A Social Robot as a Health Educator for Heart Failure Patients Using the Teach-Back Method

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Introduction

Heart failure (HF) is a chronic, progressive condition that requires patients to engage in complex self-care behaviors to prevent the condition from worsening, avoid preventable hospital readmissions, and enhance quality of life. Despite advances in treatment, HF continues to be one of the leading causes of hospitalization among adults over the age of 65 (Malik et al., 2021; Nair et al., 2020). Effective patient education is a crucial part of HF management. However, many patients possess an inadequate understanding of their disease process, prescribed treatment regimens, and self-care behaviors associated with optimal health.

In rural healthcare settings, such as Labette Health's Erie Clinic, the challenges HF patients face are further compounded by clinician time constraints, limited access to specialized HF educational resources, and barriers such as low health literacy. Traditional patient education methods, frequently nurse or provider-led, often fail to ensure comprehension and long-term retention of essential information, placing patients at increased risk of poor self-management leading to unnecessary hospital readmissions (Friel, 2016; Lambrinou et al., 2014). For healthcare providers and hospitals, these readmissions represent not only a quality-of-care concern but can result in significant financial burdens under value-based reimbursement models such as the Centers for Medicare and Medicaid Services' Hospital Readmissions Reduction Program (McIlvennan et al., 2015).

Currently, there is a performance gap that is characterized by inconsistent patient understanding of self-care principles in HF, and limited opportunities for healthcare providers to verify patient comprehension of core HF concepts during brief clinical encounters. Ideally,

patients should be able to accurately explain key HF concepts in their own words, demonstrate understanding of their disease process, medication management, dietary and fluid restrictions, symptom monitoring, and engage in those self-care behaviors that proactively reduce the likelihood of preventable hospitalizations. Achieving this outcome requires an instructional strategy that delivers a standardized, evidence-based educational approach, allowing for active learner participation and providing immediate feedback.

The performance gap addressed in this proposal is primarily instructional. While systemic and organizational constraints exist, patient deficits in knowledge, comprehension, and retention are the factors I will address through a targeted educational intervention. The teach-back method, an evidence-based strategy widely used in healthcare, directly addresses this gap by requiring learners to demonstrate understanding while allowing healthcare educators to identify and remediate knowledge deficits in real time (Yen & Leasure, 2019). Leveraging novel instructional technologies, such as a social robot to deliver patient education using the teach-back method, offers a unique opportunity to improve patient learning outcomes while at the same time reducing demands on clinical staff.

Objectives

The primary objective of this project is to develop and pilot a heart failure education module to be delivered by the Furhat social robot using the teach-back method that mirrors the interactions between a healthcare provider and a HF patient. The purpose of the instructional intervention is to improve patient understanding of HF as a chronic disease process, common treatment regimens, and self-care principles while supporting long-term knowledge retention.

Upon completion of the instructional social robot interaction, learners will be able to:

- Explain key heart failure concepts, including basic disease mechanisms and common signs and symptoms of worsening of the condition in their own words.
- Describe crucial self-care behaviors related to medication adherence, dietary and fluid management, and symptom monitoring.
- Verbalize comprehension of appropriate actions to take when early signs of heart failure worsening occur.

At the project level, the instructional design process will result in a fully developed and pilot-tested social robot interaction for HF education, along with associated assessment and evaluation tools to measure learner comprehension and instructional effectiveness.

Audience

The target audience for this instructional intervention consists of adult patients diagnosed with left-sided heart failure who receive care at Labette Health's Erie clinic in rural Southeast Kansas. This population primarily includes Medicare beneficiaries aged 65 and older who are managing HF as a chronic, progressive condition that requires ongoing self-care and disease monitoring. Learners within this group demonstrate varying levels of health literacy, exposure to heart failure education through cardiac rehabilitation immediately following their initial diagnosis, and deviations in individual adherence to prescribed treatment regimens. HF patients experience challenges related to information overload, condition-induced anxiety related to diagnosis and prognosis, and difficulty retaining complex medical information presented during brief clinical encounters (Rashid et al., 2023; Wang & Voss, 2022).

I have chosen to exclude patients with significant cognitive, visual, or hearing impairments as they are not optimal candidates for this instructional approach due to the interactive nature of the teach-back method. The instructional design prioritizes the use of clear,

plain language devoid of medical jargon and includes interactive dialogue that accommodates diverse literacy levels while respecting adult learners' autonomy and dignity. This audience represents a population well-suited for an interactive, teach-back-based educational intervention designed to improve patient comprehension in HF, enhance self-care competency, and positively affect clinical outcomes.

Instructional Design Strategy and Theoretical Framework

The instructional design strategy for this project is based on the ADDIE instructional design model, using the teach-back method as the primary approach. The ADDIE model provides a framework that is ideal to address the clearly defined instructional problems in patient health education. For this project, the performance gap involves knowledge deficits in patient understanding and self-care competencies that health educators or their proxies can help improve through targeted instruction. ADDIE supports a systematic approach to analyzing patient learning needs, designing, and developing instructional strategies that align with identified learning objectives, and evaluating outcomes to determine the effectiveness of instruction. Its emphasis on evaluation is particularly relevant in healthcare contexts, where verifying patient comprehension by measuring learning outcomes is essential for patient safety, satisfaction, and as a measure of quality of care (Lee & Lee, 2025; Oh et al., 2021).

I selected teach-back as the instructional method because it is an evidence-based strategy shown to improve patient comprehension, self-care behaviors, and health outcomes in HF (Oh et al., 2021; Yen & Leasure, 2019). Teach-back requires learners to explain key concepts in their own words after initial instruction by a health educator, which allows verification of understanding and immediate remediation by the educator when they identify knowledge gaps or misconceptions. This active, patient-centered approach is appropriate for adult learners managing

chronic health conditions such as HF that require precise, long-term adherence to self-care behaviors. Additionally, Orem's Self-Care Deficit Theory provides the conceptual foundation for this intervention by prioritizing patient autonomy, self-management, and the important supportive-educative role of healthcare interventions that address self-care deficits (Orem, 2001). Finally, Social Agency Theory further supports the use of an embodied social robot as the vehicle for instructional delivery. Learners tend to attribute social qualities to artificial embodied agents that exhibit human-like verbal and non-verbal behaviors. This can increase engagement, motivation, and potentially trust during educational interactions (Jackson & Williams, 2021). Mayer's embodiment principle suggests that embodied agents can enhance learning by using gestures, facial expressions, and eye contact (Mayer, 2014). Together, these principles support the use of a social robot to facilitate patient education that is meaningful and interactive.

Instructional Technology

The instructional technology I have selected for this project is the Furhat social robot, which will serve as the delivery platform for HF education using the teach-back method. I have chosen this social robot because it supports face-to-face, human-like interaction through verbal and non-verbal communication, all of which are essential for effective patient education. The use of an embodied social robot directly supports the instructional strategy by allowing learners to explain complex concepts in their own words and then receive immediate reinforcement and clarification of those concepts. This interactive format aligns with the teach-back methodology by supporting adult HF patients who require a comprehensive understanding of their condition and the self-care behaviors that support optimal health.

I also selected the Furhat platform due to its feasibility within the project scope. The robot is already available for use, optimized for standardized delivery of instructional content,

and supports future iterative refinement based on learner performance during pilot testing. Overall, the Furhat social robot is a practical and scalable technology for patient-centered delivery of HF education based on the teach-back method.

Timeline

The project timeline provides an overview of the instructional design phases and milestones necessary to guide the development, implementation, and evaluation of the instructional solution within the designated time frame.

Table 1

Project Timeline and Milestones

ADDIE Phase	Key Activities	Target Completion
Analysis	Confirm instructional requirements, learner characteristics, and constraints	February 22, 2026
Design	Finalize instructional objectives, teach-back prompts, and instructional flow	March 15, 2026
Development	Develop and program the Furhat interaction skill and assessment tools	April 1, 2026
Implementation	Pilot test HF instructional interaction with simulated participants	April 12, 2026
Evaluation	Review assessment results and finalize all skill revisions	April 26, 2026

Evaluation

I have designed the evaluation plan for this project to assess both learner comprehension and the overall effectiveness of the instructional intervention. I have integrated the evaluation

activities throughout the instructional design process to allow for continuous improvement and ensure alignment with the instructional objectives. Formative evaluation will occur during pilot testing of the HF instructional interaction delivered by the Furhat social robot. I will observe the learner responses to teach-back prompts to identify areas of unclear instruction or potential misunderstandings. I will document technical or interactional issues to inform revisions to instructional content and dialog flow. This formative feedback will support iterative refinement of the instructional skill before final deployment of the social robot skill in a real-world clinical or acute care setting.

Summative evaluation will focus on measuring learners' knowledge acquisition and retention related to HF knowledge, treatment regimens, and self-care principles. I will assess learner comprehension using the validated Atlanta Heart Failure Knowledge Test – version 2 (Malik et al., 2021; Reilly et al., 2009) before and after the interaction. I will analyze the test results to determine whether learners demonstrate improved understanding of key concepts, including recognition of HF exacerbation, medication management, and self-care behaviors. I will use the formative and summative evaluation to determine the efficacy of the intervention and help guide recommendations for future implementation.

Funding and Staff Requirements

This project requires no additional funding or staffing due to the use of existing instructional and technological resources. The Furhat social robot is already available for use. Development activities will focus on instructional design, content development, and scripting of teach-back interactions rather than acquiring new software or hardware. I will lead the analysis, design, development, implementation, and evaluation phases of the project. Additionally, I will seek out subject matter expertise through consultation with the clinical stakeholder, Verdon

Parham, MD, as needed to ensure accuracy and alignment with current heart failure education guidelines.

Conclusion

This proposal outlines an evidence-based approach to addressing gaps in HF patient education through the development of an instructional intervention delivered by the Furhat social robot using the teach-back method. By applying the ADDIE instructional design model, the proposed solution emphasizes systematic planning, patient-centered instruction, and meaningful evaluation aligned with healthcare quality and patient safety priorities.

The use of an embodied social robot is a novel instructional technology that may support interactive learning while addressing the constraints commonly present in rural healthcare settings. Through pilot testing and evaluation, this project will result in a refined instructional prototype that has the potential to improve patient HF health literacy, support self-care competency, reduce unnecessary hospital readmissions, and address healthcare provider clinical time limitations that affect the quality and efficacy of HF education. The proposed approach offers the opportunity to present a scalable framework for future implementation in real-world settings and may highlight the continued refinement needed for social robotic technology-enhanced patient education initiatives.

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