Initial Fetal Echocardiogram Image Quality Metric	
This metric will assess the average image quality score, as measured by the *Fetal Echo Image Quality Assessment Tool* (Appendix 1), for initial fetal echocardiograms designated as complete studies for fetuses with structurally normal hearts.	
Numerator	The sum of the *Fetal Echo Image Quality Assessment* worksheet scores for all fetal echocardiograms assessed for the measurement time period.
Denominator	The number of complete transabdominal fetal echocardiograms >18 week gestational age assessed during the measurement time period. **Excluded Populations:** • Studies in fetuses with structurally abnormal cardiac anatomy, rhythm or function • First trimester fetal echocardiograms • Multiple gestation • Studies in fetuses that have had a prior echocardiogram at the institution, as this metric is intended to apply to all initial fetal echocardiograms performed at the institution • Studies in fetuses with poor acoustic windows due to maternal body habitus, fetal position/movement, advanced gestational age or otherwise technically limited
Period of Assessment	Minimum: Quarterly review
Sources of Data	Prospective flowsheet/ retrospective review of stored fetal echocardiographic images. For each quarterly assessment, a minimum of 10 fetal echocardiograms/center/program will be reviewed. If the center performs <20 fetal echocardiograms /quarter, all studies performed for that quarter will be reviewed.

Rationale

A complete fetal echocardiogram should include technically adequate acquisition of key elements required to exclude the presence of structural and /or functional heart disease. Optimal image quality is essential for accurate diagnosis, however there is variability in imaging technique and acquisition. Assessment of image quality is subjective; however, certain elements of image quality are standard, such as image orientation, two-dimensional image appearance, and optimization of color and spectral Doppler analysis. This quality metric provides a quantitative assessment of fetal echocardiographic image quality, which then can be used by individual echocardiography laboratories to assess their performance and track progress.

The initial study at an institution is selected as the target study population, since repeat studies may be limited; therefore investigation of these studies may not adequately reflect best performance of echocardiography within any given lab.

2) Fetal Echocardiography Task Force: American Institute of Ultrasound in Medicine Clinical Standards Committee; American College of Obstetricians and Gynecologists: Society of Maternal-Fetal Medicine. AIUM practice guidelines for performance of fetal echocardiography. *J Ultrasound Med*. 2013; 32:1067-1082.

3) ISUOG Practice Guidelines (updated): sonographic screening examination of the fetal heart. Ultrasound Obstet Gynecol 2013; 41: 348–359

4) AIUM Practice Parameter for the Performance of Obstetric Ultrasound Examination 2013 , www.aium.org

5) Lee W, Allen L, Carvalho JS, Chaoui R, Cope J, Devore G, Hecher K, Munoz H, Nelson T, Paladini D, Yagel S; ISUOG Fetal Echocardiography Task Force. ISUOG consensus statement: what constitutes a fetal echocardiogram? *Ultrasound Obstet Gynecol*. 2008; 32:239-242.

6) Rychik J, Ayres N, Cuneo B, Gotteiner N, Hornberger L, Spevak PJ, Van Der Veld M. American Society of Echocardiography guidelines and standards for performance of the fetal echocardiogram. *J Am Soc Echocardiogr*. 2004; 17:803-810.

7) Allan L, Dangel J, Fesslova V, Marek J, Mellander M, Oberhansli I, Oberhoffer R., Sharland G, Simpson J, Sonesson SE; Fetal Cardiology Working Group: Association for European Paediatric Cardiology. Recommendations for the practice of fetal cardiology in Europe. *Cardiol Young*. 2004; 14:109-114.

6) The IAC Standards and Guidelines for Pediatric Echocardiography Accreditation- Section 3B: Fetal Echocardiography Testing https://www.intersocietal.org/echo/standards/IACPediatricEchocardiographyStandards2017

8) Recommendations for ultrasound output settings
https://www.aium.org/officialStatements/65
https://www.aium.org/officialStatements/9
https://www.aium.org/officialStatements/63

Attribution

This metric will be reported by each echocardiography laboratory performing maternal transabdominal fetal echocardiography. Data will be assessed quarterly by the laboratory director or their designate and reviewed with the laboratory staff involved in the performance and interpretation of fetal echocardiograms.

Method of Reporting

This measure will be reviewed at laboratory quality assurance meetings quarterly. The Fetal Echo Image Quality Metric includes a total of 15 elements for each exam assessed for the quarter. Each element is graded as “Yes” only if the study meets criteria as specified in the *Fetal Echo Image Quality Assessment Tool*.

Challenges to Implementation

1) Time required identifying, selecting and reviewing fetal echocardiograms.
2) There is inherent subjectivity in the assessment of image quality that this objective metric may not fully overcome.

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References

1) Donofrio MT, Moon-Grady AJ, Hornberger LK, Copel JA, Sklansky MS, Abuhamad A, et al. Diagnosis and treatment of fetal cardiac disease: a scientific statement from the American Heart Association. *Circulation*. 2014; 129(21):2183-242.

Appendix 1

Fetal Echo Image Quality Assessment Tool

Each worksheet is for ONE fetal echo evaluation

Patient Name:_____ **Date of Birth:** _____

EDD: _____ **Gestational Age:** _____

Sonographer: _____ **Date of Study:** _____

Interpreter:_____ **Location of Study:** _____

Echo Machine: _____ **Date of Review:** _____

Reviewer: _____ **Time Spent for Review:** _____

Indicate if each item listed is evaluated. Score as 1 for "Yes" response, 0 for "No".

Category 1

2-DIMENSIONAL IMAGING (Total possible points=6)

Question is answered "Yes" if images meet the stated criteria for quality under each category. It is recognized that fetal position and movement can affect the quality of the study. If optimal images are obtained for each view during the course of the study, question is answered "Yes".

YES	NO	
☐	☐	**Ultrasound output settings appropriate and consistent with ALARA (As Low as Reasonably Achievable)** *The ultrasound output settings are displayed on the screen. Mechanical Index (MI) should be as low as possible to allow for optimal image quality, ideally < 0.7. Thermal Index bone (TIB) should be at 0.7-1.0 for scanning time of 60 min and <0.7 for longer scanning time.*
☐	☐	**Brightness and contrast level appropriate** *Primarily affected by the gain, compression, time gain compensation and dynamic range settings, optimal settings result in a 2 D image with good spatial resolution in which individual structures such as the pericardium, myocardium, ventricular cavity, valvar structures and endovascular borders of vascular structures are clearly delineated.*
☐	☐	**Balanced Penetration: Resolution** *Primarily affected by transducer choice and imaging settings such as harmonics, optimal imaging results in preserved differentiation between the individual structures such as blood pool and endocardium, and the region of interest is visible without loss of information at greater depth. Transducer and imaging modality selection results in maximal image resolution possible for given depth of imaging*

YES	NO	
☐	☐	**Zoom / Region of interest** *Zoom and depth of imaging adjusted such that the region of interest is optimally visualized. The fetal heart should fill at least one third of the imaging sector display. The focal zone should be appropriately positioned to region of interest*.
☐	☐	**Cine loops** *The fetal heart is examined as a moving structure and images should be saved as video clips in the form of cine loops and sweeps. Live scanning should be performed at the highest frame rate possible while DICOM images are typically compressed and stored at 30fps*
☐	☐	S**weeps** *Sweep(s) of the fetal abdomen and chest are performed with appropriate transducer alignment for demonstration of visceral situs and segmental anatomy of the heart and great arteries.*

Category 2

RHYTHM ASSESSMENT (Total possible points=1)
Question is answered "Yes" if the M-mode/Doppler images meet the stated criteria for quality

YES	NO	
☐	☐	**Rhythm assessment** *Ideal image should be obtained by aligning the M-mode across the atrium and ventricle so as to obtain clearly identifiable waves from atrial and ventricular contractions. If rhythm assessment is performed by Doppler, the sample is appropriately placed and Doppler tracings are optimized as described below*

Category 3

COLOR FLOW IMAGING (Total possible points = 4)
Question is answered "Yes" if any images meeting the stated criteria for quality are present for each standard view or scan plane.

YES	NO	
☐	☐	**Frame rate appropriate** *Transducer selection and CFI settings such as box size and imaging depth is adjusted to obtain highest frame rates possible (minimum frame rate of 20fps is desirable). Color box should be limited to region of interest being interrogated.*
☐	☐	**Nyquist limit settings appropriate** *Nyquist limits are set appropriate to the structure being investigated so as to allow for diagnostic imaging (inflows /outflows > 50cm/s, venous flows <35cm/s).*
☐	☐	**Color settings appropriate** *Ideal color settings (color gain, color frequency, wall filter etc.) result in appropriate color fill of the structure being interrogated without loss of information from under gained images or excessive color bleeding or speckle artefact from over gained images.*
☐	☐	**Color persistence** *Color persistence is set to low /none such that color fill of structures is appropriate for the cardiac cycle. Of note, color persistence may be used to interrogate low velocity blood flow such as systemic and pulmonary venous flow.*

Category 4

SPECTRAL DOPPLER (Total possible points = 3)

Question is answered "Yes" if images meet the stated criteria for quality. If optimal images are obtained for each structure being interrogated during the course of the study, question is answered "Yes".

YES	NO	
☐	☐	**Alignment and placement of Doppler sample** *Spectral Doppler of cardiac structures obtained with proper alignment (as parallel to direction of blood flow as possible but angle <20 degrees at all times) and appropriate sample volume size and position so as to obtain clearly discernable spectral Doppler envelopes. Alignment angle does not apply to structures where the Doppler pattern rather than the peak velocity is being assessed (ex. ductus venosus, umbilical vein Doppler)*
☐	☐	**Appropriate Doppler scale and baseline** *Spectral Doppler scale and baseline, wall filter appropriately adjusted for the structure being interrogated such that the Doppler envelopes are complete with maximal signal size and minimal artefact*
☐	☐	**Appropriate sweep speed** *Standard sweep speed adjusted appropriately for visualization of Doppler contours and measurement of time interval, if performed. (Sweep speed of 100mm/s is suggested or adjustment of sweep speed so as to include 4-6 cardiac cycles in the acquisition)*

TOTAL SCORE (14):