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Abstract category: Improving appropriateness of diagnostic or screening services (consultations, labs, imaging exams, cardiac telemetry, EEG, echocardiography, etc)

REDUCING INAPPROPRIATE USE OF ECHOCARDIOGRAPHY IN CHILDREN: SCREENING HEART MURMURS WITH AN AI WITH ENABLED STETHOSCOPE.

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Background: Congenital heart disease is rare though often presents with a pathologic murmur, which is considered an appropriate indication for echocardiography. A stethoscope in the hands of an experienced clinician is a useful screening tool to distinguish innocent from pathologic heart murmurs with greater than 90% sensitivity and specificity. However, auscultation skills are in decline and many primary care providers have difficulty recognizing the difference. Of all children referred to Johns Hopkins in 2014 for echocardiography because of a murmur, more than 50% were normal and only 31% had pathology requiring follow-up. Inappropriate referral often results in unnecessary emotional distress to parents and patients, time off from work and school, wasted resources and labeling a child as having a mild heart problem even when reassurance is attempted by the cardiologist.

Objectives: This study explores whether incorporating an artificial intelligence (AI) algorithm and telemedicine to assist referral decision-making can decrease the number of inappropriate echocardiograms and improved clinical outcomes for patients with heart murmurs when compared to current referral behavior and outcomes. This pilot study will be used to help determine feasibility for a multi-institutional study.

Methods: The AI algorithm was initially validated using a large Johns Hopkins dataset of previously recorded pediatric and adult heart sounds. The current trial is a prospective, non-interventional pilot study, in which heart murmur recordings are being collected at four pediatric sites: the resident primary care clinic, an affiliated primary care practice, the newborn nursery and the pediatric cardiology clinic. After a clinician hears a heart murmur, the heart sounds are recorded using an electronic stethoscope connected to a smartphone app. Recordings are quality-checked in real time and transmitted to a cloud database. The referral decision of the clinician is made without knowledge of the AI interpretation. The 6 month clinical outcomes of each subject are compared to AI and remote cardiologist interpretation from listening to the recordings by telemedicine. The primary outcome measure is a difference in the positive predictive value of screening by AI compared to primary physicians. Sample size calculations assume a prevalence of heart disease among referred patients of 50%, specificity of 0.5 for primary physicians and 0.8 for AI. With power 0.8, p-value <0.05, and potentially 20% missing AI or outcome data, we plan to enroll at least 50 patients that are referred. Secondary outcome measures include comparison of the sensitivity and specificity of a trained cardiologist to the AI algorithm using a record and transmit telemedicine protocol.

Results: The study is ongoing and final results are expected to be available by November 2019. To date we have enrolled over 90 patients, 28 of whom have been referred.

Conclusions: We anticipate that incorporating a new paradigm to screen for pathologic heart murmurs in primary care settings could reduce the number of patients with only innocent heart murmurs being referred inappropriately to cardiology or echocardiography by up to 50-75%.

Clinical Implications: Improving the ability to distinguish innocent from pathologic heart murmurs in primary care settings would decrease inappropriate echocardiography and referrals. If successful, the new paradigm could help confirm the clinician's suspicion of important pathologic heart murmurs while providing evidence to reassure parents of children with innocent murmurs that their children’s hearts are normal.