The Effect of Image Review before Patient Discharge on Study Completeness and Sonographer Job Satisfaction in a Pediatric Echocardiographic Laboratory

Joyce T. Johnson, MD, MS, Joshua D. Robinson, MD, FASE, Luciana T. Young, MD, FASE, and Joseph A. Camarda, MD, *Chicago, Illinois*

Background: Incomplete echocardiographic assessment accounts for approximately 10% of preventable diagnostic errors and may place children at risk for adverse outcomes or increased testing. The aim of this study was to determine if physician review of images improves study completeness.

Methods: A prospective quality improvement (QI) study initiated physician review of first-time echocardiographic studies for completeness before patient discharge. Studies were incomplete if not all anatomic structures were diagnostically demonstrated. QI examinations were compared with controls obtained before study initiation. Demographic and clinical information and duration of scan were collected during the control and QI periods. An anonymous survey was administered to the sonographers to assess perceptions of the intervention.

Results: There were no differences between the QI (n = 63) and control (n = 63) groups in age, height, weight, and technical barriers. After study completion, 35% of control scans versus 5% of QI scans were incomplete (P < .001). In the QI group, the sonographer, physician, or both returned to scan in 12 (19%), nine (14%), and two (3%) studies, respectively. QI studies were longer than control studies (44 vs 36 min, P = .003) before review. Physician review added a median of 6 min (range, 1–28 min). The majority of sonographers believed that immediate review improved communication, and 50% believed that it improved their job satisfaction.

Conclusions: Review of initial outpatient echocardiographic examinations before patient discharge significantly improves study completeness. Review adds a nominal amount of time to total study duration, improves sonographer-physician communication, and may prevent unnecessary testing, potentially reducing the cost of care. (J Am Soc Echocardiogr 2016;29:1000-5.)

Keywords: Pediatric, Echocardiography, Quality improvement, Job satisfaction

Delayed or inaccurate echocardiographic diagnoses may place children with heart disease at risk for adverse outcomes.[1,2] This may lead to further unnecessary testing and an increased demand on parent, child, and clinician time in addition to increased health care costs. Investigators have previously evaluated the effect of various modifications to the echocardiographic process, such as teaching interventions and procedural sedation, on diagnostic errors.[3-5] Importantly, in one study, incomplete assessment of anatomy or physiology accounted for approximately 10% of diagnostic errors, all of which were thought to be preventable.[2] In addition, the setting of the study as well as the time of day of echocardiographic interpretation have been associated with diagnostic errors.[4]

The interaction between the sonographer and the attending cardiologist at the time of an imaging study has not been well examined. Several large, pediatric echocardiography laboratories engage in collaborative image review before outpatient discharge, but the

From the Division of Cardiology, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, Illinois (J.T.J., J.D.R., L.T.Y., J.A.C.); and the Department of Pediatrics (J.T.J., J.D.R., L.T.Y., J.A.C.) and Department of Radiology (J.D.R.), Northwestern University Feinberg School of Medicine, Chicago, Illinois.

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Reprint requests: Joyce T. Johnson, MD, MS, Ann & Robert H. Lurie Children's Hospital of Chicago, Northwestern University Feinberg School of Medicine, Pediatric Cardiology, 225 E Chicago Avenue, Box 21, Chicago, IL 60611 (E-mail: *jtjohnson@luriechildrens.org*).

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Table 1 Complete echocardiographic protocol

Position	Sweep	2D, color clip	Spectral Doppler
Subxiphoid transverse plane	Sweep side to side, then from spine to cardiac apex		
Subxiphoid sagittal	Sweep from aorta to IVC	IVC and hepatics Abdominal aorta	Abdominal aorta Hepatic vein
Subxiphoid coronal	Sweep posterior to anterior	Atrial septum Superior vena cava LVOT RVOT	ASD (if present) LVOT RVOT
Subxiphoid sagittal	SVC/IVC to apex	SVC/IVC atrial septum	
Subxiphoid right anterior oblique	Sweep from TV to anterior	RV inflow/outflow	
Parasternal long axis	Sweep from LV inflow/outflow to TV and then to RVOT Sweep septum in sections for VSD	LV inflow/outflow RV inflow RVOT Aortic measurements	Tricuspid regurgitation RVOT
Parasternal short axis	Sweep from base of heart to cardiac apex	Aortic valve Coronary origins RVOT and branch PAs TV Mitral valve Left ventricle at papillary level for function measurements M-mode	RVOT Tricuspid regurgitation VSDs if present
Apical	Posterior-to-anterior sweep from coronary sinus to RVOT	Four chamber Pulmonary vein and left atrium Mitral valve LVOT TV and right ventricle RVOT Three-chamber view Two-chamber view Biplane EF Tissue Doppler of mitral annulus TAPSE	Pulmonary vein Mitral valve LVOT TV RVOT
Suprasternal notch short axis	Sweep for arch sidedness	SVC, innominate vein Branch PAs Pulmonary veins	SVC
Suprasternal notch sagittal	Ductal sweep	Aortic arch	Ascending aorta Descending aorta
High right parasternal view		SVC/IVC Atrial septum	

2D, Two-dimensional; *ASD*, atrial septal defect; *EF*, ejection fraction; *IVC*, inferior vena cava; *LV*, left ventricular; *LVOT*, left ventricular outflow tract; *PA*, pulmonary artery; *RV*, right ventricular; *RVOT*, right ventricular outflow tract; *SVC*, superior vena cava; *TAPSE*, tricuspid annular plane systolic excursion; *TV*, tricuspid valve; *VSD*, ventricular septal defect.

effects of these practices on quality and completeness of the echocardiographic assessment have not been described. Our center recently implemented physician-sonographer image review before discharge from the echocardiography laboratory. We therefore sought to evaluate the impact of this quality improvement (QI) initiative on study completeness and team dynamics.

METHODS

Institutional review board approval was obtained for a prospective QI study with retrospective controls. Echocardiographic examinations were eligible for inclusion if they were first-time outpatient studies performed at either the main hospital campus or a primary satellite location where studies were conducted according to the same protocol and by the same sonographers and interpreting attending cardiologists. Echocardiographic studies were excluded if patients had known diagnoses of congenital heart disease from prior institutions or were unable to tolerate a full echocardiographic examination, necessitating truncation of the planned complete examination.

The planned intervention required that sonographers review all images (including two-dimensional imaging, measured dimensions, color Doppler images, and spectral Doppler waveforms) with the attending cardiologist before patient discharge from the laboratory. The physician was to evaluate the study for diagnostic quality and completeness and direct further imaging as necessary. Studies were

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