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Brief Report

Leveraging Remote Patient Monitoring to Effectively Put the Heart Failure Guidelines to Practice

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Guideline-directed medical therapy (GDMT) effectively reduces morbidity and mortality rates for patients with heart failure (HF).[1] Unfortunately, despite clear recommendations for initiating and titrating GDMT,[2] optimization of GDMT in patients with HF nationwide is staggeringly low.[3] Reasons, such as clinical inertia, inaccessibility of clinicians, patient-level costs, and medical constraints, are often to blame.[4] Remote patient monitoring (RPM) has helped to address these challenges and has resulted in improved care for patients with HF.[5] Further one of comprehensive RPM and centralized medication titration by health systems is required to close care gaps, improve outcomes and reduce costs. Outsourcing the GDMT titration efforts to a centralized RPM program could be one of the most impactful solutions.

We studied the impact of a health-care technology company, which leverages RPM and delivers clinical care to patients with chronic diseases alongside health care institutions. Medicare beneficiaries with the International Classification of Diseases-10 code, suggestive of an active or prior diagnosis of HF with reduced ejection fraction (HFrEF), which included current patients with HF with mildly reduced ejection fraction (HFmrEF) and HF with improved ejection fraction (HFimpEF), and who were enrolled between August 2021 and April 2023, were included in this analysis. A remote multidisciplinary clinical team monitored patients' daily vital signs as measured by a cellular-enabled blood pressure cuff, heart rate monitor and weight scale. Virtual clinical visits using standardized clinical protocols were also conducted on a regular basis to facilitate guideline-directed clinical interventions, including symptoms, vital measurements and medication optimization. The cost analysis used 5 years of deidentified healthcare claims data in patients with HF from a Cadence Health partner Accountable Care Organization (ACO) and calculated average monthly health care costs by using the 4-month period of January–April for each year. Using a differences-in-differences analysis, we estimated the effect of enrolling in Cadence on average monthly health care costs compared to patients in an ACO who were ordered for Cadence but did not enroll. Of note, although all eligible patients were contacted in a similar fashion, reasons for not enrolling included patient preference, issues surrounding cost and technology, perceptions about disease status, program safety and provider trust.

A total of 367 patients (mean [SD]: age 74 [11] years; EF 45 [2] %; blood pressure 131/77 [19/11] mmHg; heart rate 73 [11] bpm, weight 193 [49] pounds; n [%]; 122 women [33%]; 260 white [71%]) were followed for a median of 294 days. There was a significant decrease in patients' blood pressure (systolic blood pressure -7, diastolic blood pressure -5; $P < 0.001$) and weight (-2.4 pounds; $P = 0.010$) but not heart rate. At the time of enrollment, the HF status of the patients was the following: 221 had

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See page 4 for disclosure information.

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Table 1 Baseline characteristics

Enrolled Patients, n	367
Age, mean (SD), years	74 (11)
Ejection fraction, mean % (SD)	45 (2)
HFrEF, n (%)	221 (60)
HFmrEF, n (%)	109 (30)
HFimpEF, n (%)	37 (10)
Female, n (%)	122 (33)
Caucasian, n (%)	260 (71)
Blood pressure, mean (SD), mmHg	131/77 (18/11)
Heart rate, mean (SD), bpm	73 (11)
Weight, mean (SD), lbs	193 (49)
Serum Test Results, n (SD)	
Potassium, K	4.4 (0.5)
Creatinine, Cr	1.4 (3.8)
Estimated glomerular filtration rate	59 (20)
Comorbidities: n (%)	
Hyperlipidemia	328 (89)
Coronary artery disease	275 (75)
Atrial fibrillation	189 (52)
Chronic obstructive pulmonary disease	76 (21)
Ventricular tachycardia/fibrillation	60 (16)
Chronic kidney disease	109 (30)
Diabetes mellitus	168 (46)
Depression	29 (8)
Active smoking	16 (4)

Table 2 Clinical engagement

	Total Number	Mean (SD)
Vitals	309,009	842 (444)
Visits	10,068	28 (23)
Phone calls	8392	23 (16)
High-acuity clinical alerts	1748	5 (2)

HFrEF, 109 had HFmrEF, and 37 had HFimpEF. Cardiovascular risk factors were highly prevalent among enrolled patients; the majority had hyperlipidemia (89%), coronary artery disease (75%) or atrial fibrillation (52%) (Table 1). High levels of patient engagement were achieved, with total number of vital signs recorded, clinical visits and phone calls completed, and high-acuity clinical alerts resolved highlighted in (Table 2).

Patients experienced significant increases in the use of sodium-glucose cotransporter-2 inhibitors (92 [26%]−165 [45%]; $P < 0.001$) and mineralocorticoid receptor antagonists (120 [33%]−144 [39%]; $P = 0.002$) but not beta-blockers or renin-angiotensin system antagonists (Fig. 1, A). The percentage of patients taking ≥ 50% of the target dosage significantly increased for all pillars of GDMT. There was also a significant increase in the percentage of patients taking all 4 pillars of GDMT at follow-up (84 [23%] vs 26 [7%]; $P < 0.001$).

The ACO cost analysis included a total of 70 patients with HF enrolled in Cadence and 42 patients with HF ordered for Cadence but not enrolled. Compared to ordered but not enrolled patients, enrollment in Cadence resulted in a 52% reduction in total cost of care (-$1076.64 per HF patient per month) despite an increase in cost related to primary care physician and nurse practitioner visits. Most cost savings were secondary to decreases in hospital and post hospital discharge (ie, skilled nursing facility) -related spending (Fig. 1, B).

Several key limitations are worth noting. First, the study cohort is relatively small and is without a control group to compare against regarding the effect of the RPM intervention. Second, there is limited cohort profiling of the comparison group used in the cost analysis. Third, there is a paucity of clinical safety data to assess the safety of the clinical program. Last, although GDMT is used as a surrogate of hard clinical endpoints, there are no data to support improved clinical outcomes resulting from the RPM intervention.

These data highlight the benefit of a comprehensive RPM solution in improving clinical outcomes for patients with HF. In addition, they are the first data to support the effect of an end-to-end RPM solution on reducing total and hospital-associated costs. Advancements in the treatment of HF have far surpassed our ability to implement these lifesaving therapies effectively. A preferred alternative to today's homegrown GDMT clinics might include collaboration with an outside, independent RPM and virtual-care program to support GDMT titrations at primary care and cardiology clinics, particularly at under-resourced institutions and in communities serving patients at risk for and affected by social determinants of health. We must break the status quo of suboptimally treating patients with HF at the expense of poor clinical outcomes and exorbitant cost and, instead, embrace solutions such as

Fig. 1. A, Use and dosage of GDMT at follow-up vs baseline. B, Effect of Cadence on health care cost in enrolled vs nonenrolled patients. ACEi, angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor-neprilysin inhibitor; GDMT, guideline-directed medical therapy; MRA, mineralocorticoid receptor antagonists; NP, nurse practitioner; PCP, primary care physician; SGLT2i, sodium-glucose cotransporter-2 inhibitor.

comprehensive RPM programs with centralized medication titration that will help to fill the gaps in care for patients with HF.

Disclosures

DIF and MF are advisors at Cadence; SB, TF and RC are employees of Cadence.

CRediT authorship contribution statement

DAVID I. FELDMAN: Conceptualization, Data curation, Methodology, Writing – original draft, Writing – review & editing. **SARINE BABIKIAN:** Formal analysis. **THEODORE FELDMAN:** Conceptualization, Methodology, Supervision, Validation. **RANDALL CURNOW:** Conceptualization, Investigation, Supervision, Validation. **MARAT FUDIM:** Investigation, Methodology, Resources, Supervision, Writing – review & editing.

Ethics Approval

This study received the proper ethical oversight as determined by the DUHS IRB Declaration of Research (Pro00114791).

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