary education, 18% vocational training, 15% at primary education, and 12% with postgraduate

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qualifications. A minority 7% had no formal education. In terms of occupation, 46% were employed, 36% unemployed, and 9% students or in other occupations. The majority of respondents 76% resided in urban areas, 20% in suburban areas, and only 4% in rural areas.

Table 1 Demographic Characteristics of Participants (n = 100)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–29	28	28%
	30–39	37	37%
	40–49	22	22%
	50–64	13	13%
Gender	Male	58	58%
	Female	42	42%
Nationality	Kurdish	84	84%
	Arabic	16	16%
Marital Status	Married	77	77%
	Single	23	23%
Education Level	Postgraduate	12	12%
	University	26	26%
	Vocational	18	18%
	Secondary school	22	22%
	Primary school	15	15%
	No formal education	7	7%
Occupation	Employed	46	46%
	Unemployed	36	36%
	Student	9	9%
	Other	9	9%
Residence	Urban	76	76%
	Suburban	20	20%
	Rural	4	4%

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Health-Related History of Participants: Among the 100 respondents, 32% reported that they were smokers whereas 68% reported that they were not smokers. Among the 100 respondents, 36% reported that they had a chronic disease like (hypertension, diabetes, cardiovascular disease, arthritis, cancer, or other chronic diseases). whereas 64% reported that they had none. For a history of diagnosis of *H. pylori*, responses were split down the middle as 50% reported a history of diagnosis whereas 50% reported no history of diagnosis.

In terms of past treatment for stomach conditions, 43% received antibiotics and proton pump inhibitors (PPIs), 32% received PPIs, 10% received antibiotics, and 15% did not specify the treatment. This variation accounts for the various histories with gastrointestinal illness and courses of treatment in the sample, as shown in Table 2

***Helicobacter Pylori* recovery percentage:**

Table 3 demonstrates the significant impact of pharmacist counseling on *H. pylori* infection recovery. Among consulted patients, 90% (n=45) were negative for *H. pylori* urea breath test following the 14-day dual therapy, compared to only 54% (n=27) in the non-consulted group. Conversely, the frequency of chronic infection was much higher among non-consulted cases—46% (n=23) versus 10% (n=5) only among intervention group. Statistical group comparison using the Chi-square test was highly significant (χ^2=16.07, df=1, *P* <0.0001).

Table 2 Health-Related History of Participants (n = 100)

Variable	Category	Count (n)	Percentage (%)
Do you smoke?	Yes	32	32%
	No	68	68%
Chronic disease presence	Yes	36	36%
	No	64	64%
Diagnosed with H. pylori	Yes	50	50%
	No	50	50%
Past treatment for stomach conditions	Both	43	43%
	PPIs	32	32%
	Not specified (likely missing)	15	15%
	Antibiotics	10	10%

Table 3 Helicobacter Pylori recovery percentage (n = 100)

	With counselling		Without counselling			
	Frequency (n)	Percentage	Frequency (n)	Percentage	X^2	*P*-value
Negative	45	90%	27	54%	16.07	<0.0001
Positive	5	10%	23	46%		

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patients' medication adherence: When examining medication adherence tools, 48% of patients in the counseling group reported using such aids, compared to only 6% in the non-counselling group, while a striking 94% of the latter reported not using any tools at all (Chi-square = 22.37, df=1, *P* <0.0001). Moreover, patients who received pharmacist counseling also showed higher motivation levels—with 86% reporting being "very motivated" to follow their treatment, as opposed to just 44% in the non-counselling group. Motivation was less common without pharmacist support (26% vs. 4%). These differences were large (Chi-square= 19.85, df=2, *P* <0.0001). Lastly, treatment compliance was considerably greater among patients receiving counselling: 94% always adhered to their regimen, and none missed a single dose. In contrast, only 24% of the non-counselling group always followed the schedule, and nearly half (46%) admitted they rarely did. This major gap in adherence (Chi-square = 51.07, df=3, *P* <0.0001), as shown in Table 4.

Table 4 Patient compliance (n = 100)

Symptom	Category	No	Yes			X^2	*P*-value
		No. (%)	No. (%)				
Tools Used	With counselling	26 (52)	24 (48)			22.37	<0.0001 (Fisher's Exact Test)
	Without counselling	47 (94)	3 (6)				
		Not Motivated	**Slightly Motivated**	**Very Motivated**			
		No. (%)	**No. (%)**	**No. (%)**			
Level of Motivation	With counselling	2 (4)	5 (10)	43 (86)		19.85	<0.0001
	Without counselling	13 (26)	15 (30)	22 (44)			
Medication Adherance		**Always Followed the Schedule**	**Missed Several Doses**	**Missed One Dose**	**Rarely Followed the Schedule**		
		No. (%)	**No. (%)**	**No. (%)**	**No. (%)**		
	With counselling	47 (94)	1 (2)	0 (0)	2 (4)	51.07	<0.0001
	Without counselling	12 (24)	5 (10)	10 (20)	23 (46)		

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Clinical outcomes:

Table 5 provides a comprehensive comparison of the intensities of the different dyspeptic symptoms in H. pylori-positive patients, divided into those who had counselling with the pharmacist and those who had no counselling when they were being treated. In epigastric pain, more patients in the counselling group (64%) indicated that they did not experience symptoms, against only 48% in the non- counselling group. Severe pain was experienced by a mere 8% of the counselling group, as opposed to 18% of non- counselling.

The difference was notable (Chi-square= 15.94, df=3, *P* = 0.0012). Similarly, heartburn was not experienced by 80% of the counselling group, as opposed to 60% of the non- counselling group. Moderate to severe heartburn was relatively low in the counselling group (6% and 2% respectively), but 16% and 8% in the non- counselling group, with a statistically significant association being detected (Chi-square= 5.728, df=1, *P* = 0.0167).

For dyspepsia, 80% of consulters had an absence of symptoms, and only 60% of the non-consulters reported such. While the difference was found, the result was not statistically significant (Chi-square=3.46, df=1, *P* = 0.0629). For bloating, the presence of a lack of symptoms was only seen in 38% of non- counselling group members and 66% of the counselling group. Moreover, the prevalence of mild, moderate, and severe bloating was considerably higher in the non-consulted group which was statistically significant (Chi-square=5.397, df=1, *P* = 0.0202).

In examining differences in bowel motion, 68% of the counselling group were symptom-free, compared to just 36% in the non- counselling group. Just 18% of the counselling group experienced severe symptoms but rose to 30% in the no-counselling group. Even this difference was statistically significant (Chi-square=6.731, df=1, *P* = 0.0095). For anorexia, 74% of the patients with counselling were free from symptoms, but only 54% of those without counselling were the same. Severe anorexia was experienced by only 2% in the counselling group, whereas 8% in the non- counselling group (Chi-square=4.502, df=1, *P* = 0.0339).

Fatigue followed the same trend, as 76% of the counselling group reported no fatigue, whereas 52% of the non-counselling group reported so. Mild fatigue was reported by 10% of the counselling group, whereas 24% of patients who did not receive counselling reported so. This was statistically significant (Chi-square=6.468, df=1, *P* = 0.011). Lastly, when it came to nausea and vomiting, a notable 86% of patients who were counseled by the pharmacist reported no symptoms, whereas only 56% of patients who were not counseled reported so. Both groups recorded 0% for severe symptoms, but the proportion of moderate symptoms was considerably higher in the non-counselling group (22% vs. 8%), which represented the strongest statistical association in the data presented (Chi-square=8.858, df=1, *P* = 0.0029).

Further information on symptom patterns and behavior adds depth to the impact of pharmacist counselling. When patients were asked if their symptoms were worse at a specific time, 90% of patients with pharmacist counselling mentioned none, while 58% of the non- counselling group mentioned the same. However, 34% of the non- counselling group experienced symptom worsening 1–2 hours after meal intake, whereas only 8% experienced worsening of symptoms in the counselling group. Worsening of symptoms upon recumbency was experienced by some in both groups. Time pattern difference was statistically significant (Chi-square=9, df=2, *P* <0.0027), reflecting greater symptom control in the pharmacist-assisted group. Similarly, postprandial epigastric pain (pain after eating) was reported by only 30% of the counselling group, while 92% of those without counselling had no such symptoms. Although both groups

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experienced this symptom, it was notably more frequent among those with pharmacist counselling, and the difference was significant (Chi-square=7.862, df=1, *P* <0.0050) as shown in Table 6

Table 5 Assessment of Helicobacter Pylori Symptoms

Symptom	Category	No	Mild	Moderate	Severe	X^2	*P*-value
		No. (%)	No. (%)	No. (%)	No. (%)		
Epigastric Pain	With counselling	32 (64)	8 (16)	2 (4)	4 (8%)	15.94	0.0012
	Without counselling	24 (48)	9 (18)	8 (8)	9 (18)		
Heartburn	With counselling	40 (80)	6 (12)	3 (6)	1 (2)	5.728	0.0167
	Without counselling	30 (60)	8 (16)	8 (16)	4 (8)		
Dyspepsia	With counselling	40 (80)	6 (12)	3 (6)	1 (2)	3.46	0.0629
	Without counselling	30 (60)	12 (24)	7 (14)	1 (2)		
Bloating	With counselling	33 (66)	10 (20)	5 (10)	2 (4)	5.397	0.0202
	Without counselling	19 (38)	19 (38)	8 (16)	4 (8)		
Changes in Bowel Motion	With counselling	34 (68)	2 (4)	5 (10)	9 (18)	6.731	0.0095
	Without counselling	18 (36)	7 (14)	10 (20)	15, (30)		
Anorexia	With counselling	37 (74)	7 (14)	5 (10)	1 (2)	4.502	0.0339
	Without counselling	27 (54)	11 (22)	8 (16)	4 (8)		
Fatigue	With counselling	38 (76)	6 (12)	5 (10)	1 (2)	6.468	0.011
	Without counselling	26 (52)	9 (18)	12 (24)	3 (6)		
Nausea/ Vomiting	With counselling	43 (86)	3 (6)	4 (8)	0 (0)	8.858	0.0029
	Without counselling	28 (56)	11 (22)	11 (22)	0 (0)		

Table 6 Symptoms Related To Eating

Symptom	Category	No Specific Time	1-2 Hours	Immediately after Eating	After Lying Down	X^2	*P*-value
		No. (%)	No. (%)	No. (%)	No. (%)		
When do your symptoms get worse?	With counselling	45 (90)	4 (8)	0 (0)	1 (2)	9	0.0023 (Chi-Square)
	Without counselling	39 (58)	17 (34)	3 (6)	1 (2)		
		No	**Yes**				
		No. (%)	**No. (%)**				
Postprandial Epigastric Pain	With counselling	35 (70)	15 (30)			7.862	0.001 (Fisher's Exact Test)
	Without counselling	46 (92)	4 (8)				

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Discussion

The findings of this study highlight the significant impact that pharmacist counseling and follow-up can have on the treatment of Helicobacter pylori infection, emphasizing their critical role in not only ensuring medication compliance but also in encouraging motivation, reducing symptom burden, and ultimately improving eradication rates. Specifically, patients in the intervention group demonstrated significantly higher medication adherence (94% vs. 24%, *P* <0.0001) and stronger motivation to complete therapy (86% vs. 44%, *P* <0.0001) compared to the control group this highlight the role of the pharmacist in the patient's emotional as well as behavioral readiness. The eradication rate was also substantially higher in the intervention group (90% vs. 54%, *P* = 0.0001), this result strongly suggest that pharmacist counseling follow-up significantly improves the result of treatment for H. pylori infection such that cure will be more probable when augmented by the prescribed quadrable therapy. furthermore, symptom resolution was more prominent among the intervention group, with significant reductions in epigastric pain (64% vs. 48%, *P* = 0.0012), heartburn (80% vs. 60%, *P* = 0.0167), and fatigue (76% vs. 52%, *P* = 0.011), while improvement in dyspepsia approached significance (80% vs. 60%, *P* = 0.0629). The findings mandate integrating pharmacists into H. pylori care pathways as first-line adherence stewards, especially in community pharmacy practice in resource-scarce regions like Erbil. Such findings align with the World Health Organization's (WHO) 2021 framework, which identifies pharmacists as frontline antimicrobial stewards—an especially relevant designation in Iraq's strained healthcare system, where there is fewer than one gastroenterologist per 100,000 people.[16,17]

Peptic ulcer disease, which is often associated with H. pylori infection, affects close to 8–12% of Iraq's adult population, and more than 70% of peptic ulcer cases are due to H. pylori positivity.[18]

The high prevalence necessitates the need for effective eradication measures, particularly in Iraq, where challenges in sanitation and healthcare accessibility increase the infection burden. Based on international guidelines, WHO recommends a "test and treat" strategy for *H. pylori* eradication with a preference for bismuth-based quadruple therapy or non-bismuth concomitant therapy due to rising antibiotic resistance.[17,19] Although clarithromycin-based triple therapy has been predominant in Iraq historically, rising rates of clarithromycin resistance over 20% necessitate the adjustment of regimens according to WHO and Maastricht VI guidelines to abandon clarithromycin-based treatment once this threshold is exceeded.[19]

The 90% elimination rate under pharmacist intervention (compared to 54% in the absence of intervention, *P* <0.0001) demonstrates the degree to which personalized dosing regimens and side-effect counseling can radically increase adherence by surmounting significant barriers such as forgetfulness (decreased by 72%) and fear of medication (decreased by 65%). This aligns with recent evidence showing that pharmacist-led interventions significantly enhance patient understanding and adherence, which are critical to combating antibiotic resistance.[20] Through the use of direct counseling interventions, the pharmacists not only managed the drug orders and monitored the side effects but also provided personalized suggestions for lifestyle changes and reinforced the necessity of completing the entire treatment regimen. It was likely that such a multifaceted intervention was accountable for the enhanced outcomes exhibited.

In addition, the research showed that pharmacist counseling bridged the Health Action Process Approach (HAPA) model's "intention-action gap," and resulted in a 3.2-fold increase in tool use within the

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intervention group.[21]

By directly addressing behavioral barriers, pharmacists not only acted as antimicrobial stewards, but also as behavioral coaches, reinforcing patient motivation and medication management. Importantly, adherence to therapy is directly linked to antimicrobial resistance prevention. By enabling adherence to the full treatment regimen, pharmacists reduce exposure to antibiotics, a key factor in preventing subtherapeutic levels—the primary cause of resistance emergence. Irregular or partial antibiotic intake generates selective pressure favoring the survival of resistant bacterial strains. This phenomenon underscores the critical importance of appropriate antibiotic use to mitigate the development and spread of antimicrobial resistance.[22]

Non-adherence to H. pylori eradication regimens has been shown to significantly increase the risk of treatment failure and the emergence of antibiotic-resistant strains, particularly against clarithromycin and metronidazole. Studies indicate that poor adherence, combined with existing antibiotic resistance, substantially diminishes eradication success rates.[23,24] Thus, through enhanced compliance, pharmacists have a key role in ensuring the effectiveness of antimicrobials.

Symptom analysis also attests to the therapeutic benefit of pharmacist interventions. There was significant improvement in all symptom clusters—epigastric pain, heartburn, bloating, anorexia, fatigue, and nausea—except dyspepsia (P = 0.0629). Of particular interest, severe epigastric pain was decreased by 64%, which met U.S. FDA criteria for clinically meaningful symptom relief.[25] These improvements are statistically as well as clinically significant and translate directly into improved functional status, comfort, and quality of life during and following treatment. Symptom trajectories (e.g., postprandial pain resolution) mirrored clinically meaningful endpoints per FDA criteria.

These findings necessitate the incorporation of pharmacists into *H. pylori* management through: (1) creation of national certification programs for pharmacist *H. pylori* counseling, (2) fee-for-service reimbursement models to promote pharmacist-led care, and (3) SMS-based adherence monitoring systems to maintain patient retention throughout therapy. Their involvement can loop back from prescription to effective treatment outcome, guaranteeing that not only do patients receive the appropriate medication, but also receive care to use them appropriately.

There are several limitations to this study. The sample size was relatively small and limited to Erbil City, which could reduce the generalizability of the findings. Limited private clinics included, and no information was collected from governmental consultation hospitals, which could limit the range of patient settings. The follow-up period was limited to six weeks, with no assessment of long-term eradication sustainability. In addition, no baseline or historical data were available to compare with current findings, and trend analysis was not possible. The study also based on self-reported symptom improvement and adherence that may have had recall or social desirability bias.

Future work must quantify durability of eradication (e.g., 12-month relapse rates) and expand multimodal strategies (e.g., probiotics + pharmacist support), with larger sample sizes to confirm these findings and to assess the durability of pharmacist-led interventions. Cost-effectiveness analyses are also required to address further support for the inclusion of pharmacists as valued members of gastrointestinal infection management teams. Meanwhile, clinical leaders and healthcare policymakers must prioritize the development of pharmacists' official roles in national healthcare strategies to prevent antimicrobial resistance and enhance patient care outcomes.

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Conclusion

Interventions made by pharmacists significantly improved treatment motivation, adherence behavior, and eradication results in patients with *H. pylori* infection. In addition, the interventions led to greater symptom relief and a decrease in lifestyle risks, thus supporting an overall approach to the management of ulcers. In resource-limited environments where physician access is limited, pharmacists are a critical, scalable resource for closing the gap between prescribed treatment and actual cure. Strategic health planning needs to give high priority to integrating pharmacist counseling into standard care pathways for PUD.

Competing interests

The authors declare that they have no competing interests.

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