Feasibility assessment of AI-assisted home-based remote auscultation to optimize echocardiogram referrals

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Background

With the constraints placed on in-person clinical activities during the COVID-19 pandemic and the rapid switch to video visits, we had the opportunity to test the feasibility of AI-assisted home-based remote cardiac auscultation during the telemedicine visit. This form of "enhanced" telemedicine (ETM) has not been well studied to date.

Unnecessary in-person cardiology referrals and echocardiography overuse lead to financial, logistical, and emotional burdens for pediatric patients and their families which may be addressed by in-home ETM visits, even beyond the pandemic.

Objective: Assess feasibility and usefulness of in-home remote auscultation (RA) for pediatric patients referred for new or follow-up cardiology evaluation as an enhancement to the telemedicine video visit to potentially avoid unnecessary in-person visits or echocardiography.

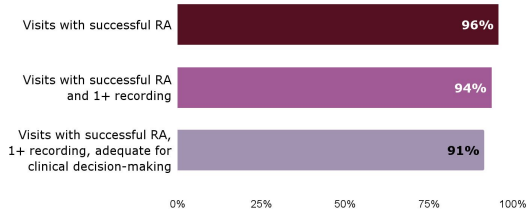
Methods

47 patients scheduled for new or follow-up pediatric cardiology evaluation by video visit were recruited, consented verbally by an IRB-approved script, and enrolled.

Prior to the scheduled video visit, families were sent a smartphone with the eMurmur Connect app and a pre-paired electronic stethoscope. The cardiologist guided equipment usage, directing the patient, or parent/guardian on how to hold and move the stethoscope. The cardiologist was able to listen remotely to the heart sounds in real time and make recordings, from which an AI algorithm derived signal-based data including heart rate and murmur characteristics.

Patients, families, and the cardiologist were asked to complete a Qualtrics survey after the visit to rate their experiences. The patient and family survey was anonymous, while the cardiologist data was visit-specific.

Feasibility Metrics



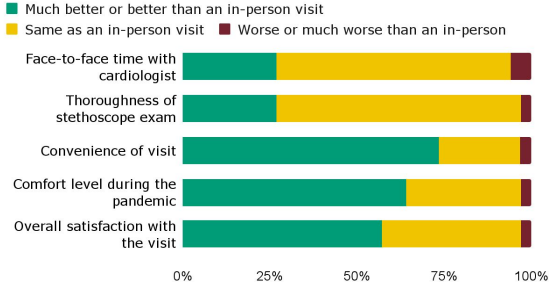
Percent of visits with amount of time spent on remote auscultation

10 - 15 min.	70%
5 - 10 min.	20%
15 - 20 min.	7%
More than 20 min.	2%
Less than 5 min.	0%

Percent of visits with clinically important auscultation findings (multi-select)

Pathologic findings	52%
No changes from previous exam	45%
Normal exam	17%
Absence of murmur	14%
Postural tachycardia	14%
Changes from previous exam	14%

Patient & Family Survey (n=30)



Results

Out of 47 visits in which RA was attempted, 42 (91%) resulted in at least one recording and were considered adequate for clinical decision-making. 10-15 minutes was the amount of time most often spent on RA during a visit. Of the 43 visits where auscultation quality was considered adequate for clinical decision-making, RA was considered helpful in 42 (98%). Of those 42, 45% showed no changes from previous exams, saving patients and families from an additional clinic visit and echocardiogram, and 14% showed changes from previous exams, prompting an in-person visit and follow-up echocardiogram. 14% had new diagnoses manageable without an in-person visit.

For patients, ETM was reported to be easy, valuable, and to increase child and family comfort from multiple perspectives (privacy, COVID-19 exposure, etc). For key patient experience metrics, >90% of patients and their families rated the ETM visit as on par with or better than an in-person visit.

One parent commented: "This process has been very well thought out and seems to work wonderfully [...] everything is very user friendly and I do feel that the children respond well with not being in a strange office setting."

Conclusions

In-home RA is feasible and holds value for patients and clinicians to potentially reduce unnecessary in-person visits and echocardiograms. This form of ETM is time- and resource-efficient, and shows particular promise for patients living in rural or other areas with limited access to specialty care, patients or families who may need flexibility around work and school commitments, and patients who are particularly vulnerable to pathogens.

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