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Physician Attitude, Awareness, and Knowledge Regarding Guidelines for Transcranial Doppler Screening in Sickle Cell Disease

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Abstract

Objective. We explored factors that may influence physician adherence to transcranial Doppler (TCD) screening guidelines among children with sickle cell disease. *Methods*. Pediatric hematologists, neurologists, and primary care physicians (n = 706) responded to a mailed survey in May 2012 exploring factors hypothesized to influence physician adherence to TCD screening guidelines: physician (internal) barriers and physician-perceived external barriers. Responses were compared by specialty using chi-square tests. *Results*. Among 276 physicians (44%), 141 currently treated children with sickle cell disease; 72% recommend screening. Most primary care physicians (66%) did not feel well informed regarding TCD guidelines, in contrast to neurologists (25%) and hematologists (6%, $P < .0001$). Proportion of correct answers on knowledge questions was low (13%-35%). Distance to a vascular laboratory and low patient adherence were external barriers to receipt of TCD screening. *Conclusions*. Additional research regarding physicians' lack of self-efficacy and knowledge of recommendations could help clarify their role in recommendation of TCD screening.

Keywords

sickle cell disease, transcranial Doppler ultrasonography, guidelines, survey, children

Introduction

Sickle cell disease (SCD) is a chronic condition with extensive morbidity that predominately affects minority children and increases the risk of stroke, a leading cause of childhood death and disability.[1-3] Without intervention, approximately 11% of children with SCD would have a stroke by 20 years of age; however, many of these strokes are now preventable.[1,4-6] Transcranial Doppler (TCD) screening detects high blood flow velocities in cerebral vessels which indicate an increased stroke risk and signal the need to initiate chronic blood transfusions as a key stroke prevention strategy.[4,7,8] *The Stroke Prevention Trial in Sickle Cell Anemia*, published in 1998, showed once transfusions are initiated, stroke incidence is sharply reduced by up to 90% relative to standard medical care.[4]

Given its importance as a stroke prevention strategy, numerous national organizations have released guidelines recommending TCD screening among children with SCD. However, these guidelines differ substantially in key areas, with the National Heart Lung and Blood Institute (NHLBI) providing the most specific guidelines.[9-11] Adherence to clinical practice guidelines such as these has been demonstrated to be beneficial in improving health outcomes for patients across many specialties.[12-16] Despite these findings, physician adherence to guidelines remains low, particularly in the clinical specialty of pediatrics.[17-21] Ambiguities and differences in these guidelines may lead to variability in physicians' recommendation of TCD screening among children with SCD, as suggested by the low rates of screening observed in numerous settings.[22-25]

Importantly, children with SCD have significantly higher healthcare utilization than children without SCD,

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indicating that opportunities for recommending TCD screening exist.[2] Because the degree of physician adherence to TCD screening guidelines may influence screening rates, our objective was to explore factors that may be related to adherence such as physicians' awareness, attitudes, and knowledge of TCD screening guidelines for children with SCD. We also assessed physician-perceived external barriers to administration of TCD screening in children with SCD among primary and specialty care physicians.

Methods

Study Population

Pediatric hematologists, pediatric neurologists, and primary care physicians (PCPs) were chosen as the study population as these physicians would be most likely to treat children with SCD. Pediatric hematologists and pediatric neurologists (n = 250 each because of cost limitations) were randomly sampled across the United States (because of insufficient numbers of these specialties in the state of Michigan) from the American Medical Association (AMA) Physician Masterfile. The AMA Masterfile is a continuously updated list of all physicians in the United States which includes both members and nonmembers of the AMA. PCPs were identified as physicians with a certification in general pediatrics, family medicine, or adolescent medicine treating children with SCD. To increase the likelihood of the physician treating a child with SCD, PCPs were included if they had 1 or more Michigan Medicaid claims reporting an International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9 CM) diagnosis code for SCD from 2008-2012 (n = 206). Consistent with other studies, we included diagnosis codes for sickle cell anemia (282.60, 282.61, 282.62), Hb SC (282.63, 282.64), Hb SD (282.68, 282.69), and Hb S β thalassemia (282.41 and 282.420).[26-28] Medicaid claims for states other than Michigan were not available to identify physicians treating children with SCD in these states.

Survey Development, Content, and Administration

The physician survey was developed by the lead author (SLR) and revised based on input from the research team. Elements of the survey were chosen based on the framework presented by Cabana et al,[29] which organized physician barriers into 7 major categories. Our survey content was developed based on factors hypothesized to influence physician adherence to TCD guidelines specifically and included the following: physician (internal) barriers (awareness, attitudes, and knowledge of guidelines), physician-perceived external barriers, and physician and practice characteristics (Figure 1, adapted from Cabana et al[29]).

Awareness of TCD screening guidelines was assessed through questions about familiarity and accessibility of national guidelines for TCD screening. Attitudes regarding TCD screening for children with SCD were assessed through agreement with a series of statements regarding outcome expectancy (SCD stroke risk, predictive value of TCD results, chronic exchange transfusion), perception of guidelines (strength of evidence, conflicting guidelines), and self-efficacy (comfort caring for children with SCD and with TCD screening, ability to reduce stroke risk). Knowledge of TCD screening guidelines for children with SCD was assessed through a series of multiple choice and open-ended questions regarding types of SCD to screen, ages to initiate and terminate screening, and actions to take based on TCD screening results. Correct responses to knowledge questions were based on agreement with NHLBI[9] guidelines for treatment of children with SCD, as these guidelines are the most specific regarding TCD screening among children with SCD and are often used among clinics developing TCD screening programs.[30] Physician-perceived external barriers to TCD screening focused on agreement with statements in 3 main areas: access/environmental barriers, patient barriers, and administrative barriers. Level of agreement with each attitude and external barrier statement was assessed using a 5-point Likert-type scale: *strongly disagree* (1) to *strongly agree* (5). Physician and practice characteristics assessed were physician's sex, race, ethnicity, age, years of practice, specialty, hours of general continuing medical education, patient characteristics, and practice affiliation. The complete survey is included in online appendix A (http://clp.sagepub.com/content/by/supple-mental-data).

The survey was piloted for content and clarity with at least 1 physician from each specialty and questions were modified based on feedback. The survey was administered via priority mail in May 2012 with a $2 incentive included. A follow-up mailing was conducted among nonrespondents without an incentive in June 2012. Survey collection was closed on December 31, 2012.

Eligibility

Physicians were eligible to complete the survey if the survey was deliverable and they indicated on the survey that she or he currently provided care for children with SCD. All eligible physicians were asked to answer questions regarding attitudes and perspectives on TCD

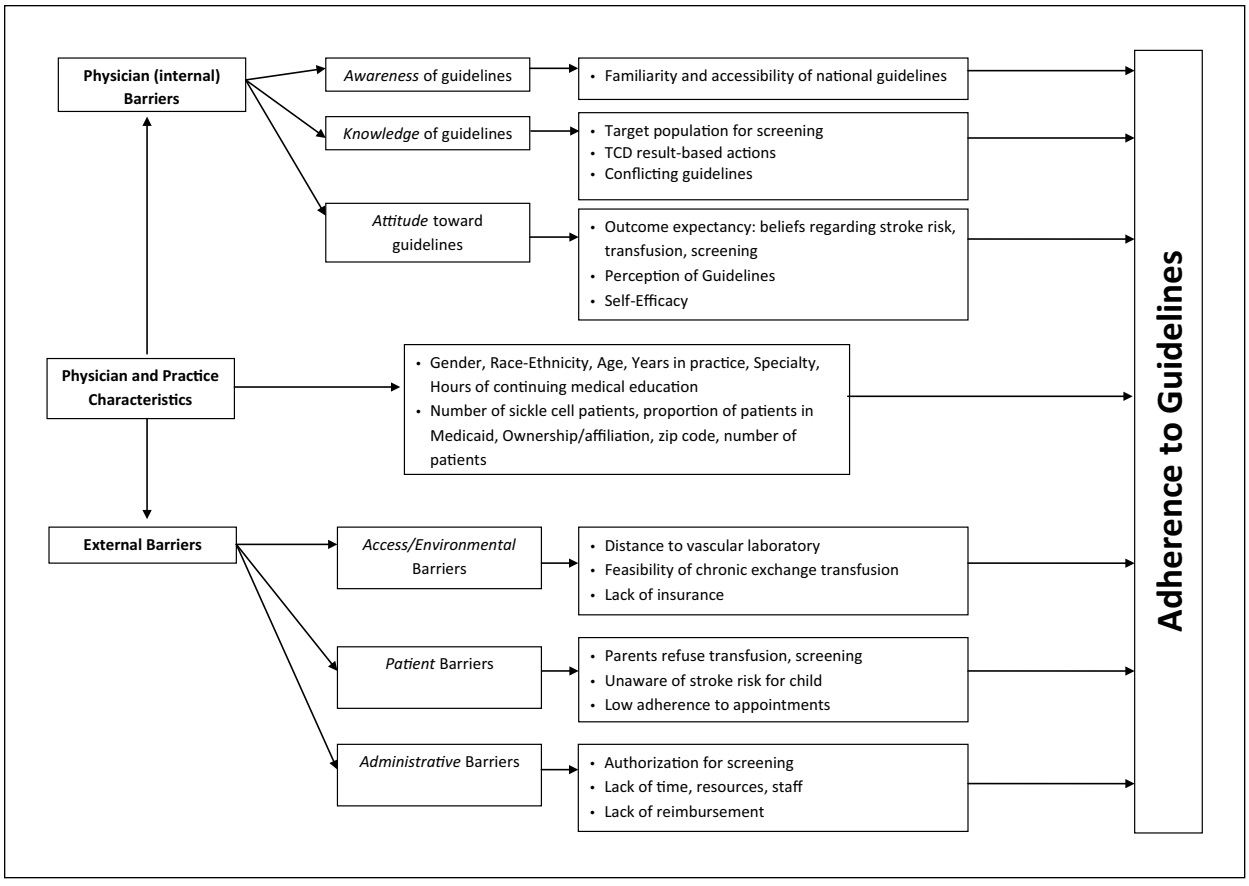

Figure 1. Potential factors influencing physician adherence to transcranial Doppler screening guidelines.[a]
[a]Adapted from Cabana et al.[29]

screening and physician and practice characteristics. Physicians who believed patients with SCD should receive TCD screening (92%) were then asked to answer questions regarding knowledge of specific guidelines and physician perceived external barriers, as these physicians would be the most appropriate recipients of interventions aimed at increasing adherence to screening guidelines.

Statistical Analysis

Means and standard deviations (SD) or frequencies and percentages were calculated for physician and practice demographics. Responses regarding attitudes toward guidelines regarding TCD screening and external barriers were collapsed into categories of agree (strongly agree or agree) or disagree (strongly disagree, disagree, neutral) and compared across specialties using chi-square tests. Knowledge of specific NHLBI guidelines was calculated as the proportion of questions answered correctly (6 knowledge questions were included in the survey) and compared across specialties using Fisher's exact tests because of small sample size for some cells. Frequencies of responses for all other questions were calculated overall and by specialty.

The study was approved by the institutional review board of the University of Michigan (#HUM000525-47).

Results

A total of 706 physicians were sent surveys; 65 were undeliverable, 8 physicians had retired, and 276 were returned by the respondent (44% response rate among deliverable surveys). Among the 276 respondents, 141 (51%) physicians currently treated children with SCD (28% PCPs, 21% pediatric neurologists, and 51% pediatric hematologists). Among these physicians, 61% were male, 73% were white, 18% Asian or Pacific Islander, 4% black, and 4% other, and 4% were of Hispanic origin. The average respondent was 52 years old (SD 11 years) and had been practicing for 19 years (SD 12 years). The respondents varied by other practice and physician

Table 1. Characteristics of Physicians Treating Children With Sickle Cell Disease Responding to Survey (n = 141).

	n (%)
Sex	
Male	84 (60)
Female	53 (38)
Race	
White	99 (70)
Black	6 (4)
Asian/Pacific Islander	24 (17)
Other	6 (4)
Ethnicity	
Non-Hispanic	126 (89)
Hispanic	5 (4)
Age in years, mean (SD)	52 (11)
Years of practice, mean (SD)	19 (12)
Specialty	
Pediatric hematology	72 (51)
Pediatrics/family medicine (PCPs)	40 (28)
Pediatric neurology	29 (21)
Hours of CME per month	
<1	3 (2)
1-5	81 (57)
>5	55 (39)
Pediatric patients with sickle cell disease (%)	
<5	78 (55)
5-10	24 (17)
11-20	14 (10)
>20	22 (16)
Pediatric patients covered by Medicaid (%)	
<5	7 (5)
5-24	19 (13)
25-49	41 (29)
>50	65 (46)
Primary practice ownership	
Private office	21 (15)
University/hospital/medical center	91 (65)
Practice network	10 (7)
Sickle cell center	13 (9)
Combination	2 (1)
Pediatric patients per year	
1-500	34 (24)
501-1500	53 (38)
1501-3000	37 (26)
>3000	14 (10)

Abbreviations: PCP, primary care physicians; CME, continuing medical education.

characteristics (Table 1). Overall, 127 (92%) out of the 141 respondents who treat children with SCD believed that children with SCD should receive TCD screening (82% PCPs, 90% pediatric neurologists, 99% pediatric hematologists) and of these, 97 (72%) currently recommend screening to their patients (34% PCPs, 64% pediatric neurologists, 94% pediatric hematologists). Reasons for not recommending TCD screening included referring the patient to a hematologist (n = 17), another doctor (n = 2), or a sickle cell center (n = 4) for screening, or lack of familiarity with guidelines (n = 6).

Internal Barriers: Awareness

Sixty-seven percent of eligible respondents indicated they were extremely, very, or moderately familiar with national guidelines regarding TCD screening among children with SCD (30% of PCPs, 61% of pediatric neurologists and 90% of pediatric hematologists, $P < .0001$), and 33% indicated they were slightly or not at all familiar. If more information was needed regarding TCD screening, 66% of respondents indicated they would refer to the American Academy of Pediatrics (AAP), 44% the NHLBI, 35% Up To Date Inc (an online, evidence-based clinical support resource), 26% the American Academy of Neurology, and 5% the American Heart Association. Other sources of information included the American Society of Hematology (n = 5), other doctors or centers (n = 5) or research papers, textbooks, other Websites or guidelines (n = 8).

Internal Barriers: Attitudes

Attitudes regarding TCD screening among children with SCD differed by statement and among specialties (Table 2). Most physicians felt comfortable caring for children with SCD and believed these children have a high risk of stroke. Additionally, most had positive perceptions of guidelines with few indicating that guidelines were based on questionable evidence or that conflicting guidelines existed. The majority (64%) of PCPs did not feel well informed regarding TCD guidelines, whereas only 28% of pediatric neurologists and 7% of hematologists did not feel well informed ($P < .0001$). Self-efficacy questions revealed similar specialty patterns, with PCPs feeling most uncomfortable discussing risks and benefits of TCD screening with patients and families and their ability to reduce stroke risk in patients with SCD. The vast majority of physicians would recommend chronic exchange transfusion based on abnormal TCD results (95% PCPs, 99% pediatric neurologists, and 93% pediatric hematologists).

Internal Barriers: Knowledge

Among physicians who believe children with SCD should receive TCD screening (n = 127), the proportion of knowledge questions answered correctly based on

Table 2. Agreement With Physician Perceptions and Attitudes Regarding Transcranial Doppler Screening (n = 141).

Statement	n (%)				
	Overall[a]	Primary Care Physicians[a] n = 40	Pediatric Neurology[a] n = 29	Pediatric Hematology[a] n = 72	*P* Value[b]
I feel comfortable caring for children with sickle cell disease.	119 (86)	28 (71)	20 (71)	71 (99)	<.001
Children with sickle cell disease have a high risk of stroke.	130 (93)	34 (87)	29 (100)	67 (93)	.13
I do not feel well informed regarding transcranial Doppler ultrasonography guidelines for children with sickle cell disease.	38 (27)	25 (64)	8 (28)	5 (7)	<.001
I do not feel comfortable discussing risks and benefits of transcranial Doppler ultrasonography with my patients and their families.	36 (26)	21 (54)	7 (24)	8 (11)	<.001
Guidelines for transcranial Doppler ultrasonography for children with sickle cell disease are based on questionable evidence.	7 (5)	5 (13)	0 (0)	2 (3)	.02
There are conflicting guidelines regarding transcranial Doppler ultrasonography for children with sickle cell disease.	15 (11)	7 (18)	3 (10)	5 (7)	.18
Transcranial Doppler ultrasonography results predict stroke risk.	96 (69)	14 (37)	17 (59)	65 (90)	<.001
I am confident in my ability to reduce the risk of stroke in my patients with sickle cell disease.	68 (49)	6 (16)	12 (41)	50 (69)	<.001
I will not recommend chronic exchange transfusion regardless of transcranial Doppler ultrasonography results.	5 (4)	2 (5)	2 (7)	1 (1)	.34
Chronic exchange transfusion is effective at reducing stroke risk among children with sickle cell disease.	108 (78)	18 (46)	24 (83)	66 (93)	<.001
Hydroxyurea is effective at reducing stroke risk among children with sickle cell disease.	54 (39)	17 (44)	10 (36)	27 (39)	.79
I am comfortable discussing the risks and benefits of chronic exchange transfusion with my patients and their families.	89 (64)	13 (33)	10 (34)	66 (93)	<.001

[a]Up to 4 physician responses missing (varies by statement).
[b]*P* value comparing percentage agreement across physician specialties.

NHLBI guidelines was low. Overall, the question with the highest percentage of correct responses was the age to begin TCD screening (35% correct), and the lowest was actions to take on an abnormal TCD screening result (13% correct). Percentage of correct responses differed among specialty, with PCPs and pediatric neurologists consistently scoring lower than pediatric hematologists (Table 3).

External Barriers

Two physician-perceived external barriers were reported by the majority of physicians to hinder receipt of TCD screening; distance to a vascular laboratory (51%) and low patient adherence to TCD appointments (56%). In general, PCPs selected more barriers than pediatric neurologists or hematologists. Physician-perceived external

Table 3. The Proportion of Knowledge Questions Answered Correctly Based on National Heart Lung and Blood Institute Guidelines (n = 127).

Knowledge Topic	Overall (%)	Primary Care Physicians n = 31 (%)	Pediatric Neurologist n = 26 (%)	Pediatric Hematologist n = 70 (%)	*P* Value[a]
Age to begin TCD Screening	35	16	12	53	<.0001
Age to end TCD screening	20	3	8	33	.0003
Sickle cell subtypes to screen	31	13	0	50	<.0001
Actions to take with normal TCD result	31	10	15	46	.0002
Actions to take with conditional TCD result	22	10	12	33	.01
Actions to take with abnormal TCD result	13	3	4	20	.02

Abbreviation: TCD, transcranial Doppler ultrasonography.
[a]*P* value comparing percentage correct across physician specialties.

barriers differed across specialties for the majority of barriers (Table 4).

Discussion

Abnormal TCD results in children with SCD are associated with a high risk of stroke and should prompt stroke prevention efforts in the form of chronic blood transfusions. Although the effectiveness of blood transfusion for stroke prevention has been known since the late 1990s, rates of TCD screening among children with SCD have remained low.[4,23] Physicians' awareness, attitudes, and knowledge of TCD guidelines for children with SCD may influence physician recommendation of TCD screening; however, no study has investigated these internal factors. In our study, the majority of physicians believed children with SCD have a high risk of stroke and should receive TCD screening, but familiarity with guidelines, self-efficacy, and knowledge of NHLBI-specific guidelines were low, particularly among PCPs, and differed considerably by specialty. Additionally, we identified distance from child's home to a vascular laboratory and patient adherence to appointments as physician-perceived external barriers.

Among attitudes regarding TCD guidelines, self-efficacy (comfort discussing risks and benefits of TCD screening and blood transfusions, ability to reduce stroke risk among patients) and outcome expectancy (TCD predicts stroke risk, blood transfusions reduce stroke risk) showed the largest specialty differences, with PCPs and pediatric neurologists consistently rating themselves lower in these categories than pediatric hematologists. However, the overall proportion of physicians with high self-efficacy and outcome expectancy was still low, indicating a need for improvement in these areas across all specialties. Interventions focusing on improving self-efficacy among physicians, such as educational toolkits, formal clinical training, and increased availability of educational resources have been successful in increasing confidence and knowledge among physicians across the board.[31-33] As most physicians felt comfortable caring for children with SCD, these educational interventions might be best focused on increasing physician knowledge of the risks and benefits of TCD screening and blood transfusions, as these were areas in need of improvement among all physicians. These educational targets are in line with the SCD-related research agenda released by the NHLBI which identified clear, evidence based guidelines for physicians as a priority,[34] and numerous quality improvement collaborations focused on improving care and outcomes among children with SCD.[35] Influencing attitudes through enhancement of knowledge and confidence may positively affect adherence to guidelines, especially among PCPs and pediatric neurologists, although this requires further study.

With regard to knowledge, questions about next steps for abnormal TCD results were answered incorrectly with the highest frequency. This indicates the need for increased physician education regarding actions to take based on TCD screening results since these actions are the basis for stroke prevention efforts. Also, questions about ages to begin and end screening were answered incorrectly by the majority of respondents which could potentially lead to differential TCD screening rates by age. As hematologists' knowledge and familiarity regarding guidelines was higher than neurologists and PCPs, increased referral by other physicians to hematologists could be an important driver of increased TCD screening. This may be especially true considering only one third of PCPs reported recommended screening to their patients and the majority of PCPs who did not recommend screening referred the patient to a hematologist

Table 4. Agreement With Physician-Perceived Barriers for Receipt of Transcranial Doppler Screening (n = 127).

Statement	n (%) Agree With Statement				
	Overall Agreement[a]	Primary Care Physicians[a] n = 31	Pediatric Neurology[a] n = 26	Pediatric Hematology[a] n = 70	*P* Value[b]
Distance from patients' homes to vascular laboratories is a barrier to receipt of transcranial Doppler ultrasonography.	64 (51)	19 (63)	7 (27)	38 (54)	.02
Authorization from private insurance carriers is a barrier to receipt of transcranial Doppler ultrasonography.	38 (30)	15 (50)	10 (38)	13 (19)	.004
Authorization from Medicaid is a barrier to receipt of transcranial Doppler ultrasonography.	26 (21)	11 (37)	7 (27)	8 (11)	.01
Lack of time/resources to describe risks and benefits to my patients and families is a barrier to receipt of transcranial Doppler ultrasonography.	25 (20)	16 (53)	4 (15)	5 (7)	<.001
Parental refusal is a barrier to receipt of transcranial Doppler ultrasonography.	32 (26)	12 (40)	3 (12)	17 (24)	.06
Reimbursement from private insurance carriers is a barrier to receipt of transcranial Doppler ultrasonography.	28 (22)	15 (50)	8 (31)	5 (7)	<.001
Reimbursement from Medicaid is a barrier to receipt of transcranial Doppler ultrasonography.	22 (18)	10 (33)	8 (31)	4 (6)	<.001
Lack of appropriate staff to interpret results is a barrier to receipt of transcranial Doppler ultrasonography.	26 (21)	7 (23)	7 (27)	12 (17)	.53
Low patient adherence to appointments is a barrier to receipt of transcranial Doppler ultrasonography.	70 (56)	18 (60)	6 (24)	46 (66)	.001
Lack of insurance is a barrier to receipt of transcranial Doppler ultrasonography.	40 (32)	15 (50)	8 (31)	17 (24)	.04
Lack of parental belief that their child is at an increased risk for stroke is a barrier to receipt of transcranial Doppler ultrasonography.	51 (41)	14 (47)	10 (38)	27 (39)	.73

[a]Up to 3 physician responses missing (varies by statement).
[b]*P* value comparing percentage correct across physician specialties.

for TCD screening. Since treatment guidelines for children with SCD recommend frequent contact with hematologists, patient adherence to these specialist appointments may be integral to increasing TCD screening rates. However, it may also be important to continue to increase knowledge of TCD guidelines among PCPs, as not all children will see a hematologist each year. Although hematologists did answer the knowledge questions correctly with the highest frequency, the proportion of correct answers among hematologists was low. There is still substantial room for improvement in their knowledge of specific guidelines, particularly if they are perceived as the primary initiator of TCD screening among children with SCD.

Our survey showed the AAP to be the most common source referenced for information regarding TCD screening. These guidelines are the most ambiguous given their recommendation that TCD screening should be discussed, if available.[11] While both the NHLBI[9] and American Heart Association[10] strongly recommend TCD screening, their respective guidelines differ with regard to recommended ages for screening, frequency of screening and actions to be taken based on screening results. The AAP's more ambiguous recommendation has provoked controversy among pediatricians who feel stronger guidelines are warranted.[36] We used the NHLBI guidelines as the standard for knowledge which may have influenced our results with respect to the proportion of correct answers.[24,30]

Few studies exist regarding physician-perceived external factors that may influence TCD screening rates. We found that physicians perceive lack of adherence to appointments and distance to a vascular laboratory to be barriers to the receipt of TCD screening. Data from a recent study showed 72% of hematologists identified patient adherence to appointments to be a barrier to TCD screening.[37] The finding that distance to a vascular laboratory may be a barrier is also supported by research in a large, managed health care plan that found living within 30 miles of a vascular laboratory was the only independent predictor for receipt of TCD screening.[23] One option to address this particular barrier to TCD screening could include offering TCD screening onsite at hematology clinics, as this eliminates travel to a vascular laboratory and has been shown to increase screening rates.[30] Although both this study and ours indicated that physicians perceive patient-oriented issues to be the main barriers to receipt of TCD screening, lack of knowledge, and self-efficacy are perceived by caregivers as greater barriers to screening than practical issues such as transportation and appointment adherence.[38] The disagreement between patient and provider perceptions of barriers to TCD screening indicates that further study is necessary among both patient guardians and providers to identify which external factors influence screening rates in order to develop interventions that focus on the correct targets.

Some limitations of this work warrant discussion. The main limitation for this study is the 44% response rate among physicians; however, this response rate is in line with other physician survey response rates.[39-41] Nonresponse rates among deliverable surveys were similar across specialties, with 58% of PCPs, 58% of pediatric neurologists, and 54% of pediatric hematologists not returning deliverable surveys. The AMA Masterfile as a source to identify all pediatric hematologists and neurologists in the United States may have been incomplete and not included all specialists. As the survey was focused on self-report, bias may exist on multiple aspects of the survey, such as awareness and attitudes regarding screening practices. Use of PCPs only in the state of Michigan may limit the generalizability. Also, we did not investigate physician initiation of blood transfusion for patients regardless of TCD screening. It is possible that some doctors begin stroke prevention efforts without prior use of TCD results, although this would not be consistent with current guideline recommendations. Given the results of our survey, we were unable to determine if the existence of multiple guidelines, lack of physician adherence to guidelines, or other factors are contributing to the low screening rates; however, we were able to identify factors that may affect adherence for future intervention targets.

Conclusion

Factors such as awareness, attitudes, and knowledge of specific guidelines may influence physician adherence to TCD screening recommendations. Additional research regarding these barriers is necessary to understand their role in physician recommendation of TCD screening, specifically in the areas of physicians' lack of self-efficacy and knowledge of recommendations as we found these to be low across all specialties. This additional research could assist in the development of targeted interventions to increase TCD screening among children with SCD. As significant differences were found among specialties, specialty-specific education may be important to improve TCD screening rates; however, substantial room for improvement exists across all specialties. Targets for increasing TCD screening among children with SCD must continue to be identified in order to prevent the devastating consequences of stroke in this high-risk population.

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Declaration of Conflicting Interests

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