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## United States Physicians' Knowledge, Attitudes, and Practices Regarding Meningococcal Vaccination for Healthy Adolescents and Young Adults

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### A B S T R A C T

**Purpose:** The United States Advisory Committee on Immunization Practices (ACIP) recommends vaccination against meningococcal serogroups A, C, W, and Y (MenACWY) for all 11–12-year-olds, with a booster dose for 16-year-olds, and against meningococcal serogroup B (MenB) for 16–23-year-olds under shared clinical decision-making (SCDM). However, uptake of the MenB vaccine and the MenACWY booster dose is low. This study investigated United States physicians' knowledge, attitudes, and practices regarding recommending MenB and MenACWY vaccines to non-high-risk older adolescents and young adults.

**Methods:** An online survey was conducted in April–May 2022 among pediatricians, family physicians (FPs), general practitioners (GPs), and internists who had recommended the MenB and/or the MenACWY vaccine(s) to at least one 16–23-year-old in the past year.

**Results:** Among 407 participants, 50% correctly identified MenB as the leading cause of meningococcal disease among adolescents and young adults. Furthermore, 46% of physicians (47% of pediatricians, 40% of FPs and GPs, 53% of internists) answered correctly that MenB vaccination is recommended under SCDM, and 82% of physicians (96% of pediatricians, 70% of FPs and GPs, 65% of internists) answered correctly that MenACWY vaccination is routinely recommended. Among MenB-vaccinators, 78% reported having received some training or other information on implementing SCDM, and 65% rated recommending MenB vaccination as very important.

**Discussion:** Knowledge gaps, which varied by specialty, were identified regarding meningococcal disease and vaccine recommendations, particularly regarding MenB. Targeted education of physicians may facilitate discussions about MenB vaccination.

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### IMPLICATIONS AND CONTRIBUTION

This survey of 407 United States physicians revealed gaps in knowledge of meningococcal vaccination recommendations, which varied among physician specialties and were more notable regarding the serogroup B meningococcal vaccine. The survey also revealed differences in how physicians approached discussing and recommending meningococcal vaccination. Targeted education of physicians about vaccine recommendations is needed.

**Conflicts of interest:** OHR and TM are employees and stockholders of GSK. GSM received grants/contracts (paid to institution) from GSK, Merck, Pfizer, Sanofi, and Seqirus; advisory board consulting fees and travel/meeting support from GSK, Merck, Moderna, Pfizer, Sanofi, and Seqirus. ED, JW, and CS are employees, and SB is a former employee, of RTI-HS, which was paid by GSK to conduct this study.

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Invasive meningococcal disease (IMD) is a life-threatening condition caused by *Neisseria meningitidis*, with a fatality rate of 10%–15% even with appropriate therapy [1–3]. Up to 40% of survivors may experience sequelae, including long-term sequelae, such as hearing loss and amputations [4]. Meningococcal serogroup B (MenB) is the leading cause of IMD among 16–23-year-olds in the United States (United States) [5–7].

The Advisory Committee on Immunization Practices (ACIP) recommends routine administration of a vaccine against meningococcal serogroups A, C, W, and Y (MenACWY) for 11–12-year-olds, with a booster dose for 16-year-olds [8]. The ACIP also recommends vaccination against MenB for 16–23-year-olds (the preferred age is 16–18 years) using shared clinical decision-making (SCDM) with patients and/or parents/guardians [8]. SCDM recommendations are individually based and informed by a decision process between patients and health-care providers; the decision may be informed by the available evidence on benefits of vaccination, patients' characteristics, values, and preferences, health-care providers' clinical discretion, and vaccine characteristics [9]. MenACWY and MenB vaccines are also routinely recommended for individuals at increased risk for meningococcal disease [8,10].

Despite the availability of safe and effective vaccines, meningococcal vaccination rates among healthy adolescents in the United States is low. Although 88.6% of 13–17-year-olds received at least one dose of a MenACWY vaccine in 2022, 60.8% of 17-year-olds had received a MenACWY booster dose [11]. Even fewer 17-year-olds (29.4%) had received at least one dose of a MenB vaccine [11]. Among 16–23-year-olds who initiated MenB vaccination in 2017–2018%, 44.7%–56.7% completed the vaccine series [12]. Since every visit to a health-care provider presents an opportunity to update and complete immunizations [13], awareness and understanding of the ACIP recommendations for meningococcal vaccination are key to preventing IMD.

This study aimed to investigate knowledge, attitudes, and practices (KAP) among United States physicians regarding recommending MenB and MenACWY vaccines to older adolescents and young adults. This study did not address vaccination practices regarding individuals with high-risk conditions. The primary objectives (POs) of this study were to evaluate physicians' attitudes that the ACIP sets the standards for vaccination practices in the United States (PO1), knowledge of the ACIP recommendations specific to a MenB two-dose vaccine series based on SCDM (PO2), and knowledge of the ACIP's routine recommendations specific to a MenACWY booster dose (PO3). Additionally, the study investigated nine secondary objectives (SOs) 1–9. All objectives are mapped to their corresponding survey questions in Table A1 (Appendix A). The results of this study could help inform strategies for improving MenACWY vaccination rates, and for increasing opportunities to discuss MenB vaccination for older adolescents and young adults.

## Methods

### Study design

A cross-sectional survey was developed to assess KAP of physicians regarding MenB and MenACWY vaccination. The survey was pretested using a feasibility assessment and cognitive pretesting. First, a web-based feasibility questionnaire was administered to 106 physicians to confirm the planned

participant eligibility criteria and appropriate response ranges to select questions. Among them, 47 physicians ultimately participated in the study. After finalization of the questionnaire, cognitive pretest interviews were conducted with five physicians (one family physician [FP], two internists, and two pediatricians) over a web-based platform (Zoom Video Communications, Inc), in order to refine the instructions and test that the questions were easily understood. The results suggested that the instructions and questions were clear. Some questions, response options, and rating scales were shortened or revised according to recommendations from the physicians.

Physicians who reported recommending the MenB vaccine completed the MenB vaccination survey section; physicians who reported recommending the MenACWY booster vaccine completed the MenACWY vaccination survey section. Physicians who reported recommending both vaccines completed the full survey.

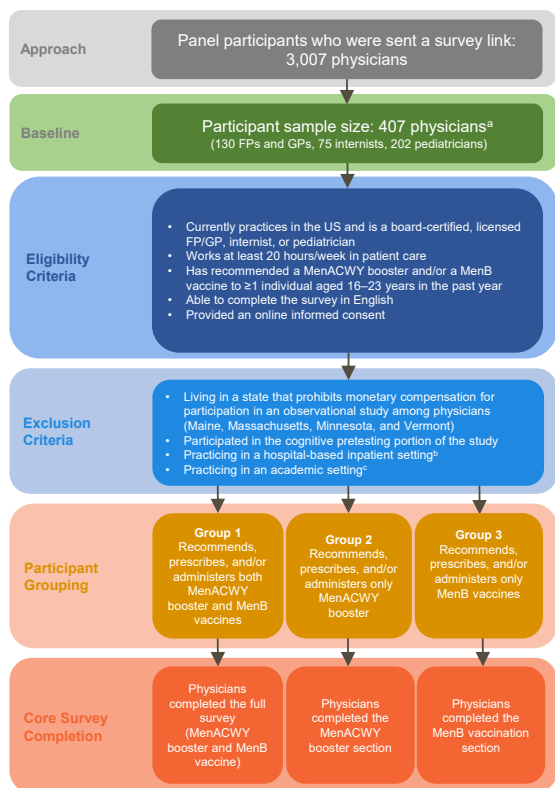
### Recruitment and data collection

M3 Global Research identified physicians via a survey research panel and sent recruitment emails to a random subset [14]. The M3 Global Research Panel is annually updated to confirm that the panel is closely representative of physicians in the United States with regard to age, gender, geography, and year of graduation from medical school. Physicians provide their specialties when signing up for an M3 Global Research panel; M3 Global Research verifies physician specialties using the National Provider Identifier or Medical Education Number, assigned by the American Medical Association to all United States physicians. The M3 Global Research Panel is annually updated to promote representation of real-world physicians by the panel members. Data were collected in April–May 2022 via a web-based, self-administered survey.

Eligible participants reported that they were a licensed and board-certified FP, general practitioner (GP), internist, or pediatrician who was practicing in the United States during the data collection period; worked in patient care at least 20 hours per week; recommended a MenB vaccine to at least one 16–23-year-old and/or a MenACWY vaccine to at least one 16–21-year-old in the past year; were able to complete the survey in English; and consented to the study. Participants received compensation (the amount was determined by the average time to complete the survey, as determined by M3 Global Research). Full eligibility and exclusion criteria are shown in Figure 1.

### Data analysis

Data analyses were descriptive and focused on summarizing all survey responses and evaluating the primary and secondary objectives. Post hoc subgroup analyses were also conducted to (1) understand the importance of recommending the MenB vaccine among the physicians who correctly responded (per Centers for Disease Control and Prevention [CDC] data [5–7]) to the survey question on current IMD epidemiology, and (2) evaluate the frequency of discussing the MenB vaccine with patients/parents among the physicians who knew that the MenB vaccine should be recommended under SCDM. Data analyses employed SAS 9.4 (or higher) statistical software (SAS; Cary, North Carolina). Response distribution percentages for each question were based on the number of physicians who had an opportunity to answer,



**Figure 1.** Study Design. <sup>a</sup>The target sample size was 350 physicians (75 FPs and GPs, 75 internists, 200 pediatricians), chosen to allow for reasonable estimates of physicians' knowledge and understanding of vaccination guidelines based on previous KAP studies. <sup>b</sup>As physicians practicing in a hospital-based inpatient setting (as they are rarely in a position to recommend, administer, and/or prescribe vaccination). <sup>c</sup>As physicians in academic settings may be stronger advocates of vaccination overall and have a better understanding of nuances around SCDM recommendations for MenB vaccination. Abbreviations: FPs: family physicians; GPs: general practitioners; MenACWY: meningococcal serogroups A, C, W, and Y; MenB: meningococcal serogroup B; US: United States. Note: the term "recommend" (meningococcal vaccines) in the survey encompassed "recommend," "prescribe," and "administer." Study participants were presented with this information at the start of the survey.

excluding those asked to skip the question because of a previous response. Results were calculated by specialty and overall.

The study was designated by the institutional review board panel at RTI Health Solutions as exempt from review. Individual data were anonymized. This cross-sectional study followed the STROBE reporting guidelines [15].

## Results

### Study participants

Survey invitation links were sent to 3,007 physicians; 899 (30%) accessed the link. A total of 407 physicians (130 FPs and GPs, 75 internists, and 202 pediatricians) completed the survey, meeting the study target sample size (Figure 1). Among all participants, 391 (96%) physicians were identified as MenB-vaccinators (having recommended the MenB vaccine to at least one 16–23-year-old patient in the past year), and 385 (95%) physicians were identified as MenACWY-vaccinators (having recommended the MenACWY vaccine to at least one 16–23-year-old patient in the past year; Figure A1).

Most physicians identified as White (66%). The predominant practice location was suburban (61%), and the predominant primary work environment was group private practice (66%). The sample was diverse by geography (33% from the South, 23% from the Northeast, 24% from the West, and 20% from the Midwest), [16] experience (28% reported practicing for 2–10 years, 27% for 21–30 years, and 24% for 11–20 years), and age (32% were 30–39 years old, 24% were 50–59 years old, and 20% were 40–49 years old). Physician characteristics are summarized in Table A2.

Physicians also reported characteristics of their 16–23-year-old patients (which were not confirmed with patient records; Table A3). Physicians estimated that 47% of those patients were White and 63% had private commercial insurance.

Survey results are presented in relation to study objectives (PO1–3 and SO1–9); the objectives are enumerated in Table A1.

### Disease awareness

Among all physicians ( $N = 407$ ), 66% reported having encountered a 16–23-year-old patient with IMD during either training or practice. Results were similar among specialties (FPs and GPs: 62%, internists: 72%, pediatricians: 67%; SO1). However, only 50% (FPs and GPs: 49%, internists: 48%, pediatricians: 51%) answered correctly that MenB currently causes the highest proportion of cases in adolescents and young adults in the US (SO1).

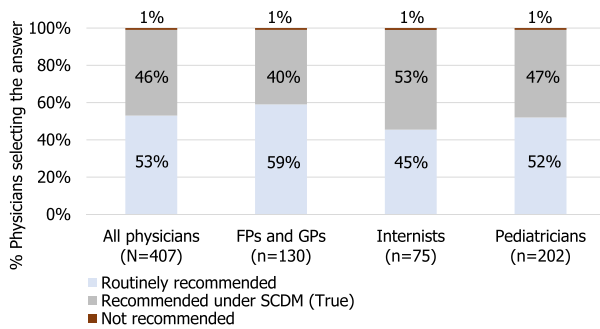
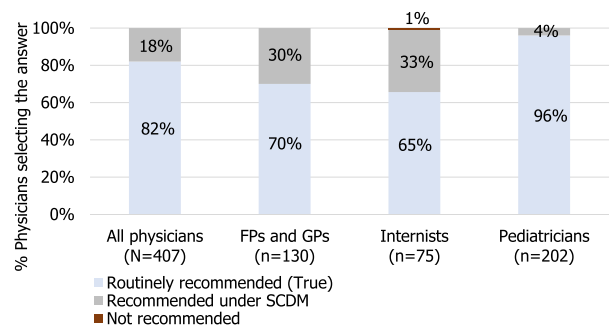
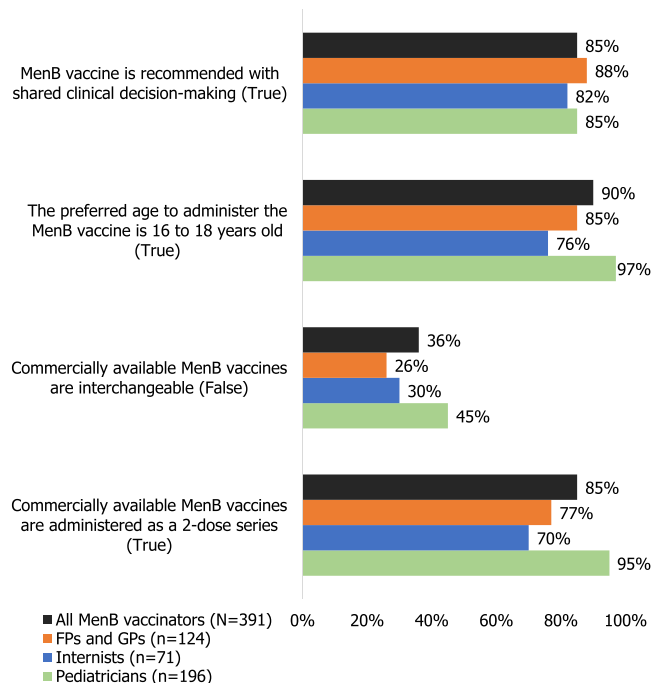
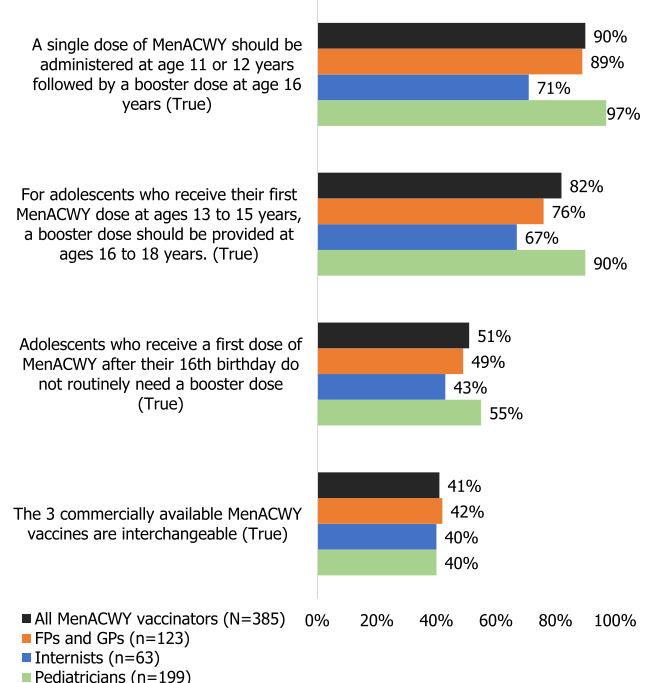
### Knowledge of vaccine recommendations

Most physicians (97%) agreed or strongly agreed that the ACIP guidelines set the standard for vaccination practices in the US (PO1). More pediatricians (66%) strongly agreed, compared with 50% of FPs and GPs, and 56% of internists (PO1).

All physicians also were asked survey questions regarding their knowledge of ACIP recommendations for MenB and MenACWY vaccines. When asked to identify the ACIP recommendations for MenB vaccines and the MenACWY booster in a multiple-choice format, only 46% of all physicians answered correctly that the MenB vaccine is recommended under SCDM (Figure 2A), while 82% answered correctly that the ACIP routinely recommends the MenACWY vaccine (Figure 2B; SO2). However, when MenB-vaccinators ( $n = 391$ ) were asked whether the MenB vaccine is recommended under SCDM in a true/false/not sure format, 85% responded correctly (Figure 2C; PO2). Additionally, 90% of MenACWY-vaccinators ( $n = 385$ ) correctly responded in the same format that a single dose of the MenACWY vaccine should be administered at age 11–12 years, followed by a booster dose at the age of 16 years (Figure 2D; PO3). Among MenB-vaccinators, only 36% correctly responded that commercially available MenB vaccines are not interchangeable (Figure 2C; SO2), and among MenACWY-vaccinators, only 41% correctly responded that the three commercially available MenACWY vaccines are interchangeable (Figure 2D; SO2). Answers to other vaccine recommendation knowledge questions are summarized in Figure 2.

### Patient/parent conversation on MenB vaccines under SCDM

Most MenB-vaccinators (78%) reported always or almost always discussing MenB vaccination with 16–23-year-olds during a well visit (FPs and GPs: 71%, internists: 59%, pediatricians: 88%). On

**A** The ACIP recommendation for the MenB vaccine**B** The ACIP recommendation for the MenACWY booster**C** Proportion of MenB-vaccinators (overall and by specialty) who selected correct statements on the MenB vaccine**D** Proportion of MenACWY-vaccinators (overall and by specialty) who selected correct statements on the MenACWY vaccine

**Figure 2.** Physicians' knowledge of meningococcal vaccine recommendations. A The ACIP recommendation for the MenB vaccine. B The ACIP recommendation for the MenACWY booster. C Proportion of MenB-vaccinators (overall and by specialty) who selected correct statements on the MenB vaccine. D Proportion of MenACWY-vaccinators (overall and by specialty) who selected correct statements on the MenACWY vaccine. Abbreviations: ACIP: Advisory Committee on Immunization Practices; FPs: family physicians; GPs: general practitioners; MenACWY: meningococcal serogroups A, C, W, and Y; MenB: meningococcal serogroup B; SCDM: shared clinical decision-making. Responses were defined as "correct" or "incorrect" according to the CDC guidelines [10,17–19].

average, these physicians reported initiating the discussions most often (79% of the time), followed by nurses or other office staff (10%), parents/caregivers (8%), and patients (3%). Conversations on MenB vaccination were most frequently initiated by pediatricians (83%), followed by FPs and GPs (74%) and internists (73%).

#### Health-care provider vaccination recommendations

Physicians reported seeing an average of 37 patients 16–23 years of age in an average week (FPs and GPs: 45, internists: 29,

pediatricians: 36; Table A4; SO3). The mean number of 16–23-year-olds to whom MenB-vaccinators reported recommending a MenB vaccine in an average week was 11, or approximately 30% of those seen (FPs and GPs: 9, internists: 5, pediatricians: 13; Table A5; SO3). The mean number of 16–21-year-olds to whom MenACWY-vaccinators reported recommending the MenACWY vaccine in an average week was 13, or approximately 35% of those seen (FPs and GPs: 11, internists: 6, pediatricians: 17; Table A6; SO3).

Among MenB-vaccinators, 65% rated recommending MenB vaccination to 16–23-year-old patients as very important (FPs

and GPs: 59%, internists: 55%, pediatricians: 72%; SO4). In comparison, among MenACWY-vaccinators, 77% rated recommending a MenACWY booster to 16-year-old patients as very important (FPs and GPs: 67%, internists: 56%, pediatricians: 90%; SO4).

In a subgroup analysis, among MenB-vaccinators who correctly responded that MenB caused the highest proportion of meningococcal cases in the United States ( $n = 198$ ), 96% (FPs and GPs: 92%, internists: 100%, pediatricians: 97%) indicated that it was very important (74%) or moderately important (22%) to recommend the MenB vaccine. However, among MenB-vaccinators who did not respond correctly ( $n = 193$ ), most (92%) still indicated that it was very important (55%) or moderately important (37%) to recommend the MenB vaccine. Among MenB-vaccinators who correctly responded that the MenB vaccine is recommended under SCDM (85%;  $n = 334$ ), 22% (FPs and GPs: 28%, internists: 38%, pediatricians: 13%) discussed MenB vaccines sometimes or rarely.

When asked how recommending MenB vaccination using SCDM differed from recommending routine MenACWY vaccination, MenB-vaccinators reported spending more time educating patients on meningococcal disease (57%) and focusing more on patients' personal risks for meningococcal disease (57%; SO5). Additionally, 44% reported discussions taking longer (SO5).

While 78% of MenB-vaccinators reported having received training or other information (such as through academic lectures or materials from a pharmaceutical company), other than formal medical training, on implementing SCDM for MenB vaccines, 22% did not; lack of training varied by specialty (FPs and GPs: 23%, internists: 30%, pediatricians: 19%; SO6). Approximately half of MenB-vaccinators (51%) reported self-training using published or posted guidelines.

#### Decision-making in vaccine recommendation

Physicians were asked survey questions about their practices regarding recommending and discussing meningococcal vaccination. CDC immunization schedule (85%) and school/college requirements (81%) were the most frequently selected resources used for deciding whether to recommend meningococcal vaccines (SO7; Figure A2). The top factors that influenced MenB-vaccinators to discuss MenB vaccination were increased risk

among college students for those planning to go to college (85%); medical history, including comorbidities (66%); and recent in-state MenB outbreaks (43%; SO8; Table 1). Factors affecting whether MenB-vaccinators used SCDM to discuss MenB vaccination included SCDM allowing patients to be more active in the decision-making process (64%), SCDM introducing confusion among patients and health-care providers (30%), and SCDM leaving patients more vulnerable to contracting meningococcal disease caused by serogroup B (30%; SO5; Table 1).

Reasons for MenB-vaccinators not to initiate conversations regarding MenB vaccines included low patient motivation to be vaccinated (37%), patients not going to college (34%), and patients not disclosing risk factors (28%). Results varied by specialty (SO8; Table 1). Reasons for MenACWY-vaccinators not to recommend a MenACWY booster included lack of patients' confirmed medical history (38%) and the amount of time allotted to the office visit (28%). In addition, 40% of MenACWY-vaccinators did not specify any reasons not to recommend a MenACWY booster (SO8; Table 2).

#### Patient/parent vaccination acceptance barriers

Physicians selected perceived barriers to patients receiving meningococcal vaccination. Potential barriers to MenB vaccination for 16–23-year-olds, as reported by MenB-vaccinators, included lack of motivation to be vaccinated (73%), lack of knowledge of meningococcal disease (61%), and lack of understanding why both MenACWY and MenB vaccines are needed for protection against meningococcal disease (52%; SO8, Table 3).

Potential barriers for 16–21-year-olds receiving a MenACWY booster, as reported by MenACWY-vaccinators, included lack of motivation to receive the vaccine (62%), lack of knowledge of meningococcal disease (46%), and safety concerns (26%; SO8, Table 3).

#### Opportunities to improve vaccination rates

MenB- and MenACWY-vaccinators selected approaches for increasing rates of MenB vaccination and MenACWY booster vaccination, respectively. Suggested approaches included strongly recommending the vaccine (77% [FPs and GPs: 65%; internists: 69%; pediatricians: 89%] and 80% [FPs and GPs: 70%;

**Table 1**

Top factors influencing MenB vaccination recommendation to 16–23-year-old patients among MenB-vaccinators

Top factors influencing MenB-vaccinators...	Overall (N = 391)	FPs and GPs (n = 124)	Internists (n = 71)	Pediatricians (n = 196)
...to discuss MenB vaccine with patients aged 16–23 years				
Increased risk among college students for those planning to go to college	85%	79%	85%	88%
Medical history (including comorbidities)	66%	74%	77%	58%
Recent MenB outbreak(s) in the state	43%	40%	39%	46%
...to use SCDM regarding MenB vaccination with patients aged 16–23 years				
SCDM allowing patients to take a more active role in the decision-making process	64%	70%	72%	58%
SCDM introducing confusion among patients and health-care providers	30%	31%	23%	32%
SCDM leaving patients more vulnerable to contracting meningococcal disease caused by serogroup B	30%	27%	24%	34%
...not to initiate conversations on MenB vaccination				
Patient motivation to be vaccinated is low	37%	53%	27%	30%
Patient is not going to college	34%	35%	45%	30%
Patient does not disclose risk factors (e.g., crowded living situation, patient is a college student or plans to go to college, travels to area where the risk of meningitis is high)	28%	36%	37%	19%

FPs = family physicians; GPs = general practitioners; MenB = meningococcal serogroup B; SCDM = shared clinical decision-making.

internists: 71%; pediatricians: 89%], respectively), discussing the potential risks of not getting the vaccine (72% for both), and discussing the benefits and side effects of the vaccine (66% and 68%, respectively; SO9).

MenB- and MenACWY-vaccinators also identified resources for improving meningococcal vaccination initiation and completion, including availability of an electronic patient reminder and/or electronic medical records reminder/recall system (57% and 56%, respectively), routine use of their state's vaccine registry (55% and 56%, respectively), and availability of an electronic immunization information system (54% and 53%, respectively; SO9). Furthermore, MenB- and MenACWY-vaccinators suggested monitoring patients' vaccination records to ensure appropriate vaccination coverage according to the recommended schedule (61% for both), staff scheduling the next immunization visit before patients and/or caregivers leave the site (63% and 59%, respectively), and receiving training and staying up to date on vaccine recommendations (52% for both; SO9).

## Discussion

While 97% of surveyed physicians agreed that the ACIP guidelines set the standard for vaccination practices in the United States, we identified gaps in knowledge of meningococcal vaccination recommendations, particularly regarding the MenB vaccine recommendation under SCDM. Knowledge gaps regarding the ACIP vaccine recommendation guidelines were greater regarding the SCDM MenB vaccine recommendation versus the routine MenACWY booster recommendation, suggesting a lack of understanding/awareness of the MenB vaccine recommendation and/or SCDM. We also identified a lack of knowledge about the current MenB epidemiology, about the guidelines and sequencing of the MenACWY booster dose, and about the interchangeability of commercially available vaccines for both MenACWY and MenB. More pediatricians in this survey answered many questions on meningococcal vaccine recommendations correctly, compared to FPs/GPs and internists.

Overall, physicians surveyed in this study reported recommending MenB vaccines to approximately 30% of the 16–23-year-olds seen in an average week. This proportion is similar to the 2022 National Immunization Survey-Teen-estimated rate of 29.4% for  $\geq 1$  MenB vaccine dose in 17-year-old adolescents [11].

**Table 2**

Barriers to recommending a MenACWY booster to 16–21-Year-Old Patients among MenACWY-Vaccinators

Top barriers	Overall (N = 385)	FPs and GPs (n = 123)	Internists (n = 63)	Pediatricians (n = 199)
Patient's vaccination history cannot be confirmed	38%	46%	44%	31%
Amount of time allotted to the office visit	28%	45%	43%	14%
Lack of clarity in the guidelines	15%	22%	25%	7%
Meningococcal disease is rare	13%	21%	11%	8%
Side effects of the vaccine	8%	14%	10%	5%
Vaccine effectiveness	6%	12%	8%	2%
None of the above	40%	22%	24%	56%

FPs = family physicians; GPs = general practitioners; MenACWY = meningococcal serogroups A, C, W, and Y.

Strongly recommending the vaccine was the top approach suggested by MenB-vaccinators for improving rates of both MenB vaccination (77%) and MenACWY booster vaccination (80%); more pediatricians selected this approach (89% in each case) than physicians of other specialties. In addition, physicians reported that they initiated conversations on MenB vaccinations in 79% cases. Those approaches and practices may contradict the "shared" aspect of the MenB recommendation and indicate that the SCDM recommendation may be confused with the routine recommendation. Moreover, 30% of physicians perceived that SCDM introduces confusion among patients and health-care providers.

Recommending a MenACWY booster to 16-year-olds was rated as very important by more physicians (77%) than recommending a MenB vaccine to 16–23-year-olds (65%). However, most MenB-vaccinators (78%) always or almost always discussed MenB vaccination. College attendance was cited as an important factor of discussing MenB vaccination, both as a reason to discuss MenB vaccination with 16–23-year-olds going to college, and as a barrier to discussing MenB vaccination with those not going to college.

A 2016 survey of United States physicians found that 51% of pediatricians and 31% of FPs reported discussing MenB vaccine "always" or "often" [20]. Similarly, a 2017 survey of United States health-care providers (including FPs, internists, and pediatricians) found that 51% of those who prescribed MenB and MenACWY vaccination almost always discussed MenB vaccines with patients/parents [21]. Our results suggest an increased proportion of providers who discuss MenB vaccination with patients compared to previous findings. However, there was variability across specialties: although FPs and GPs, internists, and pediatricians saw comparable numbers of 16–23-year-olds weekly, pediatricians recommended the highest number of MenB and MenACWY vaccines weekly.

Differences in provider attitudes may result in unequal MenB vaccination opportunities among older adolescents and young adults. Considering the current low MenB vaccine rate (29.4% among 17-year-olds for at least one dose of the MenB vaccine) [11], our study suggests there may be opportunities to increase awareness of meningococcal vaccine recommendations via targeted education, particularly among FPs, GPs, and internists. Other approaches and resources may further improve MenB and MenACWY booster vaccination rates, such as electronic immunization information and patient reminder systems. Interestingly, most respondents reported prior experience with IMD. Future studies may address whether health-care providers' KAP are influenced by prior experience with patients with IMD in the target age group, especially since the two types of meningococcal vaccines were licensed.

The ACIP has different recommendations for the MenB vaccine and the MenACWY booster. The MenB vaccine may have been recommended under SCDM, rather than routinely, due to the low current incidence of MenB disease in the United States, limited understanding of vaccine effectiveness or duration of protection, and unclear impact on nasopharyngeal carriage and herd protection [22]. In our study, physicians reported that implementing SCDM for MenB vaccination required more time and discussion with patients compared to recommending the MenACWY booster. Our results suggest that the time required for SCDM may be a barrier to implementing the SCDM recommendation, and providers' time constraints may prevent discussing vaccination [23,24]. Therefore, targeted training for physicians,

**Table 3**

Top potential barriers that patients have to receiving meningococcal vaccination, reported by physicians

Top potential barriers for patients to receiving a MenB vaccine	Overall (N = 391)	FPs and GPs (n = 124)	Internists (n = 71)	Pediatricians (n = 196)
Patient's lack of motivation to receive the vaccine	73%	73%	73%	73%
Patient's lack of knowledge of meningococcal disease	61%	65%	59%	63%
Patient's lack of understanding/clarity why two different vaccines are needed for full protection against meningococcal disease	52%	56%	49%	49%
Top potential barriers for patients to receiving the MenACWY booster	Overall (N = 385)	FPs and GPs (n = 123)	Internists (n = 63)	Pediatricians (n = 199)
Lack of motivation to receive the vaccine	62%	73%	67%	54%
Lack of knowledge of meningococcal disease	46%	56%	43%	41%
Safety concerns	26%	36%	27%	21%

FPs = family physicians; GPs = general practitioners; MenACWY = meningococcal serogroups A, C, W, and Y; MenB = meningococcal serogroup B.

particularly for FPs, GPs, and internists, is needed. Specific training goals may include increased awareness of the current epidemiology of meningococcal disease among physicians in the United States, and improved understanding of implementing the SCDM recommendation for MenB vaccination. These measures may facilitate efficient discussions about MenB vaccination during health-care visits.

### Limitations

Limitations inherent to any survey-based study include potential lack of representation of the entire population by race, location, and patients' population, due to either selection bias and responder bias, or participants' actual practices due to social desirability bias. In addition, study participants were not asked to state their gender (since this factor was not believed to drive differentiation in vaccine practices). Furthermore, this study did not include physicians who did not recommend meningococcal vaccination. KAP regarding meningococcal vaccination may also differ among physicians who choose to participate in a research panel and those who do not. Few physicians working in solo private practices, managed care/health maintenance organizations, or outpatient clinics participated; therefore, the results may not be generalizable to these categories of providers. Therefore, the results of this study may not be generalizable to all United States physicians. Self-reporting was another limitation, as survey completion timing was not controlled (possibly allowing physicians to research knowledge-related questions), and self-reported data could not be corroborated. To minimize this limitation, survey participants could not change their answers to previous questions. Learning bias was also a possible limitation, as the order of survey questions was not randomized [25]. Finally, although this study surveyed only physicians, other health-care professionals, such as nurse practitioners, physician assistants and pharmacists, also recommend meningococcal vaccines, presenting an opportunity for future studies to investigate their KAP.

### Conclusions

There was higher perceived importance regarding recommending the MenACWY booster dose compared to the MenB vaccine, possibly due to differences in recommendation guidelines and associated recommendation-related knowledge gaps among physicians. The MenB vaccine recommendation under SCDM for adolescents and young adults is inconsistently

interpreted, especially among FPs, GPs, and internists, as an appreciable proportion of vaccinators in those specialties did not regularly discuss MenB vaccination. Targeted training of physicians may improve knowledge of meningococcal disease and understanding of vaccination recommendations.

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### Supplementary Data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jadohealth.2023.11.394>.

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