Brief Communication

Cost-Benefit Analysis of Telemonitoring for Patients with Heart Failure after Hospital Discharge

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Abstract

To estimate the cost-benefit of telemonitoring in patients with heart failure (HF) from the perspective of the Brazilian Unified Health System (SUS).

An economic analysis based on a clinical trial was conducted, comparing telemonitoring with usual care. Implementation costs per patient and the expected incremental net benefit resulting from avoided readmissions were estimated in scenarios based on hospitalization costs from SIH/SUS and DRG-Brasil. The potential benefit for the state of Minas Gerais was also estimated.

The implementation cost for SUS was estimated at R$426.00 per patient (2024). Telemonitoring showed a positive expected incremental net benefit, ranging from R$47.00 (SIH/SUS) to R$2,396.00 (DRG-Brasil) per patient. For Minas Gerais, the estimated annual net benefit ranged from R$1.3 million to R$65.7 million.

Telemonitoring for patients with HF proved economically favorable from the SUS perspective, supporting its adoption and scale-up in the public sector.

Introduction

Heart failure (HF) is the leading cause of hospitalization due to cardiovascular disease (CVD) and the condition that demands the most resources.[1] The high readmission rates within the first 90 days can be partially prevented through improved transition of care from hospital to home.[2] In a randomized clinical trial, telemonitoring, in addition to usual care, was shown to reduce readmissions by 44% compared with usual care alone.[2] The aim of this study is to estimate the cost-benefit of this intervention from the perspective of the Brazilian Unified Health System (SUS) and provide evidence on the feasibility of scaling it up.

Keywords

Heart Failure; Remote Patient Monitoring; Cost-Benefit Analysis

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Methods

This study is an economic analysis based on a clinical trial that evaluated the effectiveness of telemonitoring, added to usual care, in reducing HF readmissions.[2] The economic evaluation was conducted from the SUS perspective, aiming at routine implementation. The time horizon corresponded to the intervention follow-up period (180 days). Economic benefits were estimated based on the expected reduction in hospital readmissions, according to the clinical trial parameters.

The intervention began with a consultation with the case manager within the first seven days after hospital discharge, according to guidelines. During this visit, patients received instructions for daily recording of blood pressure, heart rate, weight, and medication use, as well as the necessary equipment (sphygmomanometer and scale). Follow-up included structured telephone support – weekly or biweekly – provided by a nurse case manager, educational text messages, and the possibility of teleconsultation with a cardiologist according to pre-established clinical algorithms. Educational booklets were provided to both groups.[2]

Cost measurement included materials and supplies, equipment provided to patients, professional remuneration, and expenses related to the telehealth system (development, maintenance, and data storage). A micro-costing approach was used from the SUS perspective, considering the items and quantities actually used in the intervention. Cost parameters were obtained from official sources to reflect real implementation conditions of telemonitoring in the public sector in the state of Minas Gerais (MG) (Table S1).[3-5]

The costs of the case manager were estimated considering 6.5 hours of follow-up per patient: an initial 60-minute consultation and 11 biweekly 30-minute consultations, according to the study protocol.[2] In this configuration, a professional with a 40-hour weekly workload can monitor up to 160 patients over six months. For teleconsultations with a cardiologist, an average duration of 30 minutes was adopted, assuming that 33% of patients were referred, as reported in the

clinical trial. In the calculation for Minas Gerais (MG), the initial investment in developing the telehealth platform, already operational, was excluded, considering only maintenance and data-storage costs. All values were updated to December 2024 based on the national broad consumer price index.

The economic benefit was estimated from the avoided readmissions. To quantify the volume of hospitalizations in the SUS in MG, the annual average of records in the Hospital Information System (SIH/SUS)[6] for the period 2022-2024 was calculated, adjusted for in-hospital mortality due to HF (Table S1). The model incorporated the readmission rates observed in the clinical trial (26% in the intervention group and 46% in the control group). Monetary valuation was based on DRG-Brasil[3] reference values for diagnoses related to HF (ICD codes I50, I11.0, I13.0, I13.2, and I09.8) with severity level 1.

The DRG-Brasil system stratifies hospitalizations into four severity levels according to the complexity of procedures and the patient's health status. These values more accurately reflect the costs of hospital procedures in Brazil, as the original source is the amounts reported by health insurers for hospitalization payments. The amounts transferred by the Ministry of Health for hospital services, listed in the SIGTAP table, reflect only the portion of funding provided by the federal government.

Finally, a probabilistic sensitivity analysis was conducted to assess the impact of model uncertainty. Variability in nurse and cardiologist salaries and in equipment prices was represented by their respective standard deviations. A ±20% variation was applied to items whose values were based on the clinical trial costs. For parameters with predefined percentage variation, triangular distributions were used; for those whose uncertainty was expressed through standard deviations, gamma distributions were adopted.

The results of the economic evaluation are presented across four scenarios, defined by different hospitalization costs for HF – that is, different ways of valuing the benefits of the program, which include avoided readmissions. Scenarios 1 to 3 use DRG-Brasil values stratified by the first three severity levels, capturing variations associated with care complexity, while excluding level 4 because it is not representative of the target population (transplants and related procedures).[3] Scenario 4 uses the average hospitalization values recorded in SIH/SUS, which tend to underestimate real costs because they reflect only federal transfers.

Modeling was performed in TreeAge® Pro 2009, according to the decision tree (Figure S1).

Results

Table 1 presents the costs and the expected incremental net benefits per patient (the difference in net benefit between the intervention and control groups) across the different scenarios. The benefit of the program consists of the monetary value of avoided readmissions. These readmissions are estimated based on the probability of readmission in the control and intervention groups. In all scenarios analyzed, telemonitoring showed a positive expected incremental net benefit, indicating economic feasibility for scaling within the SUS.

Considering an implementation cost of R$426.00 per patient (Table S1), the expected incremental net benefit ranged from R$47.00 in the scenario (scenario 4) in which readmissions were valued according to the average hospitalization cost in SIH/SUS, up to R$2,396.00 in the scenario corresponding to severity level 3 of DRG-Brasil (scenario 3). When projecting these findings to the state of Minas Gerais, whose annual average number of hospitalizations (excluding deaths) was 27,439 between 2022 and 2024 (Table S1), the expected incremental net benefit was estimated to range from R$1.3 million (Scenario 4) to R$65.7 million (Scenario 3).

In the probabilistic sensitivity analysis (Table S2), incremental net benefits showed variability, with 95% credibility intervals that included zero: R$-490.00 to R$10,990.00 (Scenario 1), R$-451.00 to R$10,363.00 (Scenario 2), R$-458.00 to R$14,022.00 (Scenario 3), and R$-486.00 to R$2,784.00 (Scenario 4). The probability of a positive incremental net benefit was 35.7%, 48.1%, 47.8%, and 34.1%, respectively. Although the possibility of negative results exists, an asymmetric pattern is observed: potential losses are limited (R$-490.00 to R$-451.00), whereas potential gains can be substantially higher (up to R$14,022.00). In an alternative scenario, if an initial 30-minute consultation were conducted by a cardiologist instead of the case manager for all patients, the implementation cost would be R$428.00 per patient (Table S3).

The main limitations of this study include the non-inclusion of secondary outcomes such as the use of emergency and urgent care services, avoidable mortality, and preventable outcomes beyond 180 days, which may result in an

Table 1 – Costs and economic benefits per patient of telemonitoring in the Brazilian Unified Health System (SUS) according to the clinical trial protocol,[2] by hospitalization scenarios (R$, 2024)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Cost of the intervention per event		426		
Expected net benefit of the control group	4068	4676	7713	1297
Expected net benefit of the intervention group	5130	5960	10109	1344
Expected incremental net benefit of the intervention	1062	1284	2396	47

Scenarios 1 to 3 use DRG-Brasil values stratified by the first three severity levels.□ Scenario 4 uses the average hospitalization values recorded in SIH/SUS

underestimation of the true benefit. It is also important to note that the number and duration of consultations conducted by the case manager varied according to the patients' sociodemographic and clinical profiles, and that the data were derived from a single study, which may compromise external validity.

Conclusion

Telemonitoring, as implemented in the clinical trial protocol,[2] has a relevant impact on reducing hospital costs by lowering readmission rates among patients with HF within the SUS. The results suggest that telemonitoring yields a positive expected incremental net benefit across all severity and cost-valuation scenarios, indicating economic feasibility for scaling within the public sector as a strategy with low expected negative value and high potential benefit.

Author Contributions

Conception and design of the research: Andrade MV, Julião NA, Souza A, Noronha K, Ciminelli ALA, Malta DC, Ribeiro ALP, Rezende LC, Brant LCC; Data collection: Ribeiro EG, Ribeiro ALP, Rezende LC, Brant LCC; Data analysis and interpretation: Andrade MV, Julião NA, Souza A, Noronha K, Motta-Santos AS, Ribeiro EG, Ciminelli ALA, Malta DC, Rezende LC, Brant LCC; Statistical analysis: Andrade MV, Julião NA, Souza A, Motta-Santos AS; Manuscript drafting: Andrade MV, Julião NA, Souza A, Noronha K, Brant LCC; Critical revision of the manuscript for important intellectual content: Andrade MV, Julião NA, Motta-Santos AS, Ribeiro EG, Ciminelli ALA, Malta DC, Ribeiro ALP, Rezende LC, Brant LCC.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Nome da Universidade Federal Fluminense under the protocol number 4.428.887. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

Use of Artificial Intelligence

During the preparation of this work, the author(s) used ChatGPT to assist in summarizing the text. After using this tool/service, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the published article.

Data Availability Statement

All datasets supporting the results of this study are available upon request from the corresponding author.

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***Supplemental Materials**

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