

Improvement in the implementation of *Helicobacter pylori* management guidelines among primary care physicians following a targeted educational intervention

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Abstract

Background Consensus guidelines recommend that in regions with a high rate of clarithromycin resistance, *Helicobacter pylori* (*H. pylori*) infection be treated with 4 drugs. Compliance with this recommendation among primary care physicians (PCPs) is low. We aimed to examine whether PCP compliance with *H. pylori* treatment recommendations increased following a targeted educational intervention.

Methods A questionnaire assessing *H. pylori* treatment was sent to >2000 PCPs in June 2015 and June 2018. In the interim, 3 interventions were performed: distribution of printed materials, educational outreach visits, and education over a social media platform.

Results A total of 635 PCPs returned questionnaires, including 314 in 2015 and 321 in 2018 (148 [46.3%] male, age 44.7±10.9 years). The number of PCPs who recommended a 4-drug treatment protocol increased from 12 (3.8%) in 2015 to 119 (37.1%) in 2018 (P<0.001). The number of PCPs who recommended bismuth- or levofloxacin-based therapy for second-line treatment increased from 95 (30.3%) in 2015 to 247 (77.1%) in 2018 (P<0.001). Independent predictors for a 4-drug treatment protocol included central clinic location (odds ratio [OR] 2.78, 95% confidence interval [CI] 1.38-5.60; P<0.003), exposure to printed educational materials (OR 1.64, 95%CI 0.99-2.72; P=0.04) and exposure to the social media platform (OR 6.60, 95%CI 3.08-14.13; P<0.001). There were no independent predictors of compliance with second-line treatment.

Conclusions PCP compliance with *H. pylori* guidelines remains suboptimal. Educational initiatives may be effective in increasing PCPs' knowledge and compliance with guidelines. Direct web-based interaction between PCPs and gastroenterologists may be particularly effective.

Keywords *Helicobacter pylori*, treatment, guidelines, primary care physician, social media

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Introduction

Helicobacter pylori (*H. pylori*) infection has a direct impact on public health due to its role in the development of chronic gastritis, peptic ulcer disease (PUD) and gastric cancer. Eradication of the organism may improve the outcomes of these diseases [1]. The optimal regimen for treating *H. pylori* infection varies according to geographic region, since the choice of antibiotics must be tailored according to local resistance data. Failure to account for regional differences in *H. pylori* antibiotic resistance may significantly reduce the efficacy of *H. pylori* eradication regimens [2]. Therefore, ineffective eradication regimens not only fail to reduce the burden of *H. pylori* infection and associated pathologies, but also introduce secondary public health concerns, such as selection of antibiotic-

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resistant *H. pylori* strains, increased morbidity related to repeated antibiotic exposure, and increased costs. Current guidelines, including the Maastricht V/Florence Consensus Report, the American College of Gastroenterology Clinical Guideline and the Toronto Consensus, recommend adding a nitroimidazole drug to traditional clarithromycin (CLA)-based triple therapy (TT) for *H. pylori* eradication among treatment-naïve subjects, in regions with a high rate of CLA resistance [2-4]. Nevertheless, the implementation of this recommendation is suboptimal. In a study performed by our group in 2015 we found that over 93% of primary care physicians (PCPs) continued to prescribe TT despite the fact that our region has a high rate of primary CLA resistance [5-7]. Furthermore, only 30% of PCPs provided a second-line eradication regimen compatible with current guidelines. Additional gaps were identified regarding the indications for *H. pylori* testing and attitudes towards the oncogenic potential of the organism.

It has previously been shown that educational outreach visits (EOV) involving face-to-face meetings with healthcare professionals lead to changes in prescribing practices [8]. Such visits are more effective in changing PCP behavior than are alternative methods, such as audit with feedback. Likewise, the distribution of printed educational materials may have a beneficial effect on professional practice outcomes [9]. Over the past decade, electronic consultation (e-consult) has become an increasingly popular tool to facilitate provider-to-provider communication and may positively impact decision making [10-12]. Social media platforms also allow effective collaboration between healthcare professionals and have been shown to enhance educational interactions between health providers [13-15].

Following publication of the Maastricht/Florence V consensus report we advanced a national educational initiative to address the gaps identified in our previous study [5]. The aim of the present study was to assess the change in *H. pylori*-treatment practices following the implementation of a targeted educational intervention and to assess the relative effectiveness of each initiative.

Materials and methods

Intervention

Following the publication of our previous survey [5] three interventions were performed. Firstly, printed materials were distributed to PCPs at a national level. These included patient education flyers regarding the implications of *H. pylori* infection and treatment protocols, a letter addressed to PCPs summarizing the key statements of the Maastricht/Florence V Consensus Report [2], and how-to-prescribe cards. Secondly, EOVs were performed by trained personnel, during which the contents of the printed materials were conveyed orally. Thirdly, the key statements of the Maastricht/Florence V Consensus Report were transferred over a preexisting social media platform. This social media platform is a forum through which PCPs can interact with a single consultant gastroenterologist. The platform functions as a message board, on which all participants can view all of the comments posted, and may be accessed from both desktop and mobile devices.

The consultant gastroenterologist typically responds to questions posed by PCPs within 1 h, and often in real-time.

Questionnaire

The questionnaire previously sent in June 2015 was redistributed in June 2018 with the addition of one question (Question 14) which assessed attitudes towards testing *H. pylori* prior to commencing long-term aspirin or non-steroidal anti-inflammatory drug (NSAID) therapy in patients with a history of PUD. This question was included to differentiate adherence to the Maastricht V/Florence Consensus Report, which recommends *H. pylori* testing prior to aspirin and NSAID therapy in subjects with a history of PUD, from adherence to the ACG Clinical Guideline, which mandates testing prior to aspirin and NSAID therapy, regardless of any history of PUD [3].

The final questionnaire consisted of 14 multiple choice questions, including 2 related to treatment, 5 related to *H. pylori* detection, 3 related to gastric cancer and 4 related to screening. Questions were jointly written by an expert panel of 3 consultant gastroenterologists, including one contributor to the Maastricht IV and Maastricht V/Florence Consensus Report. The panel sought to address topics within the realm of general practice yet are presumed to be poorly managed. Study questions with answer options are shown in Supplementary Table 1. Demographic variables were collected, including age, sex, clinic location and estimated number of *H. pylori* diagnosis or treatment encounters per month. In addition, subjects were asked about exposure to printed materials or EOVs during the preceding 3 months. PCP participation in the social media platform was correlated with electronic data from the system administrator.

Distribution

Questionnaires were distributed by e-mail to the personal accounts of approximately 2000 PCPs working for Clalit Health Services (CHS) in Israel. CHS is the largest health maintenance organization in Israel and the second largest health maintenance organization in the world, with a staff of 34,000 employees and more than 3.8 million enrollees. Healthcare is delivered through a network of facilities that include 14 hospitals, 1300 primary and specialized clinics, and a network of pharmacies and dental clinics throughout 8 districts.

Responses were collected electronically during a period of 14 days, after which no further responses were allowed. PCPs who responded to <90% of questions were excluded. Only one response per IP address was permitted.

Endpoints

The primary outcome measure assessed was the change in the proportion of PCPs who provided first- and second-line therapy consistent with current guidelines, as defined below. Secondary measures included changes in PCP attitudes with respect to *H. pylori* detection, malignant potential and screening.

Statistical analysis

Given the PCP population size of 2000, we calculated that a sample size of 322 would be necessary to allow a margin of error of 5% with 95% confidence. Data analysis was performed using SAS 9.4 statistical analysis software (SAS Institute Inc. NC, USA). Continuous variables were reported as mean \pm SD. Normality of distribution of continuous variables was assessed using the Kolmogorov-Smirnov test (cutoff at $P=0.01$). Categorical variables were described using frequency distributions and were presented as frequencies: n (%). Depending on the distribution, continuous variables were compared across groups using one-way analysis of variance (ANOVA) or the Kruskal-Wallis test. Pairwise, *post hoc* comparisons for significance across differences were assessed by Bonferroni's test or the Mann-Whitney *U* test. Categorical variables were compared across groups using the chi-square test (exact as necessary). Pearson's correlation coefficient was used to test for correlations between variables. A multivariate regression model to assess for predictors compliance with first- and second-line treatment included the following variables: sex, clinic location, volume of *H. pylori* patients and educational interventions. The dependent variable of compliance with guidelines was defined as any 4-drug regimen for first-line therapy, and bismuth-based quadruple (BQT) or levofloxacin-based therapy for second-line eradication. PCP respondents who chose to refer patients to a gastroenterologist for second-line treatment were omitted from the model. All tests were 2-sided and considered significant at $P<0.05$.

Results

Respondents

A total of 332 PCPs returned questionnaires. Eleven respondents completed less than 90% of the survey and were excluded. Therefore, 321 respondents (age 44.7 ± 10.9 years) were included in the final data set, including 148 (46.3%) males. The characteristics of respondents are shown in Table 1. Two hundred seventy-seven PCPs (86.3%) reported a low number (<10) of *H. pylori* encounters per month. Exposure to ≥ 1 educational initiative was reported by 208 (64.8%) PCPs, including 98 (30.5%) exposed to EOVs, 150 (46.7%) exposed to printed materials and 48 (15%) who accessed the social media platform.

H. pylori treatment

The most commonly recommended first-line treatment was standard TT for 7-10 days in 2015 (248 [80.0%]) and TT for 14 days in 2018 (115 [35.8%]) ($P<0.001$) (Table 2). The number of PCPs who recommended a 4-drug treatment protocol increased from 12 (3.8%) in 2015 to 119 (37.1%) in 2018 ($P<0.001$) (Fig. 1). The most common 4-drug regimen was sequential therapy in 2015 (11 [3.5%]) and concomitant therapy in 2018 (91 [28.3%]). The most commonly recommended second-line treatment was metronidazole-based

Table 1 Characteristics of respondents, 2018

Characteristics	N (%)
Total	321 (100)
Male sex	148 (46.3)
Age, years, mean (SD)	44.7 (10.9)
<i>Hp</i> patients/month	
<10	277 (86.3)
10-30	17 (5.3)
31-50	12 (3.7)
>50	15 (4.7)
Clinic location	
Tel Aviv (central) region	69 (21.5)
Jerusalem	25 (7.8)
Mid-north (<i>Sharon</i>)	48 (15.0)
North (<i>Galilee/Golan</i>)	110 (34.6)
Mid-south (<i>Shefela</i>)	26 (8.1)
South (<i>Negev</i>)	41 (12.8)
Exposure to educational outreach visits	98 (30.5)
Exposure to printed materials	150 (46.7)
Interaction with GI consult over social media platform	48 (15.0)

Hp, *Helicobacter pylori*; SD, standard deviation; GI, gastroenterology

TT in 2015 (122 [38.9%]) and BQT in 2018 (199 [62.0%]). The number of PCPs who recommended bismuth- or levofloxacin-based therapy for second-line treatment increased from 95 (30.3%) in 2015 to 247 (77.1%) in 2018 ($P<0.001$).

Change in attitudes towards *H. pylori* 2015-2018

In 2018 more PCPs recommended treatment for *H. pylori*, regardless of symptoms, and recommended confirming eradication with a noninvasive test (130 [41.4%] vs. 186 [57.9%] ($P<0.001$) and 137 [43.3%] vs. 178 [55.5%] ($P=0.021$) in 2015 vs. 2018, respectively) (Table 3). The number of PCPs who acknowledged a definite association between *H. pylori* and gastric cancer, and agreed that treatment reduces cancer risk, also increased (130 [41.1%] vs. 193 [60.1%] ($P<0.001$) and 188 [65.1%] vs. 254 [79.4%] ($P<0.001$) in 2015 vs. 2018, respectively). There was no significant change in the number of PCPs who "usually" or "consistently" screened first-degree relatives of gastric cancer patients (87 [30.9%] vs. 112 [35.2%] in 2015 vs. 2018, respectively [$P=0.26$]). The number of PCPs who "usually" or "consistently" recommended screening prior to commencing long-term NSAID therapy remained low (39 [14.1%] vs. 46 [14.4%] in 2015 vs. 2018, respectively [$P\geq 0.99$]). Among PCPs who did not "usually" or "consistently" screen prior to NSAID therapy, 79 (29.0%) would nevertheless "usually" or "consistently" screen prior to NSAID therapy if the patient had a history of PUD.

Table 2 First- and second-line *Hp* treatment recommended by PCPs in 2015 and 2018

Qu		2015	2018	P
	Total, N (%)	314 (100)	321 (100)	
1	First-line treatment			
	3-drug protocol	292 (93.0)	202 (62.9)	<0.001
	Clarithromycin triple 7-10 days	248 (80.0)	87 (27.1)	
	Clarithromycin triple 14 days	44 (14.0)	115 (35.8)	
	4-drug protocol	12 (3.8)	119 (37.1)	<0.001
	Sequential therapy	11 (3.5)	19 (5.9)	
	Concomitant therapy	1 (0.3)	91 (28.3)	
	Bismuth-based quadruple	0 (0.0)	9 (2.8)	
2	Second-line treatment			
	Consistent with guidelines	95 (30.3)	247 (77.1)	<0.001
	Bismuth-based quadruple	85 (27.1)	199 (62.0)	
	Levofloxacin-based triple	10 (3.2)	48 (15.1)	
	Inconsistent with guidelines	144 (45.9)	20 (6.2)	<0.001
	Repeat first-line treatment	21 (6.7)	19 (5.9)	
	Nitroimidazole-based triple	122 (38.9)	0 (0)	
	No treatment	1 (0.3)	1 (0.3)	
	Other			
	GI referral	75 (23.9)	54 (16.8)	

Hp, *Helicobacter pylori*; *GI*, gastroenterology

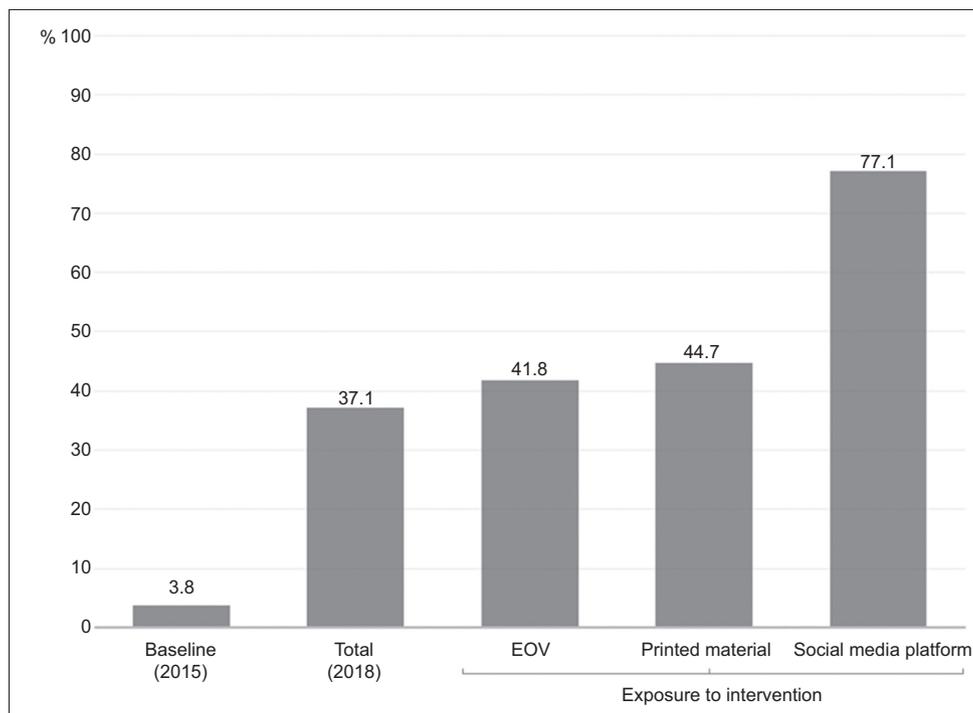


Figure 1 Compliance with guidelines for first-line *Helicobacter pylori* treatment at baseline (2015) and following exposure to educational interventions (2018)*

*Compliance defined as recommendation for 4-drug regimen

EOV, educational outreach visit

Table 3 Attitudes towards *Hp* detection, malignant potential and screening among PCPs in 2015 and 2018

Qu		2015	2018	P
<i>Detection of H. pylori</i>				
3	What is your preferred noninvasive test to diagnose <i>H. pylori</i> infection?			
	¹³ C-urea breath test	198 (63.1)	252 (78.5)	0.02
	Stool antigen test	80 (25.5)	67 (20.9)	
	Serology	1 (0.3)	1 (0.3)	
	None	7 (2.2)	1 (0.3)	
4	How many days do you withhold PPIs and antibiotics prior to <i>H. pylori</i> testing?			
	0	4 (1.3)	3 (0.9)	<.001
	5-7	165 (52.5)	116 (36.1)	
	14	99 (31.5)	175 (54.5)	
	30	18 (5.7)	26 (8.1)	
5	Do you confirm <i>H. pylori</i> eradication with a noninvasive test?			
	Yes, in all patients	137 (43.6)	178 (55.5)	0.02
	Only if symptomatic	108 (34.4)	88 (27.4)	
	Only if PUD or malignancy	20 (6.4)	18 (5.6)	
	Never	49 (15.6)	35 (10.9)	
6	What do you do when confronted with a positive <i>H. pylori</i> test in an asymptomatic patient?			
	Treat regardless of symptoms	130 (41.4)	186 (57.9)	<0.001
	Treat only if symptomatic	182 (57.9)	132 (41.1)	
7	Do you seek <i>H. pylori</i> in patients with symptoms suggestive of gastroesophageal reflux?*	2.3 (1.4)	2.1 (1.4)	0.09
<i>Oncogenic potential of H. pylori</i>				
8	What is the nature of the association between <i>H. pylori</i> and gastric cancer?			
	Definite	130 (41.1)	193 (60.1)	<0.001
	Possible	141 (44.9)	119 (37.1)	
	No connection	18 (5.7)	4 (1.3)	
9	Do you agree that <i>H. pylori</i> eradication reduces the risk of developing gastric cancer**?	2.81 (0.9)	3.07 (0.7)	<0.001
10	How do you follow-up patients with gastric intestinal metaplasia?***			
	No need for surveillance	10 (3.5)	8 (2.5)	<0.001
	Recommend GI consult	131 (45.3)	65 (20.3)	
	Recommend endoscopic surveillance	199 (68.9)	244 (76.0)	
<i>Screening for H. pylori</i>				
11	Do you screen for <i>H. pylori</i> in first-degree relatives of gastric cancer patients?*	1.4 (1.56)	2.4 (1.6)	0.07
12	Do you screen for <i>H. pylori</i> among asymptomatic family members?*	0.7 (1.1)	0.7 (1.1)	0.98
13	Do you screen for <i>H. pylori</i> prior to initiating long term therapy with non-steroidal anti-inflammatory drugs?*	0.9 (1.3)	1.0 (1.2)	0.47
14	Do you screen for <i>H. pylori</i> prior to initiating long term therapy with non-steroidal anti-inflammatory drugs in patients with a history of peptic ulcer disease?*	n/a	1.8 (1.5)	na

* VAS 0-4 results expressed as mean (SD) where 0, never; 1, rarely; 2, occasionally; 3, usually; 4, consistently

** VAS 0-4 results expressed as mean (SD) where 0, strongly disagree; 1, disagree; 2, equivocal; 3, agree; 4, strongly agree

***more than one answer accepted in 2015

Hp, *Helicobacter pylori*; PPIs, proton pump inhibitors; SD, standard deviation; PUD, peptic ulcer disease; GI, gastroenterology

Predictors of compliance with *H. pylori* treatment

Variables that were significantly associated with compliance with first-line *H. pylori* treatment guidelines included a central

clinic location (odds ratio [OR] 2.82, 95% confidence interval [CI] 1.49-5.35; $P=0.01$) and exposure to printed educational materials (OR 1.84, 95%CI 1.16-2.91; $P=0.01$) and the social media platform (OR 7.57, 95%CI 3.70-15.48; $P<0.001$). These

factors remained significant following multivariate analysis (Table 4). Factors significantly associated with compliance with second-line treatment guidelines included female sex (OR 1.54, 95%CI 0.97-2.44; $P=0.02$), and lack of EOVs (OR 0.34, 95%CI 0.14-0.85; $P=0.02$). None of these factors remained significant following multivariate analysis.

Discussion

In our follow-up survey of PCPs, we found that, despite suboptimal compliance with the recommendation to treat *H. pylori* with 4 drugs (37.1%), compliance has risen almost tenfold since 2015. Interventions such as distribution of educational printed material and electronic consultation over a social media platform may be effective in increasing the implementation of *H. pylori* treatment guidelines. Compliance with guidelines is superior among PCPs working in central, urban clinics, compared with those working in the rural periphery. This is the first study to assess changes in compliance with *H. pylori* treatment guidelines following a targeted intervention to educate PCPs.

Our finding that most PCPs do not account for a high degree of CLA resistance when prescribing first-line treatment for *H. pylori* infection is consistent with others [16,17]. A recent South American study found that over 95% of PCPs prescribe standard TT despite the high rate of local resistance of *H. pylori* to CLA (>35%) [18,19]. A similar proportion of PCPs favoring TT has been reported in Italy, Turkey and South Korea [20-22]. On the other hand, a lower proportion of PCPs prescribed standard TT in Pakistan (61%) and Mexico (64%), and in our study (63%) [23,24]. The degree of CLA resistance in Israel is >20% in adults; therefore, first-line treatment with TT should be abandoned [6,7]. According to the Maastricht V/Florence Consensus Report and the Toronto Consensus, treatment options include concomitant therapy with amoxicillin, CLA and a nitroimidazole, or BQT with bismuth, tetracycline, and a nitroimidazole, together with a proton pump inhibitor [2,4]. According to the American College of Gastroenterology's Clinical Guideline, sequential therapy with amoxicillin followed by CLA and a nitroimidazole, together with a proton pump inhibitor, remains a valid alternative [3]. We noted a significant increase in the number of PCPs who recommended treatment for *H. pylori* regardless of symptoms, and who recommended confirming eradication with a noninvasive test. This practice is consistent with the principles set forth in the Kyoto global consensus, in which *H. pylori* was characterized as an infectious disease [25]. *H. pylori* is considered an obligate pathogen and causes histological gastritis, which correlates poorly with symptoms. It follows, therefore, that treatment should be offered regardless of symptomatology and that eradication should be confirmed in all patients following treatment. Our results might suggest an increased acceptance of the Kyoto consensus.

We found that compliance with recommendations for second-line treatment was higher than compliance with recommendations for first-line treatment. After excluding PCPs who chose to refer patients to a gastroenterologist for second-line

treatment, the proportion of PCPs who recommended guideline-appropriate second-line treatment was 92.5%. This high baseline level of compliance may be the reason that exposure to printed materials and electronic consultation were not found to be significant predictors of compliance. Another reason for the lack of significance could be the fact that printed materials focused mainly on first-line, rather than second-line treatment.

Interestingly, we found that exposure to EOVs in the 3 months prior to completing the questionnaire was associated with lower compliance with second-line treatment recommendations. This, too, may be attributable to the high baseline adherence among respondents with and without EOV exposure (86.8% and 95.1%, respectively), or the fact that EOVs focused mainly on first-line treatment. Furthermore, there is a questionable correlation between EOVs within 3 months of participation and EOVs during the 3-year period during which our intervention was implemented. Another possibility is that EOVs unrelated to our study occurred (such as visits from industry representatives) and were recalled by study respondents.

We found that compliance with *H. pylori* screening prior to commencing long-term NSAID therapy is suboptimal, and that compared to 2015 these results are unchanged. A non-significant trend towards improvement in PCPs' screening of first-degree relatives of gastric cancer patients was observed, although rates remain inappropriately low (Visual Analogue Scale (VAS) 1.4 vs. 2.4 in 2015 vs. 2018, $P=0.07$). Screening asymptomatic family members (which is unnecessary) remains uncommon and in accordance with guidelines (VAS 0.7 vs. 0.7 in 2015 vs. 2018, $P=0.98$).

Limitations of our study include those inherent to any voluntary questionnaire, such as selection bias. PCPs mindful of continuing medical education are more likely to have completed the questionnaire. We could not reliably assess the frequency or distribution of EOVs during the three-year intervention period (much less that of the printed materials). For this reason we chose to assess EOVs and exposure to printed materials in the 3 months preceding the questionnaire as a surrogate. We could not presume that PCPs could reliably recall an encounter more than 3 months previously. The validity of this surrogate endpoint is unknown. Therefore our study lacks a true control group, not exposed to our interventions. Correlation between compliance with guidelines and exposure to EOVs and printed materials within the 3 months may not necessarily indicate a correlation between compliance with guidelines and exposure to our educational initiative, which took place over a period of 3 years. Another limitation is that we do not know how many of the PCPs who participated in the 2015 survey did so again in 2018. However, the impact of our intervention was measured on a representative sample of the entire PCP population, rather than on individual PCPs. Finally, we cannot be sure that the improvement in outcomes is entirely attributable to our intervention.

In conclusion, targeted education of PCPs seems to be an effective method to increase compliance with guidelines for the treatment of *H. pylori*. Internet and social media platforms may be the most effective means to enhance information-sharing between PCPs and gastroenterologists, and thereby enable a streamlined approach to *H. pylori* treatment. Nevertheless,

Table 4 Predictors of primary care physicians compliance with guidelines for first- and second-line *Hp* treatment

	First-line						Second-line					
	N (%)		Univariate		Multivariate		N (%)		Univariate		Multivariate	
			OR (95%CI)	P	OR (95%CI)	P			OR (95%CI)	P	OR (95%CI)	P
Age, y, mean (SD)	43.8 (9.9)		0.99 (0.99-1.01)	0.30	na****		45.2 (10.8)		0.98 (0.93-1.03)	0.40	na****	
Female sex	72 (41.9)		1.54 (0.97-2.44)	0.07	1.007 (0.59-1.72)	0.98	135 (96.4)		1.54 (0.97-2.44)	0.02	2.36 (0.80-7.00)	0.11
Central clinic location**	33 (47.8)		2.82 (1.49-5.35)	0.01	2.78 (1.38-5.60)	0.003	52 (92.8)		1.13 (0.34-3.77)	0.84	1.17 (0.28-4.82)	0.97
Low volume <i>Hp</i> patients***	105 (37.9)		0.72 (0.24-2.08)	0.54	0.94 (0.29-3.02)	0.94	223 (95.3)		0.719 (0.25-2.08)	0.54	0.10 (0.02-0.33)	0.95
Exposure to educational outreach visits	41 (41.8)		1.35 (0.83-2.19)	0.26	1.50 (0.87-2.69)	0.14	72 (86.8)		0.34 (0.14-0.85)	0.02	0.40 (0.14-1.17)	0.09
Exposure to written materials	67 (44.7)		1.84 (1.16-2.91)	0.01	1.64 (0.99-2.72)	0.04	116 (92.8)		1.07 (0.44-2.63)	0.88	0.97 (0.32-2.93)	0.95
Interaction with GI consult over social media platform	37 (30.0)		7.57 (3.70-15.48)	<0.001	6.60 (3.08-14.13)	<0.0001	41 (97.6)		2.61 (0.47-14.49)	0.27	2.93 (0.28-30.69)	0.37

*Percentage compliance with guidelines

** Tel Aviv region compared with northern region

***<10/month compared to 10-30/month

****age not included in logistic regression

Hp, *Helicobacter pylori*; OR, odds ratio; CI, confidence interval; SD, standard deviation; na, not applicable; GI, gastroenterology

Summary Box

What is already known:

- Recent *Helicobacter pylori* (*H. pylori*) treatment guidelines recommend the use of 4 drugs for first-line treatment
- Adherence to *H. pylori* treatment guidelines is suboptimal
- Educational outreach visits and e-consultation have been shown to be effective means of changing primary care physicians' (PCP) prescribing practices; however, they have not previously been assessed in the setting of *H. pylori* treatment

What the new findings are:

- Following a targeted intervention, compliance with *H. pylori* treatment guidelines increased almost 10-fold
- Variables significantly associated with compliance to first-line *H. pylori* treatment guidelines included a central clinic location (odds ratio [OR] 2.78, 95% confidence interval [CI] 1.38-5.60; P=0.003), exposure to printed educational materials (OR 1.64, 95%CI 0.99-2.72; P=0.04) and e-consultation over a social media platform (OR 6.60, 95%CI 3.08-14.13; P<0.0001)
- Internet and social media platforms seem to be the most effective means of enhancing information sharing between PCPs and gastroenterologists, and thereby enable a streamlined approach to *H. pylori* treatment

fewer than 40% of PCPs provide *H. pylori* treatment consistent with guideline recommendations. Therefore, steps should be taken to increase the penetration of the initiatives described.

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Supplementary Table 1

Study Questionnaire

Part A Treatment of *Helicobacter pylori* (*H. pylori*)

- Q1. What is your preferred first-line treatment for *H. pylori* infection?
1. 7-day clarithromycin-based triple therapy
 2. 10-day clarithromycin-based triple therapy
 3. 14-day clarithromycin-based triple therapy
 4. Sequential therapy
 5. Quadruple therapy (either bismuth or non-bismuth based)
 6. Other (please specify)
- Q2. What is your preferred second-line treatment for *H. pylori* infection?
1. Repeat the same treatment exactly
 2. Use the same drugs as before but increase the dose and/or treatment duration
 3. Referral to gastroenterologist for treatment
 4. Metronidazole-based triple therapy
 5. Bismuth-based quadruple therapy
 6. Levofloxacin-based triple therapy
 7. I do not attempt to treat *H. pylori* for a second time

Part B Detection of *H. pylori*

- Q3. What is your preferred noninvasive test to diagnose *H. pylori* infection?
1. A validated IgG serological test
 2. C13-urea breath test
 3. Stool antigen test
 4. I never test for *H. pylori*. If I suspect infection I refer to a gastroenterologist.
- Q4. How many days do you withhold proton pump inhibitors and antibiotics prior to *H. pylori* testing?
1. 0 days
 2. 5 days
 3. 7 days
 4. 14 days
 5. 30 days
- Q5. Do you confirm *H. pylori* eradication with a noninvasive test?
1. I routinely confirm eradication with a noninvasive test
 2. I only confirm eradication in patients with ongoing symptoms
 3. I only confirm eradication in patient with significant pathology, such as gastric ulcer or mucosa-associated lymphoid tissue lymphoma
 4. I do not routinely confirm *H. pylori* eradication in any situation.

- Q6. What do you do when confronted with a positive *H. pylori* test in an asymptomatic patient?
1. I treat all patients found to harbor *H. pylori* infection
 2. I only treat symptomatic patients
 3. I never treat for *H. pylori* infection
- Q7. Do you seek *H. pylori* in patients with symptoms suggestive of gastroesophageal reflux?
1. *H. pylori* does not cause reflux symptoms; therefore, I do not seek the organism in this setting
 2. Rarely
 3. Occasionally
 4. Usually
 5. Consistently

Part C Oncogenic potential of *H. pylori*

- Q8. What is the nature of the association between *H. pylori* and gastric cancer?
1. There is a definite link between *H. pylori* infection and gastric cancer. *H. pylori* may cause gastric cancer
 2. The link between *H. pylori* infection and gastric cancer is equivocal
 3. There is no connection between *H. pylori* infection and gastric cancer
- Q9. Do you agree that *H. pylori* eradication reduces the risk of developing gastric cancer?
1. Strongly disagree
 2. Disagree
 3. Equivocal
 4. Agree
 5. Strongly agree
- Q10. How do you follow-up patients with gastric intestinal metaplasia? (more than one response is permitted)
1. Intestinal metaplasia is commonly seen on pathology reports, has no clinical significance, and may be ignored.
 2. I refer to a gastroenterologist for counseling
 3. I refer for gastroscopy with biopsy every 2-3 years

Part D Screening for *H. pylori*

- Q11. Do you screen for *H. pylori* in first-degree relatives of gastric cancer patients?
1. There is no recommendation to test healthy family members, therefore I do not seek the organism in this setting
 2. Rarely
 3. Occasionally
 4. Usually
 5. Consistently

Q12. Do you screen for *H. pylori* among asymptomatic family members?

1. There is no recommendation to test healthy family members, therefore I do not seek the organism in this setting
2. Rarely
3. Occasionally
4. Usually
5. Consistently

Q13. Do you screen for *H. pylori* prior to initiating long-term therapy with non-steroidal anti-inflammatory drugs?

1. Never

2. Rarely
3. Occasionally
4. Usually
5. Consistently

Q14. Do you screen for *H. pylori* prior to initiating long-term therapy with non-steroidal anti-inflammatory drugs in patients with a history of peptic ulcer disease

6. Never
7. Rarely
8. Occasionally
9. Usually
10. Consistently