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COMMENT

Bridging the gap: AI in echocardiography for early detection of LVH in underserved areas

Hisaki Makimoto[1]

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Left ventricular hypertrophy (LVH) has emerged as a prognostic indicator in patients with hypertension [1]. The presence of LVH in hypertensive individuals signifies a heightened risk for adverse cardiovascular events, as evidenced by a plethora of studies demonstrating its association with increased morbidity and mortality. The critical role of imaging modalities, such as echocardiography and cardiac magnetic resonance imaging (MRI), cannot be overstated in the accurate diagnosis and assessment of LVH. These non-invasive techniques provide invaluable insights into cardiac structure and function, facilitating the early detection and ongoing management of LVH in the hypertensive population. Their application is imperative not only for diagnostic confirmation but also for stratifying risk and tailoring therapeutic interventions, thereby playing a central role in the comprehensive care of patients with hypertension.

The present study by Firima et al. demonstrates the efficacy and reliability of using a deep learning-powered software for analyzing echocardiographic images in a community-based chronic care program [2]. In total, focused echocardiographs were obtained from 756 participants by 16 nurses/nurse-assistants (Fig. 1). The analysis of the uploaded images was primarily performed using the artificial intelligence, AI-powered software at the University Hospital Basel. This research is distinguished by its focus not on the development of AI but on the practical application of existing AI tools. By integrating these tools with telemedicine, the study innovatively leverages AI to maximize its utility in real-world settings.

✉ Hisaki Makimoto
h1sak1mak1m0t0@gmail.com

1 Data Science Center/Cardiovascular Center, Jichi Medical University, Shimotsuke, Japan

Out of 754 DICOM files uploaded to the AI platform, 628 (83.3%) were effectively evaluated by the AI algorithm. A significant portion of these, 514 (81.9%), matched the assessments of an independent cardiologist, demonstrating the high accuracy of AI analysis. Additionally, 100 of the evaluable images (15.9%) required manual editing but were still deemed accurate, indicating that while AI is highly efficient, human expertise remains crucial in certain cases.

The study also found that 660 (87.5%) of all uploaded files were evaluable either through AI analysis (93%) or additional manual measurements (7%). This high rate of evaluable images underscores the effectiveness of the telemedicine framework where the echocardiography images are acquired in Africa and the analyses were performed in Europa. The study's findings also highlight that, while AI-driven automatic analysis played a pivotal role, the necessity of human intervention in a significant number of cases cannot be overlooked (Fig. 1). To rephrase, this suggests the potential to reduce the workload of human sonographers for assessment. This integration of AI and human expertise not only enhances the efficiency of the telemedicine framework but also ensures the maintenance of high-quality standards in echocardiography image analysis.

The recent development in machine learning has led to high recognition quality and diagnostic accuracy of echocardiographic AI. Ouyang et al. reported that their video-based AI could estimate the left ventricular ejection fraction with a mean absolute error of 6.0% and classified heart failure with reduced ejection fraction with an area under the curve of 0.96 [3]. Moreover, Salte et al. reported that automated left ventricular strain measurement was feasible [4]. The interrater variability has been reported to be smaller between automated readings and expert sonographers as compared to that among expert sonographers [5]. The present study supported the consistency and accuracy of the automated measurements of AI.

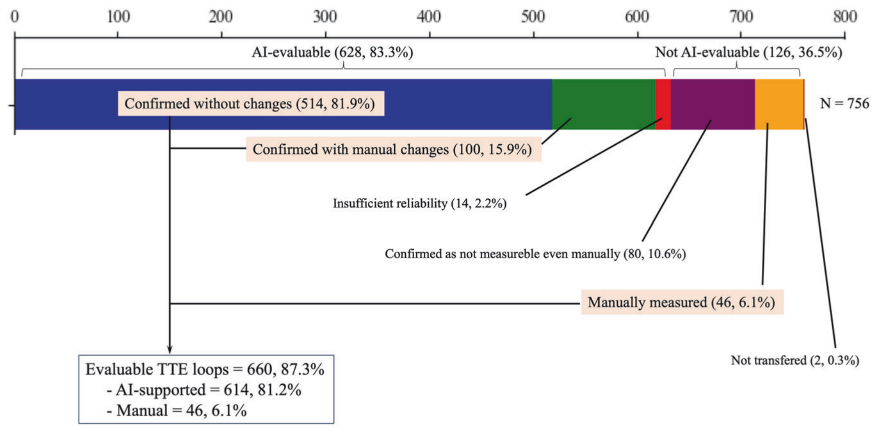

Fig. 1 Outline of acquired echocardiographic video loops. In total 756 echocardiographic video loops were acquired and 754 loops were uploaded. Finally, 660 loops (87.3%) were evaluable. Out of 660 loops, 46 loops should be measured manually. AI-supported measurement was feasible in 614 loops

The present study notably demonstrates the practicality of implementing point-of-care ultrasound (POCUS) in remote areas, a significant stride in medical technology application in settings where access to advanced diagnostic tools is limited. Central to this achievement was the two-day hands-on training program in echocardiography and image uploading for nurses and nurse-assistants without prior experience in these techniques. This training component is crucial as it directly contributes to the study's outcomes by building local capacity in diagnostic procedures.

The present study offers significant contributions in several key aspects, particularly in the context of deploying modern medical technologies in remote and underserved regions. It underscores the critical role of technology transfer and the development of skills among local healthcare workers. While the study conducted by DeWyer et al. demonstrated significantly enhanced accuracy of heart failure diagnosis through training non-expert providers in transthoracic echocardiography (TTE) in Uganda, showing a high level of agreement with expert analysis and considerable changes in initial diagnoses, the current study takes a further step [6]. It innovates by incorporating telemedicine into this model, thereby augmenting the potential of TTE in enhancing cardiac care in resource-limited settings. This approach not only reinforces the value of skill transfer in healthcare but also illustrates the transformative impact of telemedicine in bridging the gap between advanced medical technologies and their application in areas with limited healthcare infrastructure.

Future challenges and implications of this study include the necessity of integrating diagnosis with timely and appropriate medical intervention, particularly in environments with underdeveloped healthcare infrastructures. This study opens avenues for future research and implementation strategies focusing on how POCUS and similar technologies can be more effectively integrated into healthcare systems in challenging environments.

In summary, the study sets a precedent for further research into the effective utilization of POCUS and similar technologies in remote areas. It emphasizes the need for a cohesive approach that not only focuses on diagnosis but also on the subsequent steps necessary for comprehensive patient care. This approach has the potential to improve healthcare outcomes in regions where access to advanced medical facilities is limited.

Compliance with ethical standards

Conflict of interest The author declares no competing interests.

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