Primary care and referring physician perspectives on non-alcoholic fatty liver disease management: a nationwide survey

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Abstract

Introduction: The optimal approach to screening and risk stratification for non-alcoholic fatty liver disease is challenging given disease burden and variable progression. The aim of this study was to assess primary care physician and referring physician practice patterns regarding non-alcoholic fatty liver disease.

Methods: An anonymous nationwide survey was administered to primary care physicians, endocrinologists, and cardiologists in a: (1) tertiary academic hospital, (2) community hospital, and (3) the American College of Physicians Insider Panel. Survey domains assessed non-alcoholic fatty liver disease knowledge, recommendations for screening, risk stratification, treatment, and referral patterns.

Results: A total of 440 providers completed the survey (35.2% completion rate; *N* = 82 academic hospital, *N* = 21 community hospital, *N* = 337 American College of Physicians). Half were male (51.7%), 78% from internal medicine, with 5% subspecialists. Providers were knowledgeable regarding prevalence and risk factors for non-alcoholic fatty liver disease. 58% would support screening for non-alcoholic fatty liver disease and used liver enzymes to do so. Only 22.5% used serum biomarkers and 23% used transient elastography for risk stratification. Primary reason for referral was advanced fibrosis/cirrhosis. 80% reported barriers to treating non-alcoholic fatty liver disease. There was no consistent diet recommended.

Conclusion: In this nationwide survey, we demonstrated that while overall disease knowledge was good, there was an important disconnect between current guidelines and real-world clinical practice. There is also significant heterogeneity in practice patterns for first-line therapy of non-alcoholic fatty liver disease and the majority of provider's report barriers to treating non-alcoholic fatty liver disease. These findings highlight the potential role for reevaluating screening and risk stratification recommendations in primary care to better align with needs in that setting.

Keywords: cirrhosis, diet, exercise, guidelines, nutrition, obesity, physical activity, referral, risk-stratification, screening

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Introduction

Worldwide there has been a significant increase in the prevalence of obesity which has directly translated into a rise in metabolic diseases including non-alcoholic fatty liver disease (NAFLD).[1]

Within the United States, it is estimated that approximately one-third of adults have NAFLD. Among individuals with common metabolic conditions, the prevalence of NAFLD is even higher, with an estimated two-thirds of individuals with

diabetes having underlying NAFLD.[2] Currently, NAFLD is the second most common cause of cirrhosis and indication for liver transplant in the United States.[3,4] Individuals with NAFLD are estimated to have 26% higher overall healthcare costs compared with individuals without NAFLD.[5,6] A core challenge of managing patients with NAFLD is identifying the optimal strategy for screening, diagnosis, and management given the present treatment options, difficulties in uptake and sustainability of first-line treatment, and competing co-morbidities in individuals with NAFLD.

Screening individuals for NAFLD, even those at high risk for having NAFLD, is not currently recommended given limitations in diagnostic testing and treatment options, and prior studies suggesting the lack of evidence demonstrating long-term benefits and cost-effectiveness of screening.[7] NAFLD is commonly diagnosed incidentally when imaging shows evidence of fatty liver infiltration or presumptively when liver enzymes are elevated in the setting of metabolic risk factors. From a primary care provider (PCP) perspective, it is challenging to determine the best approach to managing patients with either suspected or confirmed NAFLD, given current treatment landscape. Because the presence of advanced fibrosis is associated with increased all-cause and liver-related mortality, the American Association for the Study of Liver Diseases (AASLD) guidelines state that non-invasive biomarkers like the NAFLD fibrosis score (NFS) or fibrosis-4 index (FIB-4) can be used to help identify individuals at high risk for advanced fibrosis. As an alternative, transient elastography (TE) can also be used for this purpose.[7] It is unclear to what extent PCPs use these methods and how useful these tools are in the real-world clinical practice. The ability to accurately identify NAFLD patients at high risk for advanced fibrosis or cirrhosis is critically important, as most patients with NAFLD are asymptomatic and often patients remain undiagnosed until they present with decompensated cirrhosis or hepatocellular carcinoma (HCC).

In this study, we aimed to assess PCP and other relevant referring provider's awareness regarding NAFLD risk factors and their practice patterns regarding screening, diagnosis, referral, and treatment. We were also interested in how these practice patterns varied according to provider specialty and practice setting. We hypothesized that the

application of non-invasive methods recommended to risk stratify NAFLD patients would be infrequent, highlighting an important disconnect between guideline recommendations and real-world clinical practice. In addition, we hypothesized that there would be significant heterogeneity regarding recommendations and practice patterns for first-line therapy and referral in primary care settings.

Methods

Study population

This survey was administered to PCPs, as well as subspecialty providers in cardiology and endocrinology. Providers were required to spend ≥25% of their time in adult clinical care. The survey was administered across three sources in order to capture a broad range of practice patterns across diverse care settings: (1) a tertiary academic hospital (AH), (2) a community hospital (CH), and (3) the American College of Physicians (ACP) Insider Panel. The ACP Insider Panel consists of members of the Internal Medicine Insider Research panel maintained by the ACP Research Center.[8] The complete panel is a nationally representative group of 1000 ACP members who have volunteered to participate in periodic physician surveys in return for redeemable gift cards. The panel was started in 2011 and is regularly adjusted to represent ACP membership across multiple demographics. The ACP panel consists of members practicing in both community and academic settings, but as part of this study we were not able to identify practice setting for individual ACP respondents. We identified 756 individuals in the ACP Insider Panel who would be eligible to complete the survey. Within the AH, there were a total of 324 eligible providers that included providers in general internal medicine ($N=104$), family medicine ($N=115$), medicine-pediatrics ($N=27$), geriatrics ($N=48$), and endocrinology or cardiology ($N=30$). Within the CH, there were a total of 200 general internal medicine providers eligible for the study.

Survey distribution

The closed survey was web-based using Qualtrics. A total of 28 questions were asked, with one question per page/screen. Each question required a response in order to move to the next question and the option for 'not applicable' or 'decline to

answer' provided as choices where appropriate. Once submitted, a respondent could not go back and change a question answer. Question order was not randomized but adaptive branching logic was applied based on responses to linked questions. The first email invitation was sent via email in January 2019. The Qualtrics survey design precluded individuals from completing the survey more than once. Two additional reminder emails were sent to non-responders during the survey period. As incentive for participation, respondents in the AH were entered into a raffle for a $100 VISA gift card. Participants were informed about the length of the survey, data storage protocols, research team members, and aim of the study. All respondents were assigned participant identification numbers in order to protect their information. All data were stored on a password-protected server to which only the research team members had access. Only fully completed questionnaires were analyzed.

Questionnaire development and content
Given that there are no pre-existing validated survey tools to assess provider practice patterns in NAFLD, for this study, the anonymous provider survey (Supplemental material) was developed by two hepatologists (L.M.G. and M.A.T.) with feedback by trained survey design experts. Surveys used in prior studies aimed at assessing PCP knowledge and practice patterns related to NAFLD were used to inform the design of our instrument.[9] We applied the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) as recommended by the Equator Network. The multiple-choice survey was piloted among gastroenterology, hepatology, and internal medicine attending physicians prior to distribution. Feedback was used to iteratively modify the survey instrument. The survey assessed the following domains: (1) NAFLD prevalence and risk factors; (2) screening, diagnosis, and risk stratification; (3) treatment and management; (4) referral patterns; and (5) barriers to care. We also collected information on physician demographics and specialty in order to evaluate the impact of these factors on responses.

Statistical analysis
For descriptive statistics, means and standard deviations or medians and ranges were calculated for all continuous data, and frequencies and percent for categorical data. Associations between provider characteristics with NAFLD practice patterns were calculated using chi-square, Fisher's exact test, and multivariable logistic regression. Data were analyzed using STATA. Statistical significance was assessed at p-value ≤ 0.05. The study had IRB approval from both the AH and CH.

Results

Respondent characteristics
Of the 1250 invited participants, 440 completed the survey for a response rate of 35.2% ($N = 82$ AH, $N = 21$ CH, $N = 337$ ACP). Half were male (51.7%), 78% from internal medicine, 4% from medicine-pediatrics, 7% from family medicine, 6% from geriatrics, and 5% subspecialists (endocrinology = 19 and cardiology = 3) (Table 1).

NAFLD disease prevalence and risk factor knowledge
Overall, providers were knowledgeable regarding prevalence and risk factors for NAFLD (Tables 2 and 3). The majority (73–87%) of providers chose the response 'some' in terms of what proportion of patients in their practice likely had underlying NAFLD. Providers from medicine-pediatrics and endocrinology reported higher prevalence compared with other specialties ($p < 0.001$). Providers accurately identified the most common risk factors for NAFLD, though this also differed slightly by specialty, with obstructive sleep apnea (OSA) and polycystic ovarian syndrome (PCOS) more commonly identified among medicine-pediatrics, family medicine, and endocrinologists ($p < 0.001$).

NAFLD screening, diagnosis, and risk stratification
When asked to what extent they personally agreed or disagreed with a role for NAFLD screening, 85 (19.3%) reported they strongly agreed and 171 (38.8%) reported they somewhat agree (Figure 1(a)). Opinions regarding role for screening did statistically significantly vary by sample source (Table 2). Screening responses also significantly varied by specialty with subspecialists (68%) and those in internal medicine having the highest proportion of answers in strongly or somewhat agree and family medicine reporting the lowest (33%)

Table 1. Characteristics of respondents.

Characteristic	ACP insider panel (*N* = 337)	Academic hospital (*N* = 82)	Community hospital (*N* = 21)
Male sex	191 (56.7%)	22 (28.6%)	11 (57.9%)
Specialty			
General Internal Medicine	310 (92%)	23 (28.4%)	9 (42.8%)
Medicine-Pediatrics	0	15 (18.5%)	1 (4.7%)
Family Medicine	0	28 (34.6%)	2 (9.5%)
Geriatrics	18 (5.3%)	5 (6.1%)	5 (23.8%)
Subspecialists	9 (11.1%)	9 (11.1%)	4 (19%)

ACP, American College of Physicians.

(p = 0.02). Reasons reported that prompt screening did not significantly differ by provider specialty aside from family history. When asked what methods the providers would use to screen for NAFLD, ordering liver enzymes and liver ultrasound were the most common tools (Figure 1(a)). Practice patterns for screening methods varied across sample groups and by specialty (Tables 2 and 3).

In terms of risk stratification, only 22.5% (*N* = 99) of all respondents reported having ever used non-invasive serum biomarkers (i.e. NFS, FIB-4) in their NAFLD patients. Respondents from medicine-pediatrics reported having used these biomarkers most often (p = 0.04). Among respondents who had used serum biomarkers in the past, 18.4% (*N* = 18) reported they found these very useful and 55.4% (*N* = 55) reported they found them to be somewhat useful to risk stratify patients. Perceived usefulness of serum biomarkers did not vary by sample source or specialty. Among those who use these biomarkers, 78% (*N* = 77) reported that they directly impact the care of their patients, primarily in terms of identifying which patients to refer to gastroenterology/hepatology (79%). Overall, only 23% (*N* = 101) used TE for risk assessment. Use of TE did not vary by specialty but did significantly vary by sample source (Table 2). Among respondents who had used TE in the past, 25% (*N* = 25) reported they found these very useful to risk stratify patients with NAFLD. Perceived usefulness of TE did not vary by sample source or specialty. Among those who use TE, 82% (*n* = 83) reported that they directly impact the care of their patients,

with 65% reporting it impacted referral and 60% stating it informed what tests to order.

NAFLD treatment and management
Referral patterns are demonstrated in Figure 1(b). The primary reason for referral was advanced fibrosis or cirrhosis. Overall, only 20.6% of respondents reported that they did not feel like they had any barriers to evaluating and treating patients with NAFLD in their practice. The most common barrier reported was uncertainty about the optimal treatment approach (48.5%). Reported barriers did vary by sample source (highest frequency in AH, $p < 0.001$), though the specific barrier reported did not vary by sample source. More respondents from family medicine and subspecialties reported that time was a barrier to evaluation and management ($p < 0.001$), though the other reported barriers did not significantly vary according to training background.

Referral patterns to dieticians and structured lifestyle programs are shown in Figure 2(a) and (b), respectively. Referrals to dieticians were more commonly placed by respondents in AH and the ACP sample (p = 0.03), but was not statistically significantly different by specialty. Respondents from AH were more likely to report patients had time constraints (p = 0.002) and lack of interest (p = 0.009) limiting ability to see dietician (p = 0.002) whereas respondents from the ACP and CH samples reported significantly higher proportions of difficulty in access to dieticians ($p < 0.001$). Reasons influencing referral

Table 2. Respondents answers by sample source.

Variable	ACP insider panel (*N* = 337)	Academic hospital (*N* = 82)	Community hospital (*N* = 21)	*p* value
NAFLD prevalence among their patients				**0.02**
All	0	1 (1.2%)	0	
Most	40 (11.9%)	21 (25.6%)	4 (19%)	
Some	296 (87.8%)	60 (73.2%)	17 (81%)	
None	1 (0.3%)	0	0	
NAFLD risk factors				
Type II diabetes	308 (91.4%)	76 (97.4%)	19 (90.5%)	0.47
Obesity/BMI	329 (97.6%)	82 (100%)	21 (100%)	0.66
Hyperlipidemia	270 (80.1%)	74 (92.5%)	19 (90.5%)	0.09
Obstructive sleep apnea	178 (52.8%)	62 (78.5%)	15 (71.4%)	**0.001**
Polycystic ovarian syndrome	155 (45.9%)	64 (82%)	10 (47.6%)	**<0.001**
Hypothyroidism	99 (29.4%)	32 (41%)	10 (47.6%)	0.16
Screen for NAFLD				**0.007**
Strongly Agree	69 (20.4%)	13 (15.8%)	3 (19.3%)	
Somewhat Agree	144 (42.7%)	18 (21.9%)	9 (42.8%)	
Neutral	76 (22.5%)	36 (43.9%)	6 (28.6%)	
Somewhat Disagree	40 (11.8%)	13 (15.8%)	3 (14.3%)	
Strongly Disagree	8 (2.4%)	2 (2.4%)	0	
Prompt to screen for NAFLD				
Diabetes	225 (77.8%)	60 (90.9%)	13 (61.9%)	**0.08**
Obesity	262 (90.6%)	61 (95.3%)	19 (90.4%)	0.47
Metabolic syndrome	245 (84.8%)	61 (95.3%)	16 (76.2%)	**0.03**
Hyperlipidemia	190 (65.7%)	45 (70.3%)	14 (66.6%)	0.78
Family history	135 (46.7%	43 (67.2%)	14 (66.6%)	**0.004**
Method to screen for NAFLD				
Liver enzymes	245 (84.7%)	61 (89.7%)	17 (80.9%)	**<0.001**
Liver ultrasound	228 (78.8%)	44 (64.7%)	16 (76.2%)	**<0.001**
Liver biopsy	19 (6.5%)	5 (7.3%)	1 (4.7%)	0.70
TE	44 (15.2%)	17 (25%)	2 (9.5%)	**<0.001**
Risk stratification of NAFLD				
Used serum biomarkers	78 (23.1%)	20 (24.4%)	1 (4.7%)	0.13
Used TE	66 (19.6%)	33 (40.2%)	2 (9.5%)	**<0.001**

(continued)

Table 2. (continued)

Variable	ACP insider panel (*N* = 337)	Academic hospital (*N* = 82)	Community hospital (*N* = 21)	*p* value
Diet recommended				0.18
Low fat	80 (23.7%)	18 (22.2%)	4 (19.1%)	
Low carbohydrate	79 (23.4%)	12 (14.8%)	1 (4.7%)	
Mediterranean	111 (32.9%)	36 (32.1%)	9 (42.8%)	
Other	33 (9.8%)	10 (12.3%)	3 (14.2%)	
No specific recommendation	34 (10.1%)	15 (18.5%)	4 (7.5%)	

ACP, American College of Physicians; BMI, body mass index; NAFLD, non-alcoholic fatty liver disease; TE, transient elastography.
Bolded values indicate statistically significant values

Table 3. Respondents answers by specialty.

Variable	GIM (*N* = 342)	Med-Peds (*N* = 16)	Family medicine (*N* = 30)	Geriatrics (*N* = 28)	Subspecialist (*N* = 22)	*p* value
NAFLD prevalence among their patients						<**0.001**
All	0	0	0	0	1 (5%)	
Most	45 (13.6%)	7 (43.7%)	2 (6.7%)	1 (3.6%)	8 (36%)	
Some	296 (86.6%)	9 (56.3%)	28 (93.3%)	27 (96.4%)	13 (59%)	
None	1 (0.3%)	0	0	0	0	
NAFLD risk factors						
Type II diabetes	317 (92.7%)	13 (92.8%)	28 (96.5%)	25 (89.3%)	19 (86.3%)	0.49
Obesity/BMI	336 (98.2%)	14 (100%)	29 (96.7%)	26 (92.8%)	22 (100%)	0.31
Hyperlipidemia	280 (81.9%)	13 (81.2%)	28 (93.3%)	23 (82.1%)	17 (77.3%)	0.19
Obstructive sleep apnea	186 (54.4%)	12 (75%)	25 (83.3%)	14 (50%)	17 (77.3%)	**0.001**
PCOS	169 (49.4%)	12 (75%)	24 (80%)	5 (17.9%)	18 (81.8%)	**0.001**
Hypothyroidism	103 (30.1%)	9 (56.2%)	6 (20%)	10 (35.7%)	12 (54.5%)	**0.03**
Screen for NAFLD						**0.02**
Strongly Agree	73 (21.3%)	3 (18.9%)	3 (10%)	1 (3.5%)	5 (22.7%)	
Somewhat Agree	142 (41.5%)	3 (18.9%)	7 (23.3%)	9 (32.1%)	10 (45.4%)	
Neutral	79 (23.1%)	10 (62.5%)	13 (43.3%)	11 (39.3%)	4 (18.2%)	
Somewhat Disagree	41 (11.9%)	0	6 (20%)	6 (21.4%)	2 (9.1%)	
Strongly Disagree	7 (2.1%)	0	1 (3.3%)	1 (3.5%)	1 (4.5%)	
Prompt to screen for NAFLD						
Diabetes	232 (78.6%)	13 (81.2%)	20 (66.6%)	15 (53.5%)	16 (72.7%)	0.07

(continued)

Table 3. (continued)

Variable	GIM (N = 342)	Med-Peds (N = 16)	Family medicine (N = 30)	Geriatrics (N = 28)	Subspecialist (N = 22)	p value
Obesity	270 (91.5%)	13 (92.8%)	21 (95.4%)	19 (82.6%)	18 (94.7%)	0.67
Metabolic syndrome	255 (86.4%)	13 (92.8%)	21 (95.5%)	17 (73.9%)	15 (78.9%)	0.28
Hyperlipidemia	195 (66.1%)	11 (78.5%)	15 (68.2%)	15 (65.2%)	12 (63.1%)	0.77
Family history	139 (47.1%)	8 (57.1%)	16 (72.7%)	12 (52.1%)	16 (72.7%)	**0.01**
Method to screen for NAFLD						
Liver enzymes	253 (85.7%)	12 (75%)	22 (95.6%)	19 (82.6%)	15 (78.9%)	**<0.001**
Liver ultrasound	230 (77.9%)	9 (56.2%)	16 (69.6%)	20 (86.9%)	12 (63.1%)	**<0.001**
Liver biopsy	22 (7.5%)	2 (12.5%)	0	0	1 (4.5%)	**<0.001**
TE	45 (15.2%)	4 (25%)	4 (17.4%)	5 (21.7%)	4 (18.2%)	**<0.001**
Risk stratification of NAFLD						
Used serum biomarkers	76 (22.2%)	8 (50%)	7 (23.3%)	2 (7.1%)	6 (27%)	**0.04**
Biomarkers very useful	14 (17.9%)	2 (25%)	0	0	3 (37%)	0.41
Used TE	74 (21.6%)	4 (25%)	13 (43.3%)	5 (17.8%)	4 (18%)	0.06
TE very useful	17 (22.6%)	2 (50%)	4 (30.7%)	1 (20%)	1 (20%)	0.21
Diet recommended						**0.04**
Low fat	87 (25.4%)	2 (12.5%)	5 (16.6%)	4 (14.3%)	4 (18.2%)	
Low carbohydrate	77 (22.5%)	3 (18.7%)	3 (10%)	6 (21.4%)	3 (13.6%)	
Mediterranean	108 (31.5%)	7 (43.7%)	11 (36.6%)	13 (46.4%)	7 (31.8%)	
Other	34 (9.9%)	0	4 (13.3%)	1 (3.6%)	6 (27.3%)	
No specific recommendation	36 (10.5%)	4 (25%)	7 (23.3%)	4 (14.3%)	2 (9.1%)	
Refer to dietician						0.67
All	23 (6.7%)	2 (12.5%)	0	1 (3.5%)	2 (9.1%)	
Most	117 (34.2%)	4 (25%)	8 (26.6%)	10 (35.7%)	9 (40.9%)	
Few	155 (45.3%)	9 (56.2%)	21 (70%)	11 (39.3%)	7 (31.2%)	
None	47 (13.7%)	1 (6.3%)	1 (3.3%)	6 (21.4%)	5 (22.7%)	

BMI, body mass index; GIM, general internal medicine; NAFLD, non-alcoholic fatty liver disease; PCOS, polycystic ovarian syndrome; TE, transient elastography. Bolded values indicate statistically significant values.

to dieticians were also impacted by respondent specialty, with those in medicine-pediatrics and family medicine reporting barriers related to time constraints ($p = 0.04$) and patient interest ($p = 0.006$) more often whereas those in internal medicine reported barriers related to access to dieticians more often ($p = 0.03$). Respondents from the AH and those in internal medicine and geriatrics were significantly less likely to refer patients to structured lifestyle programs ($p < 0.001$). Respondents from AH were more likely to report patient time constraints ($p < 0.001$) or patient lack of interest ($p = 0.006$) as a limitation to refer to a structured lifestyle program whereas those from the ACP sample were more likely to report difficulty with access to these
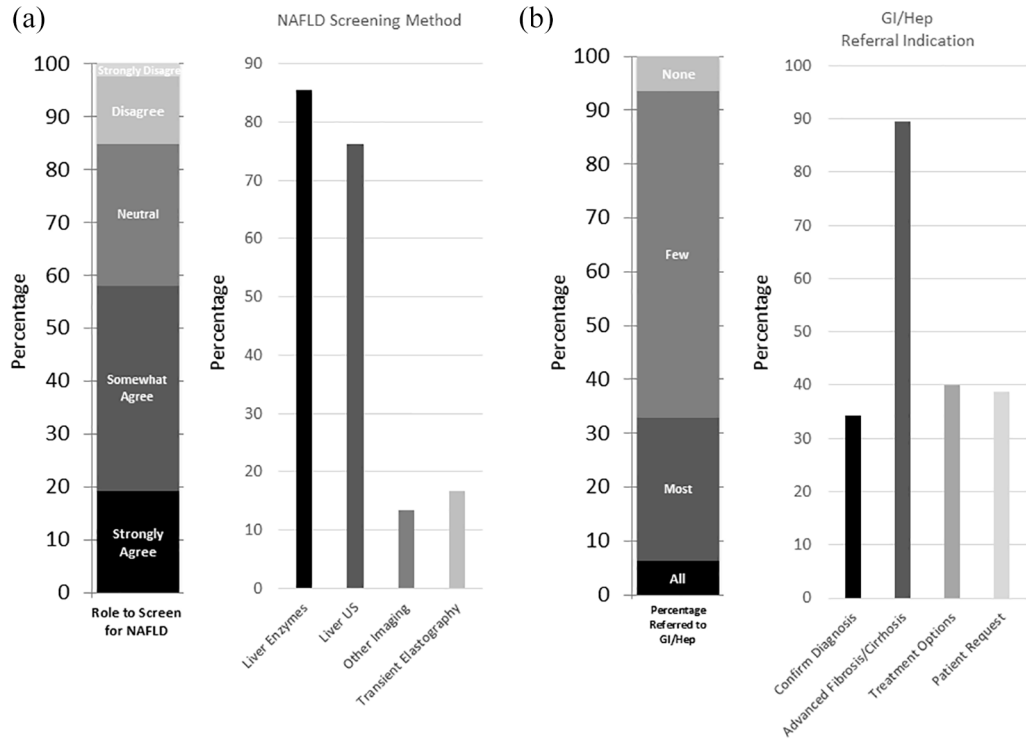
(a)

(b)

Figure 1. (a and b) PCP and referring provider NAFLD screening and referral patterns.
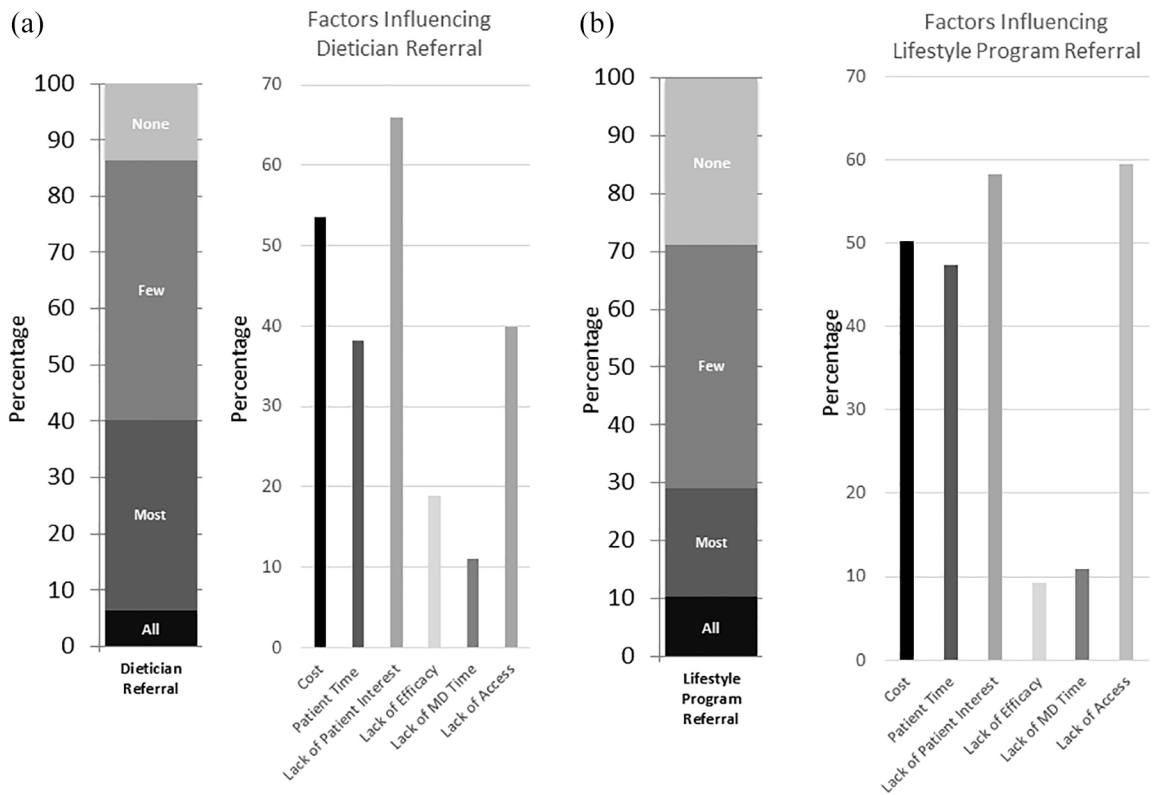
(a)

(b)

Figure 2. (a and b) PCP and referring provider dietician and lifestyle program referral patterns.

programs as a limitation in referral ($p < 0.001$). In terms of specialty, respondents from family medicine and medicine-pediatrics were significantly more likely to report patient time constraints ($p = 0.04$) and those in internal medicine more likely to report difficulty with access ($p = 0.003$) in terms of factors influencing referral to structured lifestyle programs. Variations in specific dietary regimen recommended are shown in Tables 2 and 3. Respondents in medicine-pediatrics and geriatrics were more likely to recommend a Mediterranean diet and those in internal medicine more likely to recommend a low carbohydrate diet ($p = 0.04$).

Overall, 74% ($n = 326$) of providers reported no change in their statin prescription practice based on NAFLD status, and this response did not significantly vary by sample source or specialty. Among those that did report they changed their statin prescribing practice based on the presence of NAFLD ($n = 114$), 9% ($n = 33$) reported they stop statins, 29% ($n = 95$) reported they avoid starting statins, and 61% reported they more frequently prescribe statins. These changes in statin use did significantly vary by sample source with those in the AH more commonly prescribing statins and those in the CH more frequently avoiding newly prescribing statins ($p = 0.01$). Specialty also impacted change in statin use ($p = 0.003$).

Multivariate analysis of respondent characteristics and NAFLD practice patterns
On multivariate analysis, survey source and specialty were independently associated with opinions regarding role for screening for NAFLD [odds ratio (OR) = 2.15, $p = 0.04$ for ACP and 0.34, $p = 0.01$ for geriatrics]. Use of biomarkers for risk stratification varied by specialty whereas use of TE varied by survey source. Referral patterns to structured lifestyle programs also varied by specialty (Table 4). Practice specialty was independently associated with recommendation of Mediterranean or low carbohydrate diet (OR = 0.31, $p = 0.04$), whereas sex was only independently associated with change in statin prescribing practices (OR = 0.61, $p = 0.03$).

Discussion
In the setting of increasing prevalence of obesity, metabolic syndrome and its associated conditions

have become significant public health crises. PCP and subspecialists that manage many of these chronic conditions have been faced with significant challenges in terms of diagnosis, risk stratification, and management of these co-morbidities. In current clinical practice, there remain several key uncertainties regarding the optimal approach for screening and risk stratification of NAFLD. The AASLD does not recommend screening for NAFLD and the United States Preventive Services Task Force (USPSTF) has no specific guidelines for NAFLD screening.[7] Once NAFLD is found, AASLD guidelines do make recommendations to use non-invasive risk stratification tools, that is, serum biomarkers and TE, to identify which patients may benefit from referral to subspecialists.[7]

In this nationwide survey, we demonstrated that while overall disease knowledge was good, there was an important disconnect between current guidelines and real-world clinical practice in regard to diagnosis, risk stratification, referral, and treatment. Interestingly, acknowledging the high prevalence of NAFLD, over half of respondents reported that there would be a role for screening patients for NAFLD. Opinions regarding the role for screening significantly varied by specialty and sample source, with subspecialists most strongly agreeing and respondents from the AH less likely to agree. Notably, liver enzymes were the primary method used to screen for NAFLD, despite their known limitations in sensitivity to detect NAFLD and NASH.[10–12] Data related to the cost-effectiveness and optimal approach to screening high-risk patients for NAFLD continue to evolve. Initial studies indicated that screening for NAFLD among patients with diabetes lacked cost-effectiveness, though the model used to assess cost did not take into account need for future liver transplantation or development of HCC.[13] Recent studies have demonstrated that screening among patients with type II diabetes may improve liver-related outcomes and may be cost-effective depending on the inclusion of quality-of-life decrement.[14] The role for screening will continue to evolve based on optimization of non-invasive methods to diagnose and risk stratify patients, and as the treatment landscape improves.[15,16]

Our study also highlighted the low uptake of recommendations to use non-invasive serum and imaging biomarkers to risk stratify patients. In

Table 4. Multivariate analysis of physician characteristics with survey responses.

Variable[a]	Univariate			Multivariate		
	OR	95% CI	*p* value	OR	95% CI	*p* value
Screen for NAFLD						
Male sex	1.12	0.76–2.65	0.54	0.87	0.57–1.31	0.51
Survey source						
ACP	2.82	1.71–4.65	<0.001	2.15	1.02–4.54	**0.04**
CH	2.19	0.89–5.80	0.11	1.76	10.53–5.86	0.35
Specialty						
Med-Peds	0.35	0.12–0.99	0.05	0.50	0.12–2.01	0.33
Family Medicine	0.29	0.13–0.65	0.002	0.59	0.21–1.63	0.31
Geriatrics	0.32	0.14–0.73	0.007	0.34	0.14–0.80	**0.01**
Subspecialists	1.27	0.47–3.45	0.49	1.97	0.63–6.15	0.23
Use biomarkers for risk stratification						
Male sex	1.19	0.75–1.88	0.44	1.18	0.73–1.90	0.49
Survey source						
ACP	0.99	0.53–1.64	0.81	1.93	0.67–5.55	0.21
CH[b]	0.15	0.01–1.22	0.07			
Specialty						
Med-Peds	3.5	1.27–9.63	0.01	5.71	1.27–25.58	**0.02**
Family Medicine	1.06	0.44–2.50	0.88	2.28	0.59–8.76	0.22
Geriatrics	0.26	0.06–1.16	0.07	0.36	0.08–1.60	0.18
Subspecialists	1.61	0.59–4.39	0.34	1.79	0.56–5.66	0.32
Use TE for risk stratification						
Male sex	1.07	0.68–1.68	0.76	1.33	0.81–2.17	0.25
Survey source						
ACP	0.36	0.21–0.60	<0.001	0.24	0.11–0.54	**0.001**
CH	0.15	0.03–0.71	0.01	0.07	0.01–0.60	**0.01**
Specialty						
Med-Peds	1.20	0.37–3.85	0.75	0.19	0.03–1.06	0.06
Family Medicine	2.76	1.28–5.96	0.009	0.97	0.34–2.75	0.95
Geriatrics	0.78	0.28–2.14	0.64	0.77	0.26–2.27	0.64
Subspecialists	0.96	0.31–2.99	0.95	0.38	0.09–1.54	0.17

(continued)

Table 4. (continued)

Variable[a]	Univariate			Multivariate		
	OR	95% CI	*p* value	OR	95% CI	*p* value
Refer to GI/hepatology						
Male sex	1.35	0.90–2.03	0.14	1.24	0.85–1.91	0.30
Survey source						
ACP	1.41	0.82–2.14	0.20	0.68	0.59–2.95	0.49
CH	1.36	0.48–3.82	0.55	0.30	0.33–4.35	0.30
Specialty						
Med-Peds	0.89	0.30–2.64	0.84	0.49	0.09–2.72	0.42
Family Medicine	0.49	0.19–1.24	0.13	0.69	0.21–2.17	0.51
Geriatrics	0.93	0.41–2.13	0.87	1.05	0.44–2.48	0.90
Subspecialists	0.91	0.33–2.45	0.33	0.90	0.29–2.76	0.86
Refer to dietician						
Male sex	0.73	0.49–1.07	0.11	0.70	(0.47–1.06)	0.09
Survey source						
ACP	0.95	0.58–1.59	0.85	0.68	0.33–1.41	0.31
CH	0.56	0.19–1.60	0.28	0.52	0.14–1.85	0.31
Specialty						
Med-Peds	0.86	0.30–2.43	0.78	0.39	0.10–1.57	0.19
Family Medicine	0.52	0.22–1.21	0.13	0.37	0.12–1.07	0.06
Geriatrics	0.93	0.42–2.05	0.86	0.82	0.36–1.89	0.65
Subspecialists	1.29	0.52–3.27	0.58	1.4	0.50–3.94	0.51
Refer to lifestyle program						
Male sex	0.90	0.59–1.37	0.64	0.72	0.46–1.13	0.15
Survey source						
ACP	1.86	1.03–3.37	0.03	3.58	1.32–9.64	**0.01**
CH	2.06	0.71–5.94	0.18	2.49	0.59–1.47	0.21
Specialty						
Med-Peds	1.11	0.37–3.29	0.84	1.33	0.22–8.01	0.75
Family Medicine	0.61	0.24–1.54	0.30	1.48	0.39–5.58	0.55
Geriatrics	0.98	0.41–2.30	0.96	1.05	0.42–2.58	0.91
Subspecialists	1.43	0.54–3.74	0.46	2.85	0.94–8.57	0.06
Mediterranean or low carbohydrate diet recommended						
Male sex	1.12	0.77–1.64	0.53	1.07	0.71–1.60	0.74

(continued)

Table 4. (continued)

Variable[a]	Univariate			Multivariate		
	OR	95% CI	*p* value	OR	95% CI	*p* value
Survey source						
ACP	1.54	0.94–2.54	0.08	0.87	0.41–1.82	0.71
CH	0.54	0.18–1.62	0.27	0.39	0.10–1.48	0.17
Specialty						
Med-Peds	0.49	0.16–1.45	0.19	0.42	0.10–1.68	0.22
Family Medicine	0.39	0.17–0.91	0.02	0.31	0.10–0.94	**0.04**
Geriatrics	0.60	0.27–1.34	0.21	0.67	0.29–1.55	0.35
Subspecialists	0.50	0.18–1.34	0.17	0.41	0.13–1.26	0.12
Change statin prescribing						
Male sex	0.58	0.38–0.90	0.01	0.61	0.39–0.97	**0.03**
Survey source						
ACP	0.97	0.56–1.70	0.94	0.76	0.34–1.70	0.51
CH	1.42	0.50–4.01	0.49	0.92	0.25–3.44	0.91
Specialty						
Med-Peds	0.94	0.29–3.01	0.92	0.83	0.20–3.47	0.82
Family Medicine	0.56	0.21–1.53	0.26	0.42	0.12–1.43	0.16
Geriatrics	1.83	0.82–4.07	0.13	1.48	0.63–3.42	0.35
Subspecialists	0.75	0.24–2.34	0.63	0.33	0.07–1.60	0.17

ACP, American College of Physicians; CH, community hospital; CI, confidence interval; NAFLD, non-alcoholic fatty liver disease; OR, odds ratio; TE, transient elastography.
[a]Reference category for source is academic hospital and for Specialty is general internal medicine. Multivariate model includes sex, survey source, and specialty.
[b]Numbers too small to calculate.
Bolded values indicate statistically significant values.

total, only 22.5% of all respondents reported having ever used non-invasive serum biomarkers and only 23% had ever used TE for risk stratification. Use of non-invasive serum biomarkers did significantly vary by specialty, and use of TE significantly varied by sample source with subspecialists and respondents from family medicine reporting having used serum biomarkers most often and respondents from the AH using TE most. Among those who had used serum biomarkers and TE, only 18.4% and 25% reported they found these very useful in directing the care of their NAFLD patients. These findings highlight that current recommendations are not meeting needs of PCP and referring specialists, with only a minority of providers applying available tools and a majority of providers indicating the available tools minimally help in caring for their patients with NAFLD.

Finally, our study reinforced the ongoing challenges in primary care regarding uptake and maintenance of first-line therapy for NAFLD, lifestyle interventions. Less than half of respondents reported they refer all or most of their patients to dieticians, whereas less than a third responded they refer all or most of their patients to structured lifestyle programs, citing concerns around cost and lack of patient interest as primary reasons to not refer. There was also significant heterogeneity

regarding nutritional recommendations for patients with NAFLD although data support the effectiveness of a Mediterranean diet in this population.[17]

Our study has a number of strengths and weaknesses to highlight. First, our study included a nationally representative sample of primary care and relevant referring subspecialists. This included various practice settings including both an AH and CH. This suggests that our results would be generalizable to the broad population of providers who care for patients with NAFLD. Of note, we did not specifically capture age or duration of practice of our respondents in an effort to streamline data collection and maximize anonymity of respondents. These factors may impact our results as NAFLD has become more prominent in clinical care in recent years. Our overall response rate was approximately 40%, which is consistent with response rates obtained in these national surveys. Second, this is the first study to our knowledge that evaluates implementation of current society recommendations for NAFLD care in real-world clinical practice. Of note, the proportion of respondents in the CH were much smaller than those in the AH, though many of providers in the ACP sample practice in CH and thus likely would have been captured in that sample source. We also had a very small number of subspecialist respondents which significantly limits our ability to comment on subspecialist practice patterns. Future studies focused on this specific group of providers would add to our understanding of how screening and referral might differ across PCPs and relevant referring subspecialists like endocrinologists and cardiologists. Inherent to any survey-based study are limitations regarding reported answers and actual behaviors in clinical practice. We worked with survey design specialists who designed survey stems and answers in accordance with methods that have been shown to optimize accurate responses however. Finally, we did not capture data on use of antidiabetic agents in order to keep the number of questions concise. It would be of interest to evaluate these practice patterns in future studies.

In conclusion, in this nationally representative sample of PCP and referring subspecialists, respondents demonstrated a high level of awareness of NAFLD disease prevalence and risk factors, and the majority would be in support of screening patients for NAFLD. There is a clear disconnect between methods currently used in clinical practice to screen and risk stratify patients with those recommended by society guidelines. Providers continue to struggle with finding mechanisms to optimize first-line therapy for NAFLD, with only a minority of providers referring patients to dieticians and structured lifestyle programs and significant heterogeneity in recommended first-line nutritional programs. Until such time that non-invasive methods to screen and risk stratify patients for NAFLD are optimized and treatment options are expanded, there will continue to be a significant need to improve care coordination and delivery in primary care settings. Improving diagnosis and identification of high-risk patients will ultimately translate in improved morbidity and mortality associated with NAFLD.

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Supplemental material
Supplemental material for this article is available online.

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