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Systematizing Heart Failure Population Health

Prateeti Khazanie, MD, MPH¹, Larry A. Allen, MD, MHS¹

¹Division of Cardiology, Department of Medicine, University of Colorado School of Medicine, Aurora, CO

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Introduction

The U.S. spends more money on healthcare per capita compared with other high-income countries, yet has lower life expectancy and worse health outcomes.¹ The reasons for this higher spending are thought to be driven by higher prices and greater utilization of medical technology rather than routine clinic visits and social services.¹ Heart failure affects over 6 million people in the U.S. with a total annual cost of over \$30.7 billion,² making heart failure one of the most common, expensive, and resource intensive chronic conditions in healthcare. Future solutions to help curb spending include shifts in payment models to reward healthcare providers based on their patient population's health outcomes.

Population health is an approach to healthcare that aims to improve the health of a population. It is defined as “the health outcomes of a group of individuals, including the distribution of such outcomes within the group.”³ Population health sometimes gets confused with public health, but they are different. Public health is what “we as a society do collectively to assure the conditions in which people can be healthy”⁴ and involves government health policies. Population health integrates non-clinical determinants of health with measures of health and healthcare, monitoring and reporting factors that may influence an individual's health outcomes (Figure 1).

Policymakers estimate that 80% of what affects health outcomes is associated with factors outside the healthcare system, like health behaviors, environment, psychosocial and economic factors, and others.⁵ Due to the large number of factors at play, population health policies have to focus on economic tradeoffs in healthcare because resources are always limited, and systems must determine the cost-effectiveness of resource allocation to

Address for correspondence: Prateeti Khazanie, MD, MPH, Division of Cardiology, University of Colorado School of Medicine, 12631 E. 17th Ave, Mail Stop B130, Aurora, CO 80045, prateeti.khazanie@cuanschutz.edu.

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initiatives targeting multiple determinants of health.⁶ In other words, health systems must provide high-value care, defined by “patient outcomes achieved relative to the cost of care required to achieve those patient outcomes,” while also focusing on the health of the overall population (Figure 2).⁷

Population health is one of the three pillars of the Institute for Healthcare Improvement’s (IHI) Triple Aim.⁸ The Triple Aim is the simultaneous pursuit of three linked goals -- improving the individual experience of care, reducing per capita cost of care, and optimizing the health of populations; the Quadruple Aim adds the well-being of the healthcare team, a component that is particularly important in heart failure due to intense and sometimes burdensome chronic care management (Figure 3).^{8,9} These constructs have drawn extra attention to the necessity of thinking beyond the individual patient and also to the health of populations. Rapid changes in the past decade in healthcare reimbursements, health policies, and provider incentives have shifted previously siloed fee-for-service payment structures to reimbursing for high-quality healthcare for specific populations, also known as population health management or population medicine. The goals of population health are to improve health outcomes and quality, to proactively address factors affecting at-risk patients, to identify optimal disease management programs, to improve care delivery by leveraging technology and data so providers can improve care coordination, and to create cost-effective health systems that reduce financial burden on patients and providers. These aspirational goals of population health and population health management/ medicine are particularly evocative for chronic diseases like heart failure.

Heart Failure Population Health Management Defined

Health systems are now attempting to transition from reactive to proactive structures for complex disease management. In traditional healthcare systems, healthcare teams are reactive, patients must bring problems to the attention of their teams, and the number of heart failure patients in the systems are unknown. In contrast, systems that focus on population health have healthcare teams identify all patients in the system with heart failure, risk stratify the population into different groups based on stage of disease and relevant care pathways, and then contact patients who may benefit from proactive changes to care; the denominator of patients with heart failure is known and their data are collected in registries. In order to achieve population health in heart failure, health systems and clinicians need to measure, monitor, and identify trends in patients’ health in order to address process improvement.

Fortunately, there are many guideline-directed medical therapies, device therapies, and processes of care that have been proven to improve outcomes for patients with heart failure with reduced ejection fraction, and there is hope for future therapies for heart failure with preserved ejection fraction.¹⁰ However, heart failure clinics and specialists can only see a minority of all heart failure patients, and when they do they may not have the time and processes in place to ensure appropriate consideration of all high-value care options. Thus, in order to fulfill the Quadruple Aim—to provide individualized, cost-effective care that improves the health of heart failure populations and also maintains healthcare providers’ well-being—it is imperative that health care systems focus on population health

management systems. Such systems focus on the “process of strategically and proactively managing clinical and financial opportunities to improve health outcomes and patient engagement, while also reducing costs.”⁶ The purpose of population health management/medicine in heart failure is to use patient health information aggregated from health information technology systems to understand how different heart failure populations are treated, and then to understand their outcomes based on these treatments. It also identifies optimal treatment programs and at-risk patients to enable early intervention.

Concomitant with a focus on population health and population health management, health systems must provide high-value care. However, value is extremely difficult to define because the lens for judging outcomes is different based on whether one is looking at it from the health system finance perspective, payer perspective, provider perspective, or patient perspective. One of the more widely accepted definitions of value as proposed by Porter¹¹ states that health outcomes should reflect the “health circumstances most relevant to patients,” but regardless, perspective is important, and providers should get paid to “do the right thing.” Thus, contemporary shifts in health care delivery systems from fee-for-service to value-based payment models create potential opportunities to address population health in chronic disease processes, like heart failure.

Systematizing Processes of Heart Failure Care Based on Disease Severity

There are significant opportunities to systematize processes of heart failure care. Many prior interventions have focused on treating diseases that can lead to heart failure, and the incidence of new-onset heart failure is decreasing.¹² However, once patients develop chronic heart failure, providers and health systems do a poor job of proactively managing their disease with guideline-directed medical therapy intensification and disease management. Rather, once patients have heart failure, the approach has been more reactive, and thus, health systems and payers utilize copious resources in hospitalizations and preventing readmissions rather than preventing the first hospitalization. In the future, the approaches to tackling population health management will need to be different based on patients’ ACC/AHA Heart Failure Stage, ranging from prevention to end-of-life. Depending on the stage of disease, health systems and organizations will need to design, deliver, coordinate, and pay for high quality health services to manage the Quadruple Aim for a population using the optimal resources available.

ACC/AHA Stage A.

Perhaps the greatest role for population health to improve heart failure is by preventing incident disease. In the future, population health data mining must include early identification of patients who are at high risk for heart failure before they ever present with left ventricular dysfunction or symptomatic disease. Many traditional and existing population health focused interventions have been designed to address diseases that are risk factors for heart failure, like smoking cessation, treatments for high blood pressure (medication, low-sodium diet, active lifestyle), treatment for high cholesterol, regular exercise, and other preventative interventions.¹³⁻¹⁶ Optimizing such upstream interventions

and creatively deploying them in populations, particularly high-risk populations, will help reduce progression to future disease expression.

ACC/AHA Stage B.

For patients with pre-heart failure who have systolic left ventricular dysfunction but no active symptoms, early identification and treatment is essential. This population is at considerable risk for development of symptomatic heart failure (Stages C and D). Due to the increasing ability to identify low left ventricular ejection fraction with field coding (see “Defragmenting Heart Failure Care: Medical Records Integration” by Byrd et al in this issue), left ventricular hypertrophy on routine electrocardiograms, and increasing availability of natriuretic peptides and other biomarkers, this should be a key future target for population health interventions triggered by improvements in data science.

Data from randomized controlled trials has established neurohormonal antagonist medications—beta-blockers, angiotensin converting enzyme inhibitors (ACEis), angiotensin receptor blockers (ARBs), angiotensin receptor-neprilysin inhibitors (ARNis), and aldosterone antagonists—as the foundation of therapy for patients with systolic left ventricular dysfunction. Use of these medications is recommended by multiple clinical practice guidelines,^{17,18} and is critical to improving outcomes for patients with systolic dysfunction. Unfortunately, medication adherence and intensification has not been thoroughly studied in this population which makes it ripe for future investigation.

ACC/AHA Stage C.

Once patients have symptomatic heart failure, many interventions have been tested but their uptake and effectiveness in real-world settings has been limited. Personnel-based interventions (e.g. disease management programs, transition coaches) have been popular, but can be resource intensive and often require trained personnel. Diuretic-based interventions to control fluid status (e.g. furosemide dosing based on daily weights) are the default therapeutic strategy for patients following HF hospitalization. However, focusing on diuretic titration is not evidence-based,¹⁹ and patients are frequently still congested after a hospitalization for acute heart failure.^{20,21}

Over 80% of current costs and resources are currently spent in treating prevalent disease (Stage C heart failure) largely due to fragmented care.² Although there have been multiple randomized clinical trials showing clinical efficacy of guideline-directed medical therapies for heart failure, data show that therapeutic inertia is widespread with underuse of guideline-directed medical therapies for heart failure and slow uptake of new therapies.^{22,23} Unfortunately, longitudinal gaps in pharmacotherapy are present, and the magnitude and causes of specific gaps in intensification, monitoring, and adherence for heart failure therapies remain poorly defined. Moreover, the patient and provider factors that contribute to suboptimal pharmacotherapy are largely unknown. Prior inpatient and outpatient quality initiatives (e.g. OPTIMIZE-HF,²⁴ GWTG-HF,^{25,26} IMPROVE-HF,²⁷ PINNACLE,²⁸ and CHAMP-HF^{22,29}) have focused on initiation of heart failure therapies and longitudinal use of these therapies in the care continuum. Appropriate intensification, safety monitoring, and adherence are all necessary for these therapies to effectively reduce readmissions. If prior

initiatives like these are combined with other data, their effect on population health medicine could be substantial. Finally, complex medication regimens and polypharmacy make medication nonadherence a real obstacle in heart failure management.^{30,31} In order to improve medication adherence, studies can monitor fills and actively engage patients in their own care. Future interventions will require creative solutions with patient engagement, caregiver and community activation, disease management programs, and multipronged approaches to improve outcomes.

ACC/AHA Stage D.

By the time patients develop more end-stage, advanced heart failure with symptoms refractory to traditional medical and device therapies, patients often benefit from appropriate referral for advanced heart failure and palliative care. Advanced heart failure therapies, like heart transplantation and mechanical circulatory support, require careful patient selection and are not for everyone.³²⁻³⁵ These therapies are associated with the potential for high rewards and also for high risks. For healthcare systems focusing on population health, the highest risk patients may not always return the most clinical improvement or best outcomes, and, thus, long-term investments may be more high-value in patients with moderate or rising risk rather than end-stage disease. Currently, there are considerable variations and health disparities in the types of patients who receive advanced heart failure therapies,^{36,37} and referrals to hospice are often too late.^{38,39} The relatively unpredictable course of Stage D heart failure makes timing of referrals for higher levels of care and hospice very challenging, particularly across populations. Patient preferences are varied, advanced care directives are difficult to systematize, and patients' values can change over time. Future efforts to improve population health for end-stage heart failure patients will require careful and timely patient referral, evaluation, and selection for heart transplantation, mechanical support, or hospice.

Payment Policy Changes to Promote Population Health

In response to the need to improve the patient experience and quality of care and to curb rising healthcare costs, the healthcare industry is gradually shifting from fee-for-service reimbursement to value-based models. One of the early examples of this shift in the heart failure world is the Hospital Readmissions Reduction Program (HRRP). After the Medicare Payment Advisory Commission (MedPAC) first advised Congress that readmissions may be a target to reduce costs and improve patient care in 2007,⁴⁰ the Centers for Medicare and Medicaid Services (CMS) started publicly reporting 30-day hospital risk-standardized readmission rates after hospital discharge as an indicator of quality and efficiency of care on its Hospital Compare website in 2009.^{41,42} After this, the mandatory pay-for-performance HRRP was created under the 2010 Patient Protection and Affordable Care Act with readmissions reporting beginning in 2010 and the penalty phase beginning in 2012.⁴³ This public reporting was designed to reduce costs, break down silos of care, and improve care transitions and communication with outside providers. Although the HRRP was aimed at multiple diagnoses, heart failure has been the main driver of the HRRP penalties.

The Veterans' Administration (VA), the largest integrated healthcare system in the United States, has low rates of readmission,⁴⁴ but data suggest that the readmission metric may not

be as useful in the VA System because it does not have the clinical volume to pick up differences between different VA hospitals.⁴⁵ To be included in CMS reporting, hospitals have to have at least 25 heart failure admissions annually, and 38% of VA hospitals did not meet this volume requirement for heart failure readmissions.⁴⁵ CMS 30-day risk-standardized readmission rates may not be a useful measure to distinguish performance between different VA hospitals given low hospital-level volume for these readmissions. Thus, readmissions are an imperfect outcome measure for the VA and many smaller hospitals but are a first step in the transition from fee-for-service to value-based payments.

Accountable Care Organizations (ACOs) are becoming one of the most common approaches to addressing federal incentive and penalty programs such as value-based purchasing. ACOs are groups of doctors, hospitals, and other health care providers, who come together voluntarily to give coordinated high-quality care to the Medicare patients they serve. Coordinated care helps ensure that patients, especially the chronically ill, get the right care at the right time, with the goal of avoiding unnecessary duplication of services and preventing medical errors. When an ACO succeeds in both delivering high-quality care and spending health care dollars more wisely, it will share in the savings it achieves for the Medicare program. Unfortunately, these gains have been modest in pilot programs, and further changes to the system are likely required before significant gains in healthcare value can be achieved.^{46,47} More recently, ACOs have worked to reduce readmissions. Kaiser Permanente showed a reduction in 30-day all-cause readmission rates with transitional care programs and bundling elements.⁴⁸ Another example is the Accountable Care Collaborative in Colorado that focused Medicaid payment and delivery reforms and showed 8.6% fewer hospital readmissions than nonparticipating enrollees in the first year.⁴⁹

Challenges and Evolution

Cohort Definition.

One of the major challenges in population health for heart failure is appropriate cohort definition and prioritization of interventions. Currently, most healthcare systems use administrative codes (e.g., ICD-10, CPT codes) to define heart failure cohorts. Solely relying on these codes will miss patients who should have been included in the cohort and who could have benefited from population health interventions. Identification of cohorts will be more effective if there is integration of supplemental administrative codes (e.g., ICD-10 codes for volume overload or risk of hemodynamic instability), medications (e.g., patients taking aggressive doses of diuretics for volume management), imaging studies and lab tests (e.g., ejection fraction and biomarkers like brain natriuretic peptide), along with other data. Distinguishing patients with heart failure with reduced vs. preserved ejection fraction will be imperative since the ideal processes of care for heart failure with preserved ejection fraction are less clear. Finally, identifying patients in the cohort who can be managed by the appropriate provider (e.g., primary care provider, cardiology, or advanced heart failure specialist), will be imperative. Heart failure clinics specializing in disease management can only see a fraction of heart failure patients.⁵⁰ Thus, heart failure specialists and health systems must partner with primary care physicians and community groups on the frontline to provide optimal, high-value care for heart failure patients.

Challenges with the electronic health records are addressed in detail in “Defragmenting Heart Failure Care: Medical Records Integration” by Byrd et al in this issue, but future efforts to optimize population health and population health management/ medicine will require widely accessible, structured data sources. Electronic health records are currently designed for a fee-for-service system, focusing on diagnoses and billing. However, in a population health focused system, there needs to be greater transparency for the cost of care at the point of care.

Patient Engagement.

In addition to partnering with primary care physicians and community groups and optimizing data acquisition and tracking, future interventions will need to incorporate patient perspectives into decision making. A critical gap is the failure to empower patients to engage more directly in their care. Patients have a direct stake in making sure they are getting efficacious treatments, want to be involved in decisions about their treatments, and if engaged are more likely to adhere to them. New studies, like the Electronic Health Record-leveraged, Patient-centered, Intensification of Chronic Care for Heart Failure (EPIC-HF) trial and the Personalized Patient Data and Behavioral Nudges to Improve Adherence to Chronic Cardiovascular Medications (Nudge) trial, are testing the effectiveness of patient empowerment and activation for optimization of medication plans.^{51,52}

In EPIC-HF,⁵¹ patients with heart failure with reduced ejection fraction enrolled in the intervention arm are receiving, by email and/or text, a link to 1) a short patient engagement video around heart failure medications, and 2) a link to an online PDF of a medication checklist. Patients enrolled in the control arm do not receive any materials at any point of time and receive their usual care. For both arms, medication changes in patient medical records are being assessed before and after clinic visits to measure the effectiveness of the intervention; surveys are also being compared before and after clinic visits to determine the effectiveness of the intervention. The Nudge Trial⁵² is a pragmatic patient-level randomized intervention using a mixed methods approach and cell phone technology to facilitate medication adherence for chronic cardiovascular medications. Patients are being identified through pharmacy refill data to have a 7-day gap in prescribed cardiovascular medication refills and are being randomized to one of four arms – usual care, generic reminder text, optimized nudge text, and optimized nudge plus artificial intelligence chat bot to assess barriers filling the medication. Trials such as these are testing novel interventions and whether patient engagement improves medication adherence and clinical outcomes.

Other methods of patient engagement will include incorporating patient-generated health data and clinical perspectives, including remote monitoring with CardioMEMS, devices, wearables, shared decision-making with multiple decision aids, and incorporation of patient perspectives’ on costs of care.⁵³⁻⁵⁶ Patient-centered care has become the forefront of health policy as exemplified by the Centers for Medicare and Medicaid Services requirements for the use of evidence-based decision aids for left atrial appendage closure devices and primary prevention implantable cardioverter defibrillators.⁵⁷⁻⁵⁹

Redefining Hospitalization Metrics and Choosing Measurable Outcomes.

As we evolve to move from silos of care to more patient-centered care, it will be important to recognize that, while imperfect, programs like the HRRP are a first step in curbing spending and improving value-based care. The readmission measure is very hospital-centric, and it would be better to avoid hospitalization in the first place rather than focusing solely on readmission. To improve the readmission measure, policies could include total hospitalizations, all post-discharge care (including observation stations and emergency department visits), healthy days at home, potentially preventable admission for inpatient hospital care, potentially preventable emergency department visit, and mortality rates after inpatient hospital stay.^{60,61} Health systems need to focus beyond hospital walls and incorporate and target psycho-socioeconomic issues to reduce disease disparities and inequities. Physicians will need to co-design pragmatic interventions and processes that use their healthcare teams – nurses, dietitians, pharmacists, nutritionists, health coaches – and collaborate with community organizations.

Data Integration to Achieve High Value Care in Population Health

Patients with heart failure generate large amounts of complex data with multiple clinical encounters and diagnostic tests. Their data are frequently disconnected and siloed since patients are seen by different providers and health systems and get clinical tests from different companies and lab systems. Current information technology systems are not designed to capture these different data and link them to financial reimbursement data.

Moving forward, in order to optimally integrate population health data for heart failure, accomplish the Quadruple Aim, and achieve high-value care for patients, health systems will need to combine several major categories of data -- clinical information from the patient electronic health records, diagnostics and genomic data from laboratories, financial data from billing groups, social determinants of health data, patient and caregiver satisfaction information, and provider well-being data. Thus, payers will need to partner more with health systems and policymakers in collecting and integrating clinical, diagnostic, and financial information in the future. Database creation will require more granular diagnosis codes and ejection fraction to help define the population and may require tools like natural language processing.⁶² It will also require linking medication, laboratory, clinical encounter, and device data to identify patients who are being potentially under- and overtreated. After patients are identified, health systems will need to prioritize interventions balancing risk and costs.

Conclusion

Optimal population health and population health management of patients with heart failure requires a shift in our treatment paradigm from reactive treatment to proactive prevention. Such prevention includes primary prevention to reduced incident disease and secondary prevention of heart failure exacerbations, hospitalizations, guideline-directed medical therapy optimization, standardization of advanced heart failure therapies, and smoother transitions to end-of-life care. This can only be done through systems that break down silos of care and think about care provision longitudinally from the patient perspective. Heart

failure clinicians share a collective responsibility to expand on prior quality initiatives and to collaborate with health systems and patients in order to move from fee-for-service to population-based approaches that emphasize the provision of high-value care in the community and improve outcomes for patients living with heart failure.

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Synopsis:

Population health and population health management of patients with heart failure aim to identify all patients with the condition in a population, to characterize and risk stratify subgroups of patients, to improve care delivery by leveraging technology and data so providers can improve care coordination, to engage disease management programs, and to create cost-effective health systems that reduce financial burden on patients and providers. This requires a shift in our treatment paradigm from reactive treatment to proactive primary and secondary prevention. Shifts from fee-for-service to value-based payment models promise to encourage population health.

Key Points:

- Population health and population health management/medicine are highly relevant to delivering high-value, patient-centered care for patients with heart failure.
- There are opportunities to systematize processes of care for the different ACC/AHA Heart Failure Stages.
- Future efforts to optimize population health management/medicine will require integration of complex data and multidisciplinary collaboration.

Figure 1. Population Health in Heart Failure (HF).

A) Population health is “the health outcomes of a group of individuals, including the distribution of such outcomes within the group.”³ Population health expands on traditional patient care by including factors like health behaviors, environment, psychosocial and economic factors, and others. Public health is what society collectively does to improve health with the involvement of government policies, and population health help fills in gaps in public health initiatives and focuses on health outcomes. **B)** Population health management/medicine is the “process of strategically and proactively managing clinical and financial opportunities to improve health outcomes and patient engagement, while also reducing costs.”⁶ Population health in heart failure coordinates primary, specialty, inpatient, post-acute, home, and virtual care to improve health outcomes.

Figure 2. The Value Equation.

Healthcare Value is defined as patient outcomes achieved relative to the cost of care required to achieve those patient outcomes.⁷ Patient, provider, and healthcare system factors all contribute to healthcare value. Delivery of high-value care occurs in different scenarios, including: 1) positive outcomes with net even costs, 2) positive outcomes with low costs, 3) equivocal outcomes but low cost, and 4) very positive outcomes at high cost. In the end, the lens from which value is judged is important, and it is different for patients, providers, payers, and health systems.

Figure 3. The Triple and Quadruple Aims.

Population health is a major goal of both the Triple and Quadruple Aims. The Triple Aim includes 3 goals: 1) optimizing population health, 2) improving the individual patient's experience of care, and 3) reducing per capita cost of care. The Quadruple Aim adds a 4th goal: the well-being of the healthcare team.