AMC health.

An Observational Study

Reducing Hospitalization and Cost for Medicaid Beneficiaries with Heart Failure

Original Investigation

Reducing Hospitalization and Cost for Medicaid Beneficiaries with Heart Failure through Remote Patient Monitoring: An Observational Study

Jonathan Shankman[2], MBA, MPH; Hengqiao Zhao[2], MS

BACKGROUND

Heart failure has become an increasing burden on adult populations under the age of 65 who are covered under Medicaid Managed Care plans. Remote monitoring and remote care management interventions can help identify pre-acute decompensation of these individuals, thereby increasing the chances for more timely intervention to forestall preventable and costly utilization.

OBJECTIVES

To assess the impact of a remote monitoring and virtual care management program for Medicaid members with heart failure, and to measure whether the program impacted all-cause hospital admissions, all-cause 30-day readmissions, total costs and return on investment (ROI).

DESIGN

Retrospective analysis of a non-randomized intervention cohort with two, separate, propensity matched observational control arms.

PARTICIPANTS

Adult patients with stage II or higher heart failure enrolled in Managed Medicaid insurance plans.

INTERVENTION

Remote home monitoring program including biometric measurements, automated coaching for self-care, and automated monitoring surveys delivered via telephonic interactive voice response, combined with virtual nurse coaching.

MAIN MEASURES

All-cause hospital admissions (per 1000 patients per year), all-cause 30-day readmissions, total healthcare costs, and return-on-investment (ROI) measured as the total cost difference divided by cost of implementing program.

KEY RESULTS

Patients in the intervention group had 186 per 1,000 patients fewer all-cause admissions per year than the primary control, (95% confidence interval -54, 425), but with a $p<0.128$, these results were not statistically significant. For those hospitalized during the study period, the intervention cohort did, however, have a 36% lower 30-day all-cause readmission rate than the primary control that was statistically significant (95% confidence interval 0.3% rate, 18.9% rate; $p<0.042$). Most significantly, program enrollees showed an average per member per month savings of $676 compared to controls, for a return on investment of 5.48 (95% confidence interval $395, $957; $p<0.01$).

CONCLUSIONS

These results support the efficacy of a consistent, well-defined approach to acting on information generated by remote monitoring processes to mitigate the exacerbations of heart failure in a timely, impactful way to reduce costs and improve outcomes for Medicaid managed care members.

Introduction

Approximately 6.7 million Americans over 20 years of age have heart failure, costing the US healthcare system nearly 31 billion dollars every year, of which 68% is attributable to direct medical care. The prevalence is expected to rise to 8.7 million in 2030, 10.3 million in 2040, and 11.4 million by 2050[1]. Patients with heart failure experience 4-fold higher overall 2-year healthcare expenditures compared with individuals without heart failure. Indeed, the annual median total medical costs for heart failure care in 2019 were estimated at $24,383 per patient, with heart failure-specific hospitalizations driving costs (median $15,879 per patient)[2]. Although HF is most prevalent among adults >60 years, since 2016, the proportion of younger patients (aged 35-64) with heart failure has increased faster than that of those 65 and older. The problem is growing even more severe among racial and ethnic minority groups, as social determinants of health are driving widening disparities between these sub-populations and non-Hispanic whites. A larger share of Medicaid and CHIP enrollees are Hispanic and non-Hispanic Black than the U.S. population, and a smaller share are non-Hispanic White. As a result, 1% of all Medicaid beneficiaries had heart failure in 2021, or just over 7 million beneficiaries[3].

Timely intervention to avoid these urgent care episodes requires knowledge of the earliest stages of pre-acute decompensation so that care managers can assess signs and symptoms in situ, remotely, and facilitate diuretics – or follow-up evaluations in the prescribing provider's office - as quickly as possible. These signs and symptoms can manifest both physiometrically (e.g., rapid weight gain from fluid retention, elevated blood pressure and heart rate, etc.) through objective machine-reported data, and as described subjectively by the patient (e.g. difficulty breathing, edemas, poor sleep, etc.). In addition, self-care, especially self-preventive care, needs to be bolstered to minimize risk. As there is never sufficient time for overextended remote care managers to provide the optimal amount of tailored health education (regarding symptom awareness, medication management, diet, activity, etc.) and coaching to improve this health literacy and motivate behavior modification, digital tools to automate much of this outreach are required to supplement what cannot be done live.

AMC Health, a telehealth vendor and facilitator of virtual care programs, co-designed a heart failure remote monitoring program with a large, national, managed Medicaid payer. The proof of concept entailed an intervention for identified members with Stage II or higher heart failure in four state markets for no longer than 12 months.

The implementation of this program assumed that the remote monitoring intervention must be driven by an agreed-on process that governs who bears the responsibility for the clinical response to information and alerts, and must be applied through a unified approach to remote patient management using a consistent workflow across large populations of patients to maximize generalizability of findings. The purpose of this retrospective study was to assess the efficacy of inserting the remote monitoring program into existing plan-provided case management regimes—without having to hire additional clinic staff, disrupt existing practice workflows or re-engineer the way that case managers operate—and to measure whether the heightened surveillance and subsequent interaction with patients by AMC Health's remote care managers can impact all-cause admission and readmission rates and total costs, including the ROI derived from any cost savings.

Description of the Telehealth Intervention

Patients were identified for the telehealth intervention in 4 state markets via the payer's claims database, and had to be greater than 18 years of age, with a documented diagnosis of heart failure (stage II or higher), and not enrolled on any other focused, disease management program. Candidates who made the initial qualifications went through an additional layer of qualification for the intervention using AMC Health's proprietary, machine learning derived candidate selection algorithms that predict probabilities of reduced, preventable utilization and cost for individuals with Stage II or higher heart failure who enroll onto a remote heart failure management program. Features feeding these models include, but are not limited to, utilization and cost history (with a focus on diagnosis, inpatient/ER visits), risk (derived from age, gender, comorbid conditions, etc.), and prescriptions.

Patients were excluded from the telehealth intervention if they were documented as living in a custodial nursing care setting or had select diagnoses that would interfere with the remote monitoring process (e.g., schizophrenia and other psychotic or dissociative disorders, end stage kidney disease, brain damage, coma, paralysis, documented substance abuse), or qualify the patient for a separate, intensive case management tract under other payer programs.

All candidates were mailed a letter explaining the objectives and benefits of the remote home monitoring program, followed by a screening phone call to determine level of interest, confirm no cognitive or functional limitations, and to gain informed consent. Enrolled patients received a telemonitoring kit from AMC Health that included a Bluetooth-enabled digital weight scale, blood pressure monitor, and cellular modem to collect device measurement data, via Bluetooth, and transmit to a secure web portal, in near-real-time.After delivery of the kit, patients received another call from an AMC Health engagement specialist to walk through the device's use, confirm transmission of initial readings to the AMC Health clinical dashboard called CareConsole®, and to introduce the primary nurse care manager (provided by AMC Health) who would perform an initiating comprehensive assessment.

Following the initial assessment (which could involve medication reconciliation), if biometric readings from the monitoring equipment formed a pattern of concern, an alert was posted to CareConsole® for review by the patient's care team.It was the primary nurse telecare manager's responsibility to triage these daily alerts, assess biometric, symptom and behavioral patterns of concern, and provide proactive education and clinical intervention when warranted. Telecare managers also routinely connected with the prescribing providers, as appropriate, when further assessments, or a change in medical management, were required. The AMC Health remote care managers coached patients prior to scheduled appointments (with a copy of the patient's biometric report faxed to the provider in advance), to help the patients maximize benefit of the encounter, and followed up afterward to confirm any new prescriptions or changes in management, answer any questions, and reinforce the provider's plan of care. The telecare managers also followed up after any ED encounter or hospitalization to assist in transitions-of-care, and to support any modifications to the plan of care following the event. When gaps in care or in social determinants of acre were identified by the AMC Health remote care team (e.g., an inability to get prescriptions filled, food insecurity or lack of transportation to clinical appointments, etc.), these deficits were escalated to appropriate health plan liaisons who could intervene locally. The AMC Health primary telecare manager was also able to involve Certified Diabetic Educators, as needed, for participants with co-morbid diabetes, to provide supplemental coaching for limited periods of time. For all enrollees, monthly summary reports on biometric patterns and other events were sent to the participants' prescribing providers, regardless of whether biometric or survey alerts were generated during that time, as well as prior to any scheduled appointments.

Upon enrollment, patients were also assigned automated, interactive surveys delivered via telephonic interactive voice response (IVR). These surveys employed branching logic to solicit patient self-reported data on symptoms, behavior, environment, and access to care.

Patient answers to these questions could also generate alerts to CareConsole®.These surveys could be triggered by biometric values of concern detected by the dashboard (e.g., "We received your blood pressure readings, and they have been high for you. We'd like to ask you some questions to make sure you are ok…"). Other surveys were regularly scheduled to collect routine information while imparting focused health education on the patient's condition.

Evaluation Methods

This was a retrospective quality review employing a pre-post parallel study design comparing patients recruited into the telehealth intervention group with two separate, concurrent controls – identified through propensity score matching - who did not receive the intervention.

The Outcomes Variables Measured include: All-cause hospital admissions (per 1000 patients per year), all-cause 30-day readmissions, the difference in total healthcare costs (measured as the difference-in-difference of total costs - summed over the time period - between the intervention and control cohorts), and return-on-investment (ROI) measured as the above total cost difference divided by cost of implementing program.
The intervention cohort were enrolled between October 1, 2021 (the index date) and March 30, 2021. The end of the study period was January 31, 2022. All program enrollees included in the evaluation had a minimum program enrollment of 9 months, and a maximum of 12 months post the index date. Intervention members' utilization and cost were followed regardless of whether they disenrolled from the program prior to end of the study period.

The Controls

The primary control consisted of members in the 4 program implementation states who qualified for the intervention, but who could not be reached during the enrollment period despite the attempt (candidates who were successfully contacted but declined to enroll in the intervention were excluded from the control to prevent any possible contamination by self-deselection bias). The secondary control consisted of equally qualified members in 22 separate state markets for which the intervention was not offered. The primary control was used to calculate relative differences in all-cause admissions and 30-day readmissions, as well as total costs and ROI. The secondary control - chosen as a plausibility test in case the smaller n of the Primary lacked statistical significance - was reserved for the overall costs and ROI analysis only.

An index date was defined for each patient as either the date when they enrolled (intervention patients) or the last date when contact for enrollment was attempted, albeit unsuccessfully (primary control). For the secondary control, index dates were randomly assigned from the program enrollment period.

A propensity score (PS) (i.e., propensity for being enrolled) was estimated for each enrolled member based on:

- Demographic and geographic information
- Days since last hospital discharge
- Co-morbid conditions and Covid-19 condition at baseline
- The PMPM (per member per month) costs incurred in the period 1-year prior to the enrollment date
- AMC Health proprietary predictive risk scores at baseline. These machine learning-derived scores assess the risk of utilization and likelihood of cost reduction were they to enroll in a heart failure, remote management program. The features used in these models include, but are not limited to, elements of utilization history, morbidity profile, age and gender

These propensity scores were then weighted using IPW-ATT (Inverse Probability Weighting - Average Treatment Effect in the Treated):

- Treatment group: 1
- Control groups: $\frac{PS}{1-PS}$

Outcomes Calculations

Patient answers to these questions could also generate alerts to CareConsole®.These surveys could be triggered by biometric values of concern detected by the dashboard (e.g., “We received your blood pressure readings, and they have been high for you. We’d like to ask you some questions to make sure you are ok…”). Other surveys were regularly scheduled to collect routine information while imparting focused health education on the patient’s condition.

The analysis of outcomes used the payer’s claims database for utilization and cost data. Cost data were compiled after a 3-month claims adjudication period following the end of the study period (January 31, 2022). All claims costs were included in the analysis, including inpatient, ambulatory, lab and pharmacy claims. All statistical analysis was performed using R software (The R Group, Vienna, Austria) with contrasts of $p<0.05$ considered statistically significant.

As stated above, cost savings and ROI are calculated based on the intervention group's relative performance compared to the control groups over the same period. A difference in differences (DID) comparison is made between the control groups' pre-period and post-period costs and the intervention group's pre-period and post-period costs. The equation of ROI calculation and involved variables are as follows:

- The pre-intervention period was defined as a minimum of 6 months and up to 12 months prior to the index date, and the intervention period was defined as a minimum of 9 months and maximum of 12 months post the index date.
- ROI = $\frac{Total\ Costs\ Savings}{Total\ Bill\ Amounts}$
- Difference-in-Difference Model is defined as a weighted regression model:

$$\bar{y} = a + \beta_1 M + \beta_2 P + \delta_1 M * P + e$$

where β_x are coefficients on engagement status (M) and Period (P) while the "DiD" treatment effect is captured in coefficient δ_1.

- The DID treatment effect (i.e., the projected cost of treatment)

$$\delta_1 = (\bar{y}_{T,P} - \bar{y}_{T,B}) - (\bar{y}_{C,P} - \bar{y}_{C,B})$$

is developed as the population average outcome of interest $\bar{y}$ decomposed across periods Baseline (B) and Post (P) and between study groups Treatment (T) and Control (C).

Results

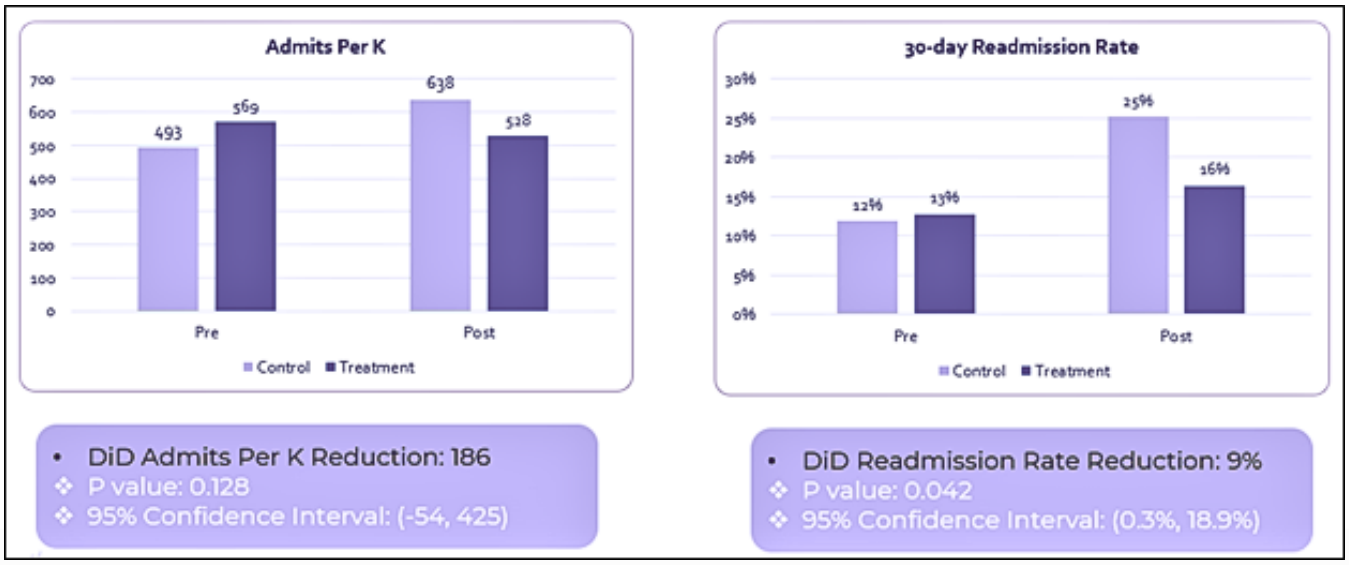
After propensity matching, 453 intervention patients matched to 441 primary control members and 6,693 secondary control members.

Patients in the intervention group (Image 1) had 186 per 1,000 patients fewer per year than the primary control, (95% confidence interval -54, 425), but with a p<0.128, these results were not statistically significant. For those hospitalized during the study period, the intervention cohort did, however, have a 36% lower 30-day all-cause readmission rate than the primary control that was statistically significant (95% confidence interval 0.3% rate, 18.9% rate; p<0.042).

After propensity matching, 453 intervention patients matched to 441 primary control members and 6,693 secondary control members.

Patients in the intervention group (Image 1) had 186 per 1,000 patients fewer per year than the primary control, (95% confidence interval -54, 425), but with a p<0.128, these results were not statistically significant. For those hospitalized during the study period, the intervention cohort did, however, have a 36% lower 30-day all-cause readmission rate than the primary control that was statistically significant (95% confidence interval 0.3% rate, 18.9% rate; p<0.042).

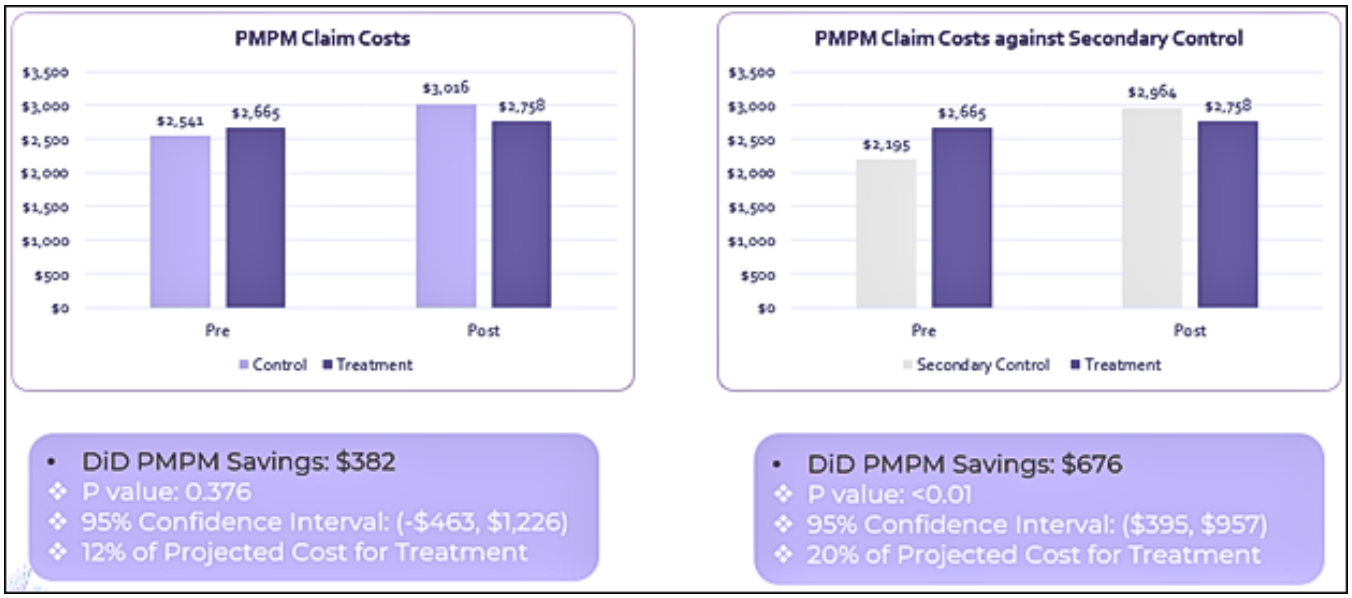
Image 1– Hospitalization Reduction



The average 12-month prior expenditure was $2,665 per member per month (PMPM) for the intervention group, $2,541 for the primary control group, and $ 2,195 for the secondary control. The total PMPM claims cost savings (Image 2) - based on the difference-in-difference (DiD) calculation - was $382 (= 12% of project cost) against the primary control representing an ROI of 3.39, but this was not statistically significant (95% confidence interval $-463, $1,226; p<0.376).

PMPM savings against the secondary control, however, was a statistically significant $676 (=20% of projected cost), representing a 5.48 ROI (95% confidence interval $395, $957; p<0.376).

Image 2– PMPM Claims Cost Savings

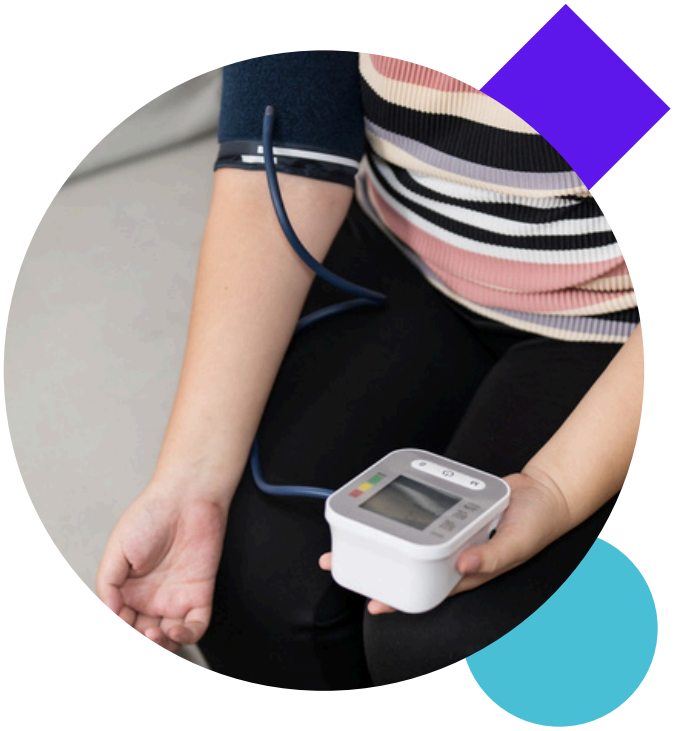


Discussion

The findings support predicate studies that suggest remote monitoring interventions can positively affect hospitalizations 30-day readmissions, total claims costs and overall ROI for heart failure. Specifically, there are published studies that describe statistically valid, positive telehealth outcomes determined by Randomized Controlled Trials (RCT) supporting reductions in all-cause hospitalizations[4],[5],[6],[7],[8] and cost[9]. There are also numerous RCTs that have shown no statistically valid differences between intervention cohorts and those receiving usual care[10],[11],[12],[13],[14],[15],[16],[17].

There's a greater number of observational studies using a variety of Propensity Score Matching (PSM) methodologies to identify retrospective, concurrent controls that demonstrate statistically valid positive outcomes for Heart Failure telehealth interventions[18],[19],[20],[21],[22]. Indeed, these retrospective studies are more common when it comes to extracting outcomes among members of commercial managed care entities, as these entities rarely have the luxury of offering telehealth services to only a subset of qualified individuals under pristine, randomized study contexts, particularly when CMS and individual state departments of health have been promoting remote patient monitoring as a standard of care.

If the telemonitoring intervention described in this study was indeed effective in reducing all-cause hospitalizations, both those direct hospitalization costs and all associated post-



hospitalization utilization (such as post-hospital rehabilitation in skilled nursing facilities, skilled home care and other ambulatory care related to the hospitalization) would also be affected. The associated cost savings from just these events could explain the difference in cost savings and subsequent ROI. The hypothesis is that by having a consistent, structured process to respond to remote monitoring data resulted in more timely responses to pre-acute decompensation of patients with heart failure that would otherwise have led to a hospitalization event. This may include nurse instructions to increase a diuretic at the right time, or that the patient requires further evaluation through a provider office visit. It may also include focused health coaching on diet and medication adherence at the earliest sign of biometric or patient self-reported data suggesting the patient is drifting away from adherence to the provider's plan of care.

Few studies have investigated direct return-on-investment (ROI) for the intervention, and most studies that looked at hospitalization rates used an index hospitalization as a start to the intervention, limiting applicability to approaches seeking at-risk candidates without a recent hospitalization. Fewer still have involved heart failure cohorts younger than age 65, and those covered by Medicaid who are not dually (i.e., Medicare and Medicaid) eligible.

What is notable was that this intervention was conducted within months following the first availability of Covid vaccines during the pandemic of starting a program at the height of the Covid crisis. There was a concern that any analysis of hospital utilization, (and any healthcare utilization for that matter) among the control populations would be artificially suppressed given the prevalent reluctance to seek medical treatment on their own, likely out of abject fear, despite their morbidity. The intervention cohort, on the other hand, were far more likely to go the ED or to seek preventive care when warranted, given the encouragement of the telecare managers. In the end, however, this scenario did not play out, which begs the hypothesis that the relative outcomes might have been even stronger in a non-pandemic year.

Given the framework of past studies, this study operated under two assumptions. First, for a remote monitoring intervention to have the best chance of driving desired outcomes, it

must be driven by a confirmed process that governs who bears the responsibility for the clinical response to information and alerts generated by this surveillance. Second, for its efficacy to be studied in a way that has bearing on real world patient care structures, this intervention must be applied through a unified approach to remote patient management, using a consistent workflow across large populations of patients.

Given these assumptions, the purpose of the study was to determine the following:

- Whether a remote monitoring regime for patients with heart failure was effectively integrated into existing patient-provider arrangements, without having to disrupt existing practice workflows or reengineer the way these providers practice. In practical terms, this means that these practices did not have to hire additional staff to process the remote monitoring data but could outsource this activity with 3rd party telecare managers, acting as physician extenders, to assess and triage information and provide education and coaching. The role of the practices then is to react to triaged information suggesting a possible need for either further patient evaluation or a change in medical management of the patient according to standard best practice. This would best accommodate existing American models of chronic care management whereby physician extenders assume the majority of outreach and care coordination tasks in support of physician-directed plans of care, and not the physicians themselves.

- Did this heightened surveillance, and subsequent interaction with patients by remote care managers, done on behalf of these practices, make a difference (in terms of improved outcomes and reduced costs) in a model where there is not necessarily an anchoring hospitalization to trigger the process. Primary outcome variables are all-cause admission rates (defined as admits/1,000), total costs and the ROI derived from any cost savings.

Study Limitations

The salient strength of the study remains that it assessed a unified approach to telecare management that defined not just how the technology was used to collect information from the home, but for how that information was acted upon according to a conformed workflow that governed who bore the responsibility for responding to the alerts generated, and trends identified, by the technology. Moreover, it involved an intervention introduced to a widely dispersed patient population, at scale, across numerous, diverse practices, thereby reflecting how these technologies can be used in real-world practice, and not just in artificially controlled environments, with small patient populations, managed by a tightly coordinated group of clinicians.

The limitations of the study are those inherent in any analysis dependent on retrospectively determined controls, as there is the inability to accommodate unknown variables in determining a propensity score. Only a prospective study with randomized controls will help determine the strength of these covariables. There is also the inability to control for variability in individual provider approach to heart failure management and their responsiveness to the events escalated to them by the remote care managers, even for similar patient morbidity profiles. Only a within-cohort study can mitigate the effects of such secular variables.

Still, the study remains an intriguing addition to the growing corpus of literature that supports the efficacy of a consistent, well-defined approach to using information gleaned from remote monitoring processes, and for acting on that information to mitigate the exacerbations of Heart Failure in the timeliest way.

REFERENCES

1. Bozkurt, B. et al. HF STATS 2024: Heart Failure Epidemiology and Outcomes Statistics An Updated 2024 Report from the Heart Failure Society of America. J Card Fail. 2024 Sep 14:S1071-9164(24)00232-X.

2. Urbich, M. et al. 2020. A Systematic Review of Medical Costs Associated with Heart Failure in the USA (2014–2020). Pharmacoeconomics. 2020 Aug 19;38(11):1219–1236.

3. Source: Medicaid.gov

4. Scherr D, Kastner P, Kollmann A, et al. Effect of home-based telemonitoring using mobile phone technology on the outcome of heart failure patients after an episode of acute decompensation: Randomized controlled trial. J Med Internet Res. 2009;11:e34.

5. Koehler F, Winkler S, Schieber M, et al. Impact of remote telemedical management on mortality and hospitalizations in ambulatory patients with chronic heart failure: The telemedical interventional monitoring in heart failure study. Circulation. 2011;123:1873e1880.

6. Kashem A, Droogan MT, Santamore WP, Wald JW, Bove AA. Managing heart failure care using an internet-based telemedicine system. Journal of Cardiac Failure, 2015; 14(2), 121-6.

7. Martín-Lesende I, Orruño E, Bilbao A, et al. Impact of telemonitoring home care patients with heart failure or chronic lung disease from primary care on healthcare resource use (the TELBIL study randomised controlled trial) BMC health services research. 2013; 13, 118

8. Giordano A, Scalvini S, Zanelli E, et al. Multicenter randomised trial on homebased tele-management to prevent hospital readmission of patients with chronic heart failure. Int J Cardiol. 2009; Jan 9;131(2):192-9.

9. Weintraub A, Gregory D, Patel AR, et al. A Multicenter Randomized Controlled Evaluation of Automated Home Monitoring and Telephonic Disease Management in Patients Recently Hospitalized for Congestive Heart Failure: The SPAN-CHF II Trial. J Card Fail. 2010; Apr;16(4):285-92.

10. NCT02344342. University of Michigan Advanced Heart Failure Tele-Monitoring and Flexible Diuretic Project. 2015. Available at: https://clinicaltrials.gov/ct2/show/NCT02344342. Accessed May 15, 2019.

11. de Lusignan S, Wells S, Johnson P, Meredith K, Leatham E. Compliance and effectiveness of 1 year's home telemonitoring. The report of a pilot study of patients with chronic heart failure. Eur J Heart Fail. Dec;3(6):723-30.

12. Gattis WA, Hasselblad V, Whellan DJ, O'Connor CM. Reduction in heart failure events by the addition of a clinical pharmacist to the heart failure management team: Results of the Pharmacist in Heart Failure Assessment Recommendation and Monitoring (PHARM) Study. Arch Intern Med.1999; Sep 13;159(16):1939-45.

13. Goldberg LR, Piette JD, Walsh MN, et al. Randomized trial of a daily electronic home monitoring system in patients with advanced heart failure: The Weight Monitoring in Heart Failure (WHARF) trial. Am Heart J. 2003; Oct;146(4):705-12.

14. Lynga P., Persson H, Hägg-Martinell A, et al. Weight monitoring in patients with Severe Heart failure (WISH). A randomized controlled trial. Eur J Heart Fail. 2012; Apr;14(4):438-44.

15. Mortara A, Pinna GD, Johnson P, et al. Home telemonitoring in heart failure patients: The HHH study (Home or Hospital in Heart Failure). Eur J Heart Fail. 2009; Mar;11(3):312-8.

16. Seto E, Leonard KJ, Cafazzo JA, Barnsley J, Masino C, Ross HJ. Mobile phone-based telemonitoring for heart failure management: A randomized controlled trial. J Med Internet Res. 2012; Feb 16;14(1):e31.

17. Lewington S, Clarke R, Qizilbash N, Peto R, Collins R. Prospective Studies Collaboration. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. Lancet. 2002;360:1903-1913.

18. Sokoreli I, De Massari D, Pauws SC, et al. Effectiveness of telehealth for heart failure management in routine practice. International Journal of Integrated Care. 2016;16(5):S39.

19. Srivastava A, Do JM, Sales VL, Ly S, Joseph J. Impact of patient-centered home telehealth programme on outcomes in heart failure. J Telemed Telecare. 2019; Aug;25(7):425-430.

20. Srivastava A, Do JM, Sales VL, Ly S, Joseph J. Home telehealth reduces adverse outcomes in heart failure. Journal of the American College of Cardiology. 2017; Volume 69, Issue 11 Supplement, March 2017

21. Maeng DD, Starr AE, Tomcavage JF, Sciandra J, Salek D, Griffith D. Can telemonitoring reduce hospitalization and cost of care? A health plan's experience in managing patients with heart failure. Popul Health Manag. 2014; Dec;17(6):340-4.

22. Cleland JGF, Louis AA, Rigby AS, Janssens U, Balk AHMM. Noninvasive home telemonitoring for patients with heart failure at high risk of recurrent admission and death: The Trans-European Network-Home-Care Management System (TEN-HMS) study. J Am Coll Cardiol. 2005; May 17;45(10):1654-64.

1 World Trade Center, 85th Floor New York, NY 10007
| Phone: 877-262-2240

AMCHEALTH.COM