The Importance of Echocardiography in Physicians' Support of Endocarditis Prophylaxis

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Background: Guidelines advocate for antimicrobial prophylaxis for prevention of bacterial endocarditis. Our objective was to explore physicians' perspectives regarding the importance of echocardiography in the evaluation and management of endocarditis prophylaxis.

Methods: A total of 260 cardiologists and 300 family physicians practicing in Ontario, Canada, were surveyed. Our main outcome measures were physician ratings of the importance of a murmur, echocardiogram findings, echocardiogram comments, comorbid conditions, guidelines, patient insistence, and medicolegal concerns on the decision to recommend prophylaxis, as well as the degree of echocardiographically detected mitral valve abnormality required prior to recommending prophylaxis.

Results: The survey response rate was 62%. Echocardiographic findings were rated by 81% of physicians as the most important factor influencing the decision to provide prophylaxis. Conversely, only 27% of physicians placed similar importance on clinical findings. Family physicians relied more heavily on echocardiographic than on clinical findings when supporting endocarditis prophylaxis recommendations. On average, prophylaxis was recommended for moderate to severe regurgitation in a normal valve and mild regurgitation in a mildly abnormal structural mitral valve. Physicians who reported greater reliance on echocardiographic findings advocated for prophylaxis at lower echocardiographic thresholds than did those who reported greater reliance on murmur detection for endocarditis prophylaxis decisions.

Conclusions: Physicians strongly support the use of echocardiography in endocarditis prophylaxis decision making. However, the importance of echocardiography relative to other factors varies across physician specialties. Further studies must evaluate the role of echocardiography in the assessment and management of antimicrobial endocarditis prophylaxis to assist in the development of clear clinical guidelines.

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BACTERIAL ENDOCARDITIS IS rare but life threatening. Guidelines produced by the American Heart Association in 1997,[1] the Société Française de Cardiologie in 2002,[2] the European Society of Cardiology in 2004,[3] and the British Society for Antimicrobial Chemotherapy in 2005[4] continue to recommend antimicrobial endocarditis prophylaxis for patients with native valvular heart disease who undergo certain medical procedures despite the absence of randomized controlled trial evidence of efficacy and the cost and risk of antibiotic-related complications associated with the provision of prophylactic antibiotics.[5]

One might argue that the economic and outcome impact of endocarditis prophylaxis in the population is dependent on the screening methods used to identify eligible candidates. For example, the broader incorporation of echocardiography into the clinical decision-making process may identify subclinical valvular abnormalities that pose modest risks for infective endocarditis, which might otherwise not have been detectible through physical examination alone. However, the role of echocardiography in the evaluation and management of endocarditis prophylaxis remains unclear.[6-9] To our knowledge, no study has systematically explored health care provider perspectives regarding the importance of echocardiography in relation to other factors (eg, murmur detection) for supporting endocarditis prophylaxis recommendations.

Accordingly, the purpose of this study was 2-fold[1]: to determine the self-reported importance physicians place on echocardiography relative to other factors when supporting recommendations for endocarditis prophylaxis and to determine physicians' self-reported thresholds to support recommendations for endocarditis prophylaxis against native valve endocarditis. Given significant variations in cardiovascular evaluation and management strategies across physician specialties,[7,10-16] we hypothesized that the support of echocardiography and its impact on endocarditis prophylaxis recommendations would vary significantly between cardiovascular specialists and primary care providers.

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Table 1. Physician Estimation of the Percentage of Echocardiograms Ordered to Determine if Endocarditis Prophylaxis Is Required*

	% Echocardiograms Ordered†				
Specialty	**<1**	**1-10**	**11-20**	**21-30**	**31-40**
Family physician	34 (26)	55 (42)	18 (14)	5 (4)	15 (12)
Cardiologist	57 (34)	94 (56)	15 (9)	0	1 (1)
Total	**91** (31)	**149** (50)	**33** (11)	**5** (2)	**16** (6)

*Data are given as number (percentage) of physicians.
†P = .002 (Mantel-Haenszel test for trend) was determined for differences in the percentage of echocardiograms ordered by family physicians vs cardiologists.

METHODS

PARTICIPANTS

All Ontario adult cardiologists (n = 260) and a random sample of Ontario family physicians (n = 300) were surveyed by mail. Individuals were excluded if they were not currently practicing as a family physician or adult cardiologist in Ontario, did not read English, or could not be contacted. To ensure confidentiality, all surveys were collected by an independent agency. There was no monetary benefit for participating.

SURVEY

Questions 1 to 3 of the survey examined physicians' affiliation with an academic center, specialty, and years in practice. The fourth question used a Likert-type scale (1, not important, to 5, very important) to determine the self-reported importance of murmur, echocardiogram findings, specific echocardiogram comment, comorbid conditions, guidelines, patient insistence, and medicolegal concerns on supporting recommendations for endocarditis prophylaxis. The fifth question asked physicians to estimate the number of echocardiograms ordered in their practice specifically to determine if prophylaxis is required. The final series of questions examined physician self-reported echocardiographic thresholds for supporting antibiotic prophylaxis recommendations by incorporating scenarios that sequentially worsened the degree of structural mitral valve abnormalities and associated regurgitation severity. We focused on mitral valve abnormalities in these scenarios given its high prevalence in the general population.[17,18]

STATISTICAL ANALYSIS

The Wilcoxon signed rank test was used to determine the presence of a significant ordering to the importance of the 7 clinical factors; the Bonferroni correction was applied when determining the importance of sequential factors influencing endocarditis prophylaxis decision making (resulting in a statistical significance threshold of $P<.008$). The χ^2 test was used to determine the existence of a significant difference between cardiologists' and family physicians' ratings of importance of each of the 7 clinical factors as well as their self-reported threshold of valvular regurgitation prompting their recommendation of endocarditis prophylaxis; if significance was achieved, the Mantel-Haenszel test of linear association was subsequently performed. The Spearman rank correlation test was performed on paired data to determine any correlation between the self-reported importance of each of the 7 clinical features and demographic variables as well as the self-reported threshold of valvular regurgitation prompting the recommendation of endocarditis prophylaxis. $P<.05$ was considered statistically significant. Data were analyzed with SAS software (SAS Institute, Cary, NC). Ethics approval was obtained from the Sunnybrook and Women's College Health Sciences Centre Research Ethics Board, Toronto, Ontario.

RESULTS

Of the 560 potential participants, 73 were excluded (54 family physicians [31 underwent further specialist training and no longer practice as a family physician, 19 retired, and 4 with no current contact address in Ontario] and 19 cardiologists [10 not actively practicing as an adult cardiologist, 5 with no current contact address in Ontario, 3 not English speaking, and 1 deceased]). We received 300 completed surveys for an overall response rate of 62% (300/487 = 62% overall response; 168/241 = 70% cardiologists' response; and 132/246 = 53% family physicians' response). Most responders were male (74%), practiced within a city (86%), and graduated from medical school after 1982 (67%). Of the responders, 49% maintained an academic affiliation (74% cardiologists vs 25% family physicians; $P<.001$). There was no significant difference between responders and nonresponders with regard to sex, location of practice, and year of graduation.

Physicians estimate that only a minority of echocardiograms in their clinical practice are ordered to determine the need for endocarditis prophylaxis (**Table 1**). However, family physicians reported that endocarditis prophylaxis comprised a significantly larger proportion of their referral indications for echocardiography than did cardiologists ($P = .002$).

The **Figure** and **Table 2** rank the importance of each factor's influence on physician decision-making perspectives for endocarditis prophylaxis. Echocardiography was rated as the most important factor that had an impact on the support of endocarditis prophylaxis recommendations; 81% of all respondents ranked echocardiography as extremely important. In contrast, only 27% of physicians rated the presence of a murmur to be of extreme importance. Cardiologists reported a greater emphasis on clinical examination ($P = .005$) and lesser emphasis on echocardiography ($P = .01$) in supporting recommendations for prophylaxis compared with their primary care provider counterparts. While other factors were viewed as being of lesser importance than echocardiography, 80% of physicians acknowledged that comorbidity and medicolegal concerns played some role in their support of endocarditis prophylaxis, while 71% of physicians rated clinical guidelines as being of extreme importance in their support of endocarditis prophylaxis.

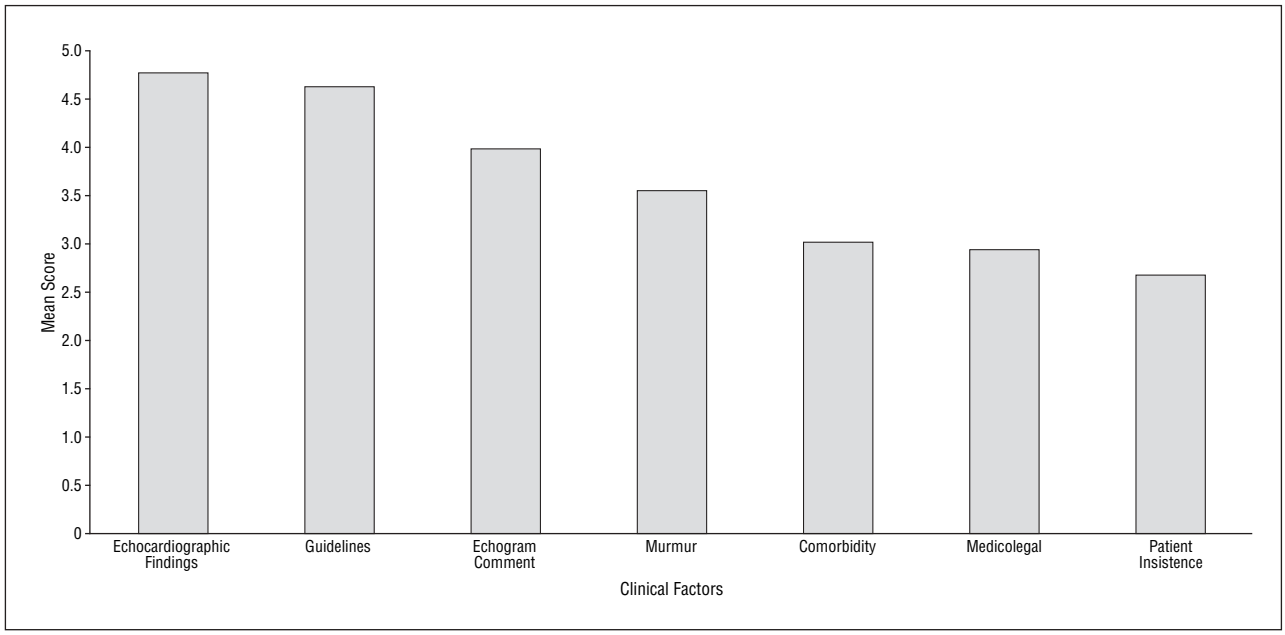

Figure. Mean ranking of importance of each clinical factor influencing the decision to recommend endocarditis prophylaxis. *P* value was obtained using the Wilcoxon signed rank test. The Bonferroni correction was used for the sequential analysis of the individual factors. $P<.001$ for the sequential comparison of each factor except medicolegal vs patient insistence, which was $P=.002$

In general, self-reported thresholds for supporting recommendations for endocarditis prophylaxis reflected the following: (1) moderate to severe regurgitation in a normal mitral valve; (2) mild mitral regurgitation with a mildly abnormal structured valve; and (3) always provide prophylaxis in a moderate to severely abnormally structured mitral valve (**Table 3**). Family physicians supported endocarditis prophylaxis recommendations at lower degrees of regurgitation than did cardiologists (Table 3). Physicians' threshold of valvular regurgitation prompting the recommendation of prophylaxis was inversely correlated with their perceived importance of echocardiography ($r=-0.16$; $P=.005$) and positively correlated with their perceived importance of the presence of murmurs on clinical examination ($r=0.11$; $P=.05$).

COMMENT

Our study highlights the value physicians place on echocardiography when supporting recommendations for antimicrobial endocarditis prophylaxis. Echocardiography was reported as the most important factor in supporting the recommendation for endocarditis prophylaxis and overshadowed all other factors including clinical guidelines and physical examination. Moreover, physicians who placed greater importance on echocardiography supported endocarditis prophylaxis at lower severities of valvular abnormality than those relying more heavily on murmur detection.

There are several plausible explanations for the value physicians place on echocardiography. First, cardiac auscultation is limited by low accuracy.[19] Second, echocardiography can identify subclinical valvular lesions. Third, echocardiography can provide ancillary diagnostic information for other cardiac conditions. Given the increase in the availability of echocardiography throughout Ontario[20] and the impact of resource capacity on the utilization of technology,[21] echocardiography may be used liberally to evaluate patients' risk for endocarditis; this occurs despite a limited role of echocardiography in current guidelines on endocarditis prevention[1-4]—for example, the 1997 American Heart Association guidelines[1] define a role for echocardiography solely in the assessment of risk associated with mitral valve prolapse.

Widespread use of echocardiography for endocarditis prophylaxis decision making will result in the greater identification of acquired valvular dysfunction, a phenomenon which itself increases with aging. For example, Croft and colleagues[17] noted that 50% of individuals 60 years or older and 60% of individuals 80 years or older had valvular heart disease that would require endocarditis prophylaxis. The self-reported reliance of echocardiography observed in our study and its potential implications on management decisions if implemented widely in screening, coupled with the preexisting controversy over the risk-benefit tradeoffs associated with endocarditis prophylaxis in general,[5,22] raise questions about the appropriate role (if any) echocardiography has in the evaluation and management of endocarditis prophylaxis for acquired valve disease.

We have also demonstrated that self-reported echocardiographic thresholds for supporting endocarditis prophylaxis recommendations were generally low but variable across physicians. For example, 15% of physicians surveyed supported endocarditis prophylaxis among persons with a normal mitral valve and either no, trivial, or mild mitral regurgitation, whereas 46% of respondents supported endocarditis prophylaxis for moderate or severe structurally abnormal valve, regardless of the presence or absence of valvular regurgitation. Physicians who viewed echocardiography as an important tool in guiding their support for antimicrobial prophylaxis advo-

Table 2. Rank of Importance of Various Factors Influencing Physicians' Decision to Recommend Endocarditis Prophylaxis*

Factor/Specialty	Rank of Importance on Decision to Recommend Prophylaxis					*P* Value†
	1 (Not Important)	2	3	4	5 (Very Important)	
Echocardiogram findings						
Family physician	0	1 (0.8)	5 (3.9)	6 (4.6)	20 (90.8)	.01
Cardiologist	0	1 (0.6)	7 (4.1)	36 (21.2)	124 (74.1)	
Total	**0**	**2** (0.7)	**12** (4.0)	**42** (14.0)	**144** (81.3)	
Endocarditis guidelines						
Family physician	0	1 (0.8)	5 (3.9)	27 (20.2)	99 (75.2)	.50
Cardiologist	1 (0.6)	4 (2.4)	9 (5.3)	41 (24.3)	113 (67.5)	
Total	**1** (0.3)	**5** (1.7)	**14** (4.7)	**68** (22.5)	**212** (70.8)	
Comment on echocardiogram report						
Family physician	0	1 (0.8)	5 (3.9)	11 (8.5)	115 (86.8)	<.001
Cardiologist	21 (12.4)	22 (13.0)	35 (20.7)	55 (33.1)	35 (20.7)	
Total	**21** (7.0)	**23** (7.7)	**40** (13.4)	**66** (22.5)	**150** (49.3)	
Murmur on examination						
Family physician	9 (7.0)	22 (16.3)	40 (30.2)	37 (27.9)	24 (18.6)	.005
Cardiologist	10 (6.0)	16 (9.5)	39 (23.1)	46 (27.4)	57 (33.9)	
Total	**19** (6.4)	**38** (12.5)	**79** (26.3)	**83** (27.6)	**81** (27.3)	
Patient comorbidity						
Family physician	6 (4.7)	16 (12.4)	44 (33.3)	38 (28.7)	28 (20.9)	<.001
Cardiologist	35 (20.4)	43 (25.8)	48 (28.7)	28 (16.8)	14 (8.4)	
Total	**41** (13.5)	**59** (19.9)	**92** (30.7)	**66** (22.0)	**42** (13.9)	
Medicolegal concerns						
Family physician	17 (12.3)	31 (23.8)	36 (26.9)	22 (16.9)	26 (20.0)	.20
Cardiologist	29 (17.0)	40 (24.7)	46 (27.1)	35 (20.6)	18 (10.6)	
Total	**46** (15.0)	**71** (24.3)	**82** (27.0)	**57** (19.0)	**44** (14.7)	
Patient insistence						
Family physician	17 (13.2)	28 (20.9)	46 (34.9)	30 (22.5)	11 (8.5)	.002
Cardiologist	29 (17.0)	57 (34.1)	53 (31.8)	22 (12.9)	7 (4.1)	
Total	**46** (15.4)	**85** (28.4)	**99** (33.1)	**52** (17.1)	**18** (6.0)	

*Data are given as number (percentage) of physicians unless otherwise specified.
†*P* values were calculated using the Mantel-Haenszel test for trend and demonstrate differences in the importance of each clinical factor on each specialty's (family practice vs cardiology) decision to provide endocarditis prophylaxis.

Table 3. Amount of Mitral Valve Regurgitation Prompting the Physicians' Recommendation of Endocarditis Prophylaxis for Varying Degrees of Structural Mitral Valve Abnormality*

Valvular Structural Abnormality/Specialty	Degree of Valvular Regurgitation Prompting Endocarditis Prophylaxis, No. (%)					*P* Value†
	Always	Trace	Mild	Moderate to Severe	Never	
Normal valve						
Family physician	6 (4.5)	1 (0.9)	26 (19.8)	76 (57.7)	23 (17.1)	.008
Cardiologist	1 (0.6)	0	13 (7.9)	129 (76.8)	25 (14.6)	
Overall	**7** (2.2)	**1** (0.4)	**39** (12.7)	**205** (69.1)	**48** (15.6)	
Mild abnormality						
Family physician	33 (25.2)	11 (8.7)	48 (36.5)	38 (27.8)	2 (1.7)	<.001
Cardiologist	10 (6.0)	4 (2.4)	62 (36.8)	84 (50.0)	8 (4.8)	
Overall	**43** (13.9)	**15** (5.0)	**110** (36.7)	**122** (41.0)	**10** (3.6)	
Moderate to severe abnormality						
Family physician	79 (60.0)	20 (15.0)	26 (20.0)	7 (5.0)	0	<.001
Cardiologist	59 (35.1)	21 (12.5)	67 (39.9)	21 (12.5)	0	
Overall	**138** (45.5)	**41** (13.5)	**93** (31.6)	**28** (9.4)	**0**	

*Data are given as number (percentage) of physicians unless otherwise specified.
†*P* values were calculated using the Mantel-Haenszel test for trend between each specialty's (family practice vs cardiology) decision to provide endocarditis prophylaxis for each degree of structural valvular dysfunction.

cated for endocarditis prophylaxis at lower echocardiographic thresholds of valvular dysfunction compared with those who reported a heavier reliance on clinical findings to influence decisions. Such findings may be attributable to physicians' inability to determine the risk associated with subclinical valve lesions demonstrated on echocardiogram given the inadequate descriptions of at-risk lesions in clinical guidelines.[1-4]

Most respondents in our study rated clinical guidelines as being of extreme importance in influencing their support of endocarditis prophylaxis. With the exception of mitral valve prolapse, none of the major guidelines[1-4] describe the degree of valvulopathy necessary prior to recommending antimicrobial prophylaxis. For example, American and European guidelines[1,3] comment solely on acquired valvular dysfunction with no further descriptors, whereas British guidelines state antimicrobial prophylaxis is required with "substantial leaflet pathology and regurgitation"[4] but fail to define "substantial." Explicit descriptions of acquired native valve disease requiring prophylaxis in these guidelines may alleviate the variable thresholds for recommending endocarditis prophylaxis.

Variations in endocarditis prophylaxis perspectives were also apparent across physician specialties. On average, cardiologists reported placing less importance on echocardiography (and/or associated comments regarding endocarditis prophylaxis necessity) and advocated for support of endocarditis prophylaxis at more severe levels of valvular dysfunction than did family physicians. These findings, which may be related to improved auscultatory skills, experience managing valvular heart disease, and familiarity with endocarditis guidelines by cardiologists compared with family physicians, add to the growing body of literature demonstrating differences in cardiovascular care between cardiologists and primary care physicians.[7,10-16]

Our study has several limitations. First, the results are based on survey responses and not actual physician practice. Furthermore, a physician's self-reported echocardiography referral propensity for endocarditis prophylaxis may not necessarily correlate with his or her overall propensity to use echocardiography in the population. Therefore, reliable estimates regarding the impact and yield of echocardiography for endocarditis prophylaxis in the population remain unclear. Recent work, however, has suggested that surveys may reflect actual clinical practice.[23,24] Second, this survey was confined to cardiologists and family physician practicing within Ontario, where the costs of echocardiograms and antibiotics for hospitalized procedures are covered under the universal health insurance plan; this may increase the use of echocardiography and antibiotics. Third, while Ontario is the largest province in Canada and consists of over 10 million people, the extent to which our findings are generalizable to other jurisdictions is unknown; nonetheless, the survey was distributed to both academic and community physicians, and a response rate over 60% was achieved.

In conclusion, physicians view echocardiography as a very important tool in influencing their support and thresholds for endocarditis prophylaxis recommendations for patients with acquired valvular heart disease. This tool is viewed more importantly than other clinical factors including murmur on clinical examination. Yet, the thresholds for supporting endocarditis prophylaxis based on echocardiography findings vary considerably across physicians and physician specialties. Our results underscore the need to better evaluate the role of echocardiography in the assessment and management of antimicrobial endocarditis prophylaxis to assist in the development of clear clinical guidelines.

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