

Letters

RESEARCH LETTER

High Rates of Echocardiographic Abnormalities in an Underserved Population



Disparities in cardiovascular care for marginalized groups are often due to lack of access, driven by social determinants of health. This includes access to echocardiography, which is significantly lower in rural, low-income, and minority groups in the United States.

Piedmont Health Services (PHS) is a Federally Qualified Health Center that operates 12 community health centers in 7 counties in central North Carolina. The PHS Cardiology Clinic is staffed by faculty from the Division of Cardiology at the University of North Carolina (UNC) who are embedded in a PHS facility and provide free/low-cost care. Patients seen at the PHS Cardiology Clinic are an underserved population with 70% of patients being an ethnic/racial minority, 68% being uninsured, 79% having comorbidities and approximately one-third having preexisting cardiovascular disease.¹ The clinic offers echocardiography with images acquired by a certified sonographer or cardiologist using a desk-top portable machine (CX50, Philips) capable of 2-dimensional imaging and color, pulsed wave, tissue, and continuous wave Doppler interrogation as indicated. Interpretation is performed by a UNC faculty echocardiographer.

To evaluate the prevalence of echocardiographic abnormalities in an underserved population and to determine whether identification of echocardiographic abnormalities in this population led to guideline-directed changes in medical care, we performed a retrospective study of 291 patients undergoing echocardiography at the PHS Cardiology Clinic from January 1, 2010 through December 31, 2020. Data are presented as mean \pm SD (normally distributed), median (IQR) (non-normally distributed), or count (%) unless otherwise indicated. Comparison between groups was done using Student's *t*-test, Mann-Whitney rank sum test, analysis of variance or Mantel-Haenszel chi-square.

Patients undergoing echocardiography at the PHS Cardiology Clinic were younger (IQR: 49 [38-59] years vs 61 [IQR: 49-71] years; $P < 0.001$), more often female (69.4% vs 50.3%; $P < 0.001$) and less likely to be White (21.6% vs 63.3%; $P < 0.001$) than those having echocardiography at the local academic medical center. Common comorbidities included hypertension (45%), diabetes (25%), hyperlipidemia (30%), and tobacco use (28%). The majority of patients were of Hispanic ethnicity (55.3%), and without insurance (69.1%).

The most common indications for echocardiography were a murmur ($n = 109$, 37.5%), palpitations/arrhythmia ($n = 90$, 30.9%), unexplained dyspnea ($n = 76$, 26.1%), ischemic evaluation ($n = 59$, 20.3%), and suspected heart failure/cardiomyopathy ($n = 40$, 13.8%). When classified according to the American Society of Echocardiography Appropriate Use Indications, 72.5% of echocardiograms were appropriate, 10.3% were maybe appropriate and 17.2% were rarely appropriate. The rates of abnormal findings were 53.6%, 43.3%, and 20% in appropriate, maybe appropriate and rarely appropriate indications, respectively.

A total of 133 (46%) echocardiograms were abnormal with 100 (34%) of these being new diagnoses. Clinically significant findings, defined as abnormalities that would change management of the patient, were identified in 72 (24.7%) patients (Table 1). This included important congenital, valvular, or cardiomyopathic disease in 60 patients (20.6%), pulmonary hypertension in 6 patients, pericardial effusion \geq mild in 5 patients, dilated ascending aorta in 10 patients, and right ventricular enlargement in 13 patients (some patients had more than 1 finding).

Patient care before and after the echocardiogram was compared in the subset of patients with clinically significant echocardiographic findings subject to recommendations in the American Heart Association/American College of Cardiology Valvular Heart Disease,² Congenital Heart Disease,³ and Management of Heart Failure⁴ guidelines. This population was comprised of 43 patients with 60 actionable findings including severe aortic stenosis ($n = 2$), severe mitral regurgitation ($n = 1$), pulmonic stenosis ($n = 2$), patent ductus arteriosus ($n = 1$), ventricular

TABLE 1 Echocardiographic Findings and Implementation of Guideline Direct Care in Patients Covered by AHA/ACC Valvular Heart Disease,² Congenital Heart Disease,³ and Management of Heart Failure Guidelines⁴

		Implementation of At Least 1 Guideline Directed Change in Care	% of Patients With Guideline Directed Change in Care
Any abnormality	133 (45.7%)		
Mild left ventricular hypertrophy	39 (13.4%)	N/A	
Moderate left ventricular hypertrophy	8 (2.7%)	N/A	
Aortic sclerosis	42 (14.4%)	N/A	
Aortic stenosis			
Mild	4 (1.4%)	1	25%
Moderate	2 (0.7%)	1	50%
Severe	2 (0.7%)	2	100%
Aortic insufficiency			
Mild	20 (6.9%)	N/A	
Moderate	8 (2.7%)	6	75%
Severe	0		
Mitral regurgitation			
Mild	25 (8.6%)	N/A	
Moderate	3 (1.0%)	1	33%
Severe	1 (0.3%)	1	100%
Mitral valve prolapse	8 (2.7%)	N/A	
Degenerative mitral valve disease	29 (10.0%)	N/A	
Mitral annular calcification	17 (5.8%)	N/A	
Pulmonic stenosis	2 (0.7%)	1	50%
Pulmonic regurgitation	2 (0.7%)	N/A	
Pulmonary hypertension	6 (2.1%)	N/A	
Tricuspid regurgitation			
Mild	5 (1.7%)	N/A	
Moderate	2 (0.7%)	1	50%
Severe	0		
Prosthetic heart valve	4 (1.4%)	4	100%
Right ventricular enlargement	13 (4.5%)	N/A	
Dilated left atrium	45 (15.4%)	N/A	
Dilated right atrium	18 (6.2%)	N/A	
Bicuspid aortic valve	5 (1.7%)	4	80%
Patent ductus arteriosus	1 (0.3%)	1	100%
Pericardial effusion \geq mild	5 (1.7%)	N/A	
Dilated ascending aorta	10 (3.4%)	N/A	
Ventricular septal defect	6 (2.0%)	4	66%
Atrial septal aneurysm	2 (0.7%)	N/A	
Decreased LV systolic function			
Mild LV dysfunction (45% < EF \leq 50%)	10 (3.4%)	9	90%
Moderate LV dysfunction (35% < EF \leq 45%)	4 (1.4%)	4	100%
Severe LV dysfunction (EF \leq 35%)	6 (2.0%)	5	83%

Values are n (%) unless otherwise indicated.
ACC = American College of Cardiology; AHA = American Heart Association; EF = ejection fraction; LV = left ventricle.

septal defect (n = 6), bicuspid aortic valve (n = 5), and left ventricular systolic dysfunction (n = 20). Implementation of at least 1 guideline directed intervention occurred in 35 (81.4%) of patients in response to 45 (75%) of the significant findings on

echocardiography within 3 months of the echocardiogram. The most common reasons for recommendations not being put into practice were cost, lack of insurance, transportation problems, or relocation out of the service area.

Our results add to the literature demonstrating high rates of undiagnosed echocardiographic abnormalities in underserved populations. A study of limited ultrasonography performed by an internist using a hand carried machine identified significant valvular disease or left ventricular dysfunction in 12.4% of primary care patients treated at an urban health care clinic located in an impoverished area, despite excluding patients with an indication for echocardiography.⁵

This analysis had several limitations including the use of a portable machine for echocardiographic imaging which may have resulted in an underestimation of the degree of abnormalities. In general, however, echocardiograms at the Federally Qualified Health Center included 2-dimensional and Doppler imaging, were performed by certified cardiac sonographers, and were deemed diagnostic in quality by expert echocardiographers. Second was the inability to identify patients who obtained cardiac care outside of the PHS and UNC systems which may have resulted in an underestimation of the use of guideline-directed therapy.

In summary, we found a high prevalence of clinically important echocardiographic abnormalities in underserved patients, which led to the implementation of guideline-recommended interventions. Improving access to low-cost/free echocardiography may have a significant impact on the cardiovascular outcomes of patients with limited access to care.

Sara J. King, MD
Clark Williamson, BS
Sterling A. Wheaton, MD
Jarred J. Lobo, BS
Paula F. Miller, MD
Thelsa P. Weickert, MD
Alan L. Hinderliter, MD
*George A. Stouffer, MD

*Division of Cardiology
University of North Carolina
Chapel Hill, North Carolina 27599-7075, USA
E-mail: rstouff@med.unc.edu

<https://doi.org/10.1016/j.jacadv.2023.100618>

© 2023 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

REFERENCES

1. Wheaten SA, Williamson C, Piehl CM, et al. Improving disparities in access to cardiovascular care: effects of embedding a clinic in an FQHC. *JACC: Adv.* 2022;1:1-2.
2. Otto CM, Nishimura RA, Bonow RO, et al. 2020 ACC/AHA guideline for the management of patients with valvular heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol.* 2021;77:450-500.
3. Stout KK, Daniels CJ, Aboulhosn JA, et al. 2018 AHA/ACC guideline for the management of adults with congenital heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol.* 2019;73:1494-1563.
4. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol.* 2022;79:e263-e421.
5. Kirkpatrick JN, Davis A, DeCara JM, et al. Hand-carried cardiac ultrasound as a tool to screen for important cardiovascular disease in an underserved minority health care clinic. *J Am Soc Echocardiogr.* 2004;17:399-403.