Telemedicine strategies in older patients with cardiovascular diseases

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INTRODUCTION

Care of older patients with cardiovascular diseases has become a major healthcare issue. Frail patients at older ages commonly present some characteristics that affect adherence to physicians' prescription and attendance to medical visits, especially in patients with restricted mobility or reduced social support. Telemedicine is an attractive tool for improving management and prognosis of these patients. Telemonitoring of cardiac devices such as pacemakers or defibrillators is one of the most consolidated examples of a successful application of telemedicine. However, this article will focus on application of telemedicine strategies in other cardiac settings.

TELEMEDICINE FOR AORTIC STENOSIS

The prevalence of aortic stenosis (AS) is closely related to age, frailty and other geriatric syndromes. Telemedicine is being increasingly studied at different stages of the disease, both among patients with asymptomatic severe AS, in order to select the optimal timing for intervention, and in patients with indication for treatment. Among AS patients waiting for transcatheter aortic valve intervention (TAVI), the randomized, ResKriVer-TAVI study[1] is designed to investigate whether a digital concept of telemedical interventional management (TIM) improves clinical outcomes as compared to usual care. TIM includes a daily assessment of weight, blood pressure, a 2-channel electrocardiogram, peripheral capillary oxygen saturation, and a self-rated health status until admission for TAVI. The primary endpoint consists of days lost due to cardiovascular hospitalization and all-cause death within 180 days after the heart team's decision.

Telemedicine strategies are also being tested for AS patients after the TAVI procedure. Liu *et al.*[2] assessed a series of 100 AS patients undergoing elective TAVI and discharged home with a smartwatch at least 1 day before the procedure. Vital signs, including heart rate, rhythm, oxygen saturation, and activity, were continuously recorded, along with single-lead electrocardiogram for the subsequent month after discharge. A designated heart team member provided remote health care with the data from the smartwatch when the patient had a need. Most (76%) of the thirty-eight cardiac events were detected and confirmed by the smartwatch. Six patients were advised and readmitted to the hospital for arrhythmia events, of whom 4 patients received pacemaker implantation. The authors concluded that wearable devices can facilitate remote health care for patients discharged home after undergoing TAVI and enable a novel remote follow-up strategy.

TELEMEDICINE FOR ACUTE CORONARY SYNDROMES

Telemedicine programs can also contribute

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Access this article online

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DOI: 10.1515/jtim-2025-0012

to improve adherence and management of patients with acute coronary syndromes (ACS). Some studies have shown an increase therapeutic adherence among ACS patients with the use of resources such as telehealth cardiology clinics. Telemedicine can also contribute to improve cardiac lifestyle risk factors control and cardiac rehabilitation completion, along with a reduction of clinical events among ACS patients. Alshahrani *et al.*[3] assessed the role of a telemedicine based approach on outcomes after an admission for ACS ($n = 337$) in the randomized *TELE-ACS* study. There was a reduced rate of readmission over 6 months (HR: 0.24; $P < 0.001$) and emergency department attendance (HR: 0.59) in the telemedicine arm, along with fewer unplanned coronary revascularizations (3% *vs.* 9%). However, some studies have shown a notable lack of suitability for specific cohorts of patients to participate in telemedicine interventions, emphasizing the risk of digital marginalization for some subgroups such as patients without caregivers or those with low educational levels.

HOME TELEMONITORING SYSTEMS FOR HEART FAILURE

In recent years, the focus on the integration of eHealth solutions such as telemedicine (home telemonitoring systems [hTMS]) in heart failure (HF) management has increased exponentially. HF monitoring is based on the development of more proactive healthcare models, particularly after acute hospital admission in order to prevent of adverse clinical events. Current studies show that invasive technologies improve clinical outcomes for HF patients. Nevertheless, their use is limited across the entire HF population (Supplementary Figure 1). As a result, there is growing interest in non-invasive hTMS, which offers cost-effective, safe, and adaptable solutions for population-based HF management[4-9]. However, the real impact of these technologies remains uncertain due to the significant heterogeneity in published trials, particularly regarding the eHealth solutions assessed and the diverse HF care models and patient populations involved.[4-9]

The contribution of eHealth is even more uncertain in frail elderly patients. These patients are often under-prescribed eHealth solutions, based on the misconception that they offer limited benefits. Additionally, such populations are frequently under-represented in clinical trials. Recent efforts aim to demonstrate that non-invasive eHealth strategies can be beneficial across all HF patients' strata.

Patients enrolled in the non-invasive hTMS trials had a slightly higher mean age than those included in invasive studies. Nevertheless, these age ranges do not accurately represent the "real world" of HF population. Older frail patients are increasingly more represented in recent studies, suggesting a more reliable representation of the results in this population[4-9] (Supplementary Table 1). Moreover, non-invasive hTMS demonstrated benefits regardless of age, suggesting that this should not be a barrier to prescribing digital solutions for HF monitoring.

FUTURE DIGITAL SOLUTIONS FOR HEART FAILURE

There is scarce data about comorbidity, frailty, psycho-social or socioeconomic status in major clinical trials of non-invasive hTMS,[4-6,8,9] thus precluding knowledge about the potential impact of eHealth solutions on most vulnerable patients. A post-hoc analysis of the iCOR trial[7] showed that non-invasive hTMS-based monitoring was more effective in preventing events and more cost-effective, regardless of the five frailty phenotypes identified. These findings highlight the need for comprehensive geriatric and frailty assessments in future eHealth studies and clinical practice to ensure equitable use of non-invasive hTMS for all HF patients.

Therefore, the future of digital solutions in HF monitoring should offer user-friendly solutions that are near to the patient and the care team, combining telemonitoring and teleintervention strategies. In addition, integrating these tools into HF care models and focusing them on patients at high-risk for new adverse events (ideally in the post-discharge transitional period) is warranted.

The *HERMeS* trial (Heart failure Events reduction with Remote Monitoring and eHealth Support)[10] could be a game-changer in HF monitoring after hospital discharge. It was designed to evaluate the impact of a non-invasive hTMS service based on mHealth, combining telemonitoring with videoconference (teleintervention) for HF patients in the post-discharge phase, compared to usual care (UC). A total of 506 HF patients were randomised (1:1) to either UC or mHealth. The median age was 73 ± 13 years, 32% were frail, and over 55% had limited digital skills or needed caregiver support. Awaiting further details of the results, the advantages of mHealth extended across various subgroups of HF patients, making it an equitable solution for providing high-quality care.

CONCLUSION

In conclusion, non-invasive hTMS solutions should be crucial in the current and future of monitoring in all subgroups of older patients with cardiovascular diseases. It is crucial to include a thorough multi-dimensional geriatric and frailty assessment in future research on the effectiveness of eHealth in order to assess the real impact

on these populations and to offer this kind of monitoring for an all corners' population.

Acknowledgements

None.

Author Contributions

A. Ariza-Solé, and F Formiga contributed to the design and execution of the paper. A Ariza and S Yun drafted the report, which was critically revised by F. Formiga and J Comin. All authors approved the final report.

Source of Funding

None.

Ethical Approval

Not applicable.

Informed Consent

Not applicable.

Conflict of Interest

None declared.

Use of Large Language Models, AI and Machine Learning Tools

None declared.

Data Availability Statement

No additional data is available.

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How to cite this article: Yun S, Ariza-Solé A, Formiga F, Comín-Colet J. Telemedicine strategies in older patients with cardiovascular diseases. J Transl Intern Med 2025; 13: 97-99.