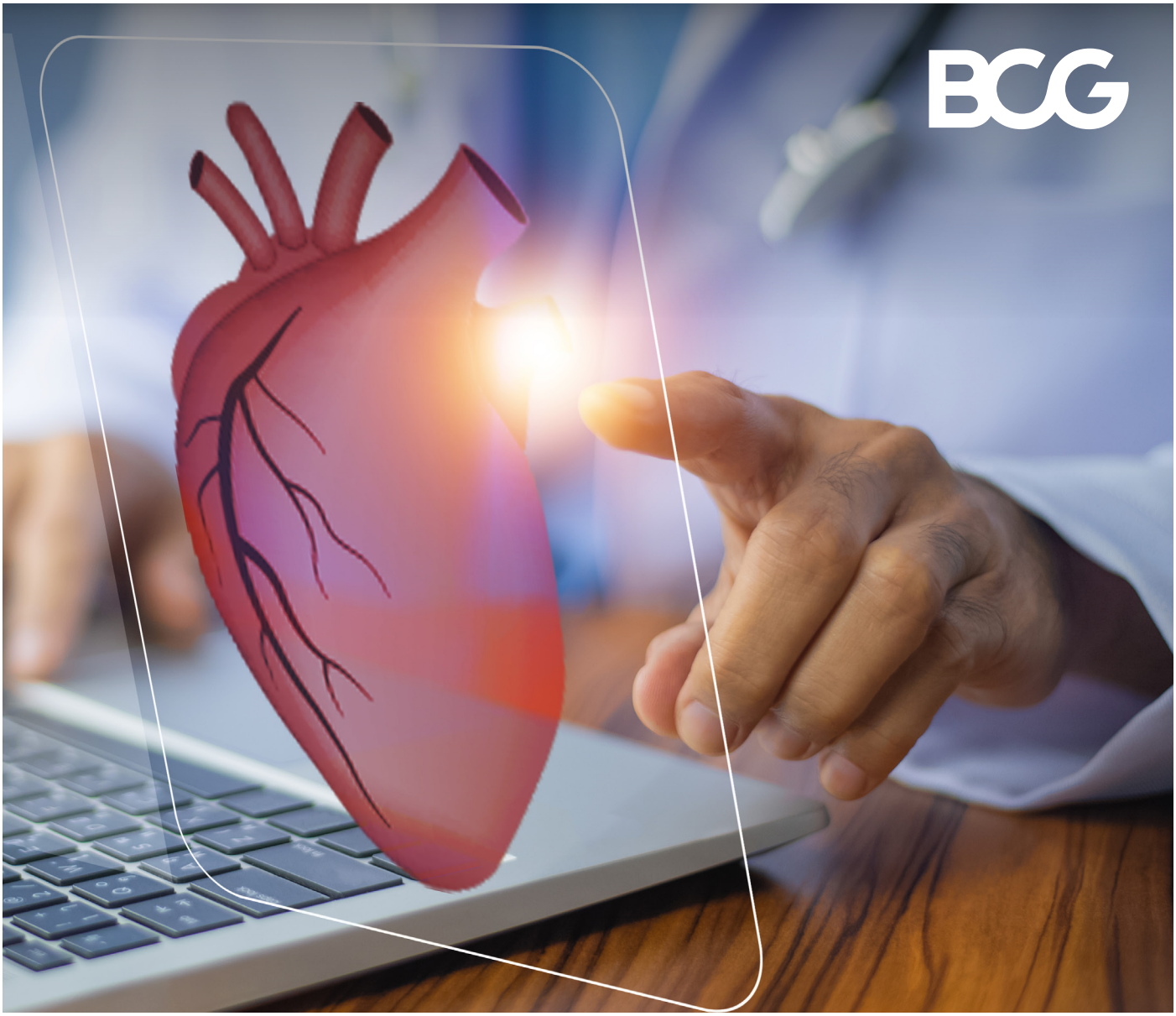

WHITE PAPER

Improving Health Equity with Patient Analytics

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By Isabel Boero, Julia Bieniewska, Meenal Pore, Nigel Markey, Chris Meier, and Myrto Lee

Executive Summary

Heart failure is a common and potentially fatal disease. In the US, approximately 3 million people suffer from one specific type of heart failure, HFrEF (Heart failure with reduced ejection fraction). In this report, we analyze patient data to better understand the journey and outcomes of HFrEF patients in the US. Main findings include: Only 65% of HFrEF patients visit an outpatient cardiologist annually; the numbers are particularly low in some major urban areas like Atlanta and Sacramento.

- Only 65% of HFrEF patients visit an outpatient cardiologist annually; the numbers are surprisingly low in some major urban areas like Atlanta and Sacramento.
- Patient-level factors and insurance status had an impact on a HFrEF patient's likelihood of receiving outpatient cardiology care. Black Medicaid patients who were older and had more serious conditions were significantly less likely to see an outpatient cardiologist than Medicare patients.
- There is also a link between insurance type and hospitalization. Medicaid HFrEF patients were much more likely to be hospitalized because historically they have been undermanaged.
- Health care providers, systems, payers, and industry players can take several steps to close the current gaps in health care, including assessing current state gaps, sharing the results, and raising awareness by bite-sized communications. Whatever is done, it will need to be tailored to local communities' needs where inequalities exist—no one size fits all.

The increasing availability of patient-level health care data is fuelling new insights that can be used to address health disparities and improve patient care. With a deeper understanding of how and when a patient interacts with their health care system, providers and payers can assess whether patients are receiving appropriate care in a timely manner, and target outreach and interventions more effectively.

To illustrate this point, BCG analyzed Komodo Health claims of over 98,000 US patients diagnosed with heart failure with reduced ejection fraction (HFrEF) between 2019 and 2021.[1] (See "About the Research" below.) We assessed the care and outcomes of patients with different clinical characteristics across a range of demographics to understand 1) which factors most influenced the percentage of patients managed by an outpatient cardiologist, which is a marker for appropriate clinical care; and 2) how outpatient cardiology care impacted the percentage of patients hospitalized for heart failure in the first year after diagnosis.

1.

Introduction and Objectives

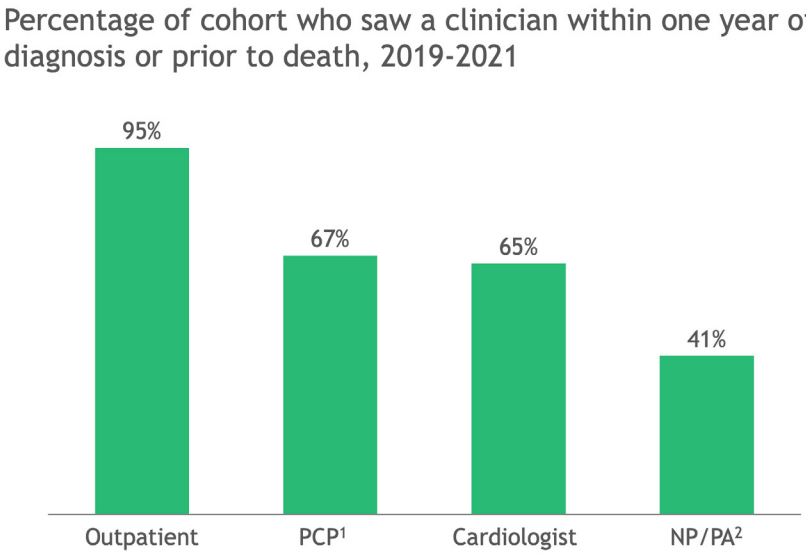
Approximately three million people in the US have HFrEF.[2] This disease is associated with high mortality—50% mortality in five years, according to the National Health Institute[3] —along with morbidity in frequently hospitalised patients.

Fortunately, medical therapies can improve a HFrEF patient's survival and quality of life. US Heart Failure guidelines[4] recommend that patients be managed by a multi-disciplinary team that is led by a cardiologist, who frequently is responsible for calibrating the dosage of life-saving drugs.

Outpatient Cardiology Visits

Given the central role of the outpatient cardiologist, it is important for HFrEF patients to visit one within a year of their diagnosis. Concerningly, however, only 65% of the patients in the analyzed cohort did. (See Exhibit 1.)

Exhibit 1 - Only 65% of HFrEF Patients Visit a Cardiologist Within a Year of HF Diagnosis or Before Death

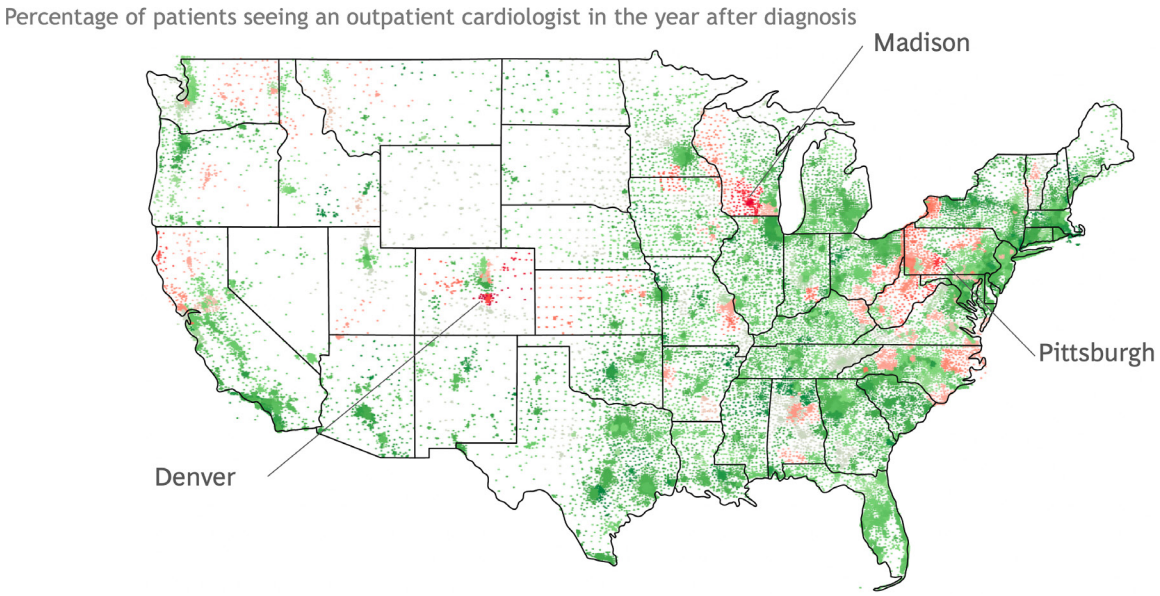


1. PCP: primary care provider.
2. NP: nurse practitioner; PA: physician assistant.
Note: "Outpatient" includes visits to any outpatient provider
Source: BCG analysis.

A heatmap analysis revealed that there are many regions in the US where HF patients do not typically see cardiologists, including Atlanta, Madison, and Sacramento—an unexpected finding given the size of these metropolitan areas. (See Exhibit 2.) This finding suggests some places where societal and industry outreach efforts should be focused to reduce inequities.

2. Adam DeVore, "Effect of a Hospital and Post-discharge Quality Improvement Intervention on Clinical Outcomes and Quality of Care for Patients with Heart Failure with Reduced Ejection Fraction," Cleveland Journal of Medicine, 2021.
3. Ibadete Bytyçi and Gani Bajraktari, "Mortality in heart failure patients," Anatolian Journal of Cardiology, August 19, 2014.
4. Paul A. Heidenreich et al., 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines, Journal of the American College of Cardiology, 2022.

Exhibit 2 – In Some Major US Urban Areas, Many HFrEF Patients Do Not See an Outpatient Cardiologist in the Year After Diagnosis



Factors Impacting Visit Likelihood

To determine which factors significantly impacted a patient's likelihood of seeing an outpatient cardiologist, our team conducted a multivariate analysis adjusting for patient demographics, clinical history, region, and cardiologist density (number of cardiologists per Zip3 region). (See Exhibit 3.)

Exhibit 3 - Statistically Significant Factors Impacting an HF Patient's Likelihood of Visiting an Outpatient Cardiologist

Factors	Percent increase or decrease in likelihood (95% confidence interval, upper and lower bounds)
Factors significantly increasing likelihood	
Diagnosed with high cholesterol	20% (17%, 22%)
Diagnosed with AF[1]	18% (16%, 21%)
Diagnosed with CAD[2]	18% (16%, 20%)
Asian or Pacific Islander	18% (10%, 26%)
Medicare beneficiary	10% (4%, 16%)
Taking ACE-I and ARB[3]	9% (7%, 12%)
Diagnosed with COPD[4]	6% (1%, 11%)
Taking beta-blockers	4% (2%, 6%)
Factors decreasing likelihood	
Hospitalised less than six months before diagnosis	-21% (-22%, -19%)
Medicaid beneficiary	-9% (-13%, -5%)
Diagnosed with CKD[5]	-9% (-11%, -6%)
Taking MRAs[6]	-6% (-10%, -1%)
Black or African American	-5% (-9%, -1%)
Comorbidity composite score[7]	-3% (-3%, -2%)
Age	-1% (-1%, -1%)

Note: Incremental risks presented above can be interpreted as a HFrEF patient with [comorbidity/ intervention] has an [y] percent greater/lesser likelihood of seeing an outpatient cardiologist in the three months after a HFrEF diagnosis when controlling for demographics, insurance, health status, medications or interventions, local cardiologist density, and Zip3 region. Medications and diagnoses were evaluated in the six months prior to diagnosis. 1. AF: atrial fibrillation; 2. CAD: coronary artery disease; 3. ACE-i and ARB: ACE-inhibitors and angiotensin receptor blockers; 4. COPD: Chronic Obstructive Pulmonary Disease; 5. CKD: chronic kidney disease; 6. MRAs: mineralocorticoid receptor antagonists; 7. As calculated by Charlson score.
Source: BCG analysis.

3

Surprisingly, cardiologist density had no significant impact on patients' likelihood of seeing an outpatient cardiologist. Patient-level factors, by contrast, proved critical. For example, CAD[5] patients were 18% more likely to see a cardiologist. By contrast, CKD patients were 9% less likely, perhaps because they were under the care of a nephrologist who could adjust their HF medications if necessary.

Insurance status, too, had an impact on the likelihood of a patient receiving outpatient cardiology care. Medicaid patients were 9% less likely to see an outpatient cardiologist while Medicare patients were 10% more likely to have seen one. Given that 37% of the cohort had Medicaid, the share of patients facing suboptimal care is not insignificant.

Moreover, our analysis suggests that Black Medicaid HFrEF patients who were older and had more serious conditions were significantly less likely to see an outpatient cardiologist. (See Exhibit 4). There was no difference in the likelihood of a male or female patients receiving outpatient cardiologist care.

Exhibit 4 - Statistically Significant Factors Impacting a Medicaid HF Patient's Likelihood of Visiting an Outpatient Cardiologist[1]

Factors	Percent increase or decrease in likelihood (95% confidence interval, upper and lower bounds)
Factors increasing likelihood	
Diagnosed with hypercholesterolaemia	24% (20%, 29%)
Diagnosed with CAD	24% (20%, 29%)
Diagnosed with AF	20% (15%, 25%)
Taking ACE-i and ARB	17% (13%, 22%)
Asian or Pacific Islander	17% (8%, 27%)
Taking beta-blockers	9% (5%, 13%)
Factors decreasing likelihood	
Diagnosed with CKD[4]	-21% (-22%, -19%)
Black or African American	-9% (-13%, -5%)
Male	-9% (-11%, -6%)
Co-morbidity composite score[1]	-6% (-10%, -1%)
Black or African American	-5% (-9%, -1%)
Age	-3% (-3%, -2%)

1. The reference population included white female patients with HF in a hospital in the Northeast region of the US. Medications and diagnoses were evaluated six months prior to diagnosis.
Note: Incremental risks presented above can be interpreted as a Medicaid patient with HFrEF and [comorbidity/intervention] has an [y] percent greater/lesser likelihood of seeing an outpatient cardiologist in the three months after a HFrEF diagnosis when controlling for demographics, insurance, health status, medications or interventions, local cardiologist density, and Zip3 region. Medications and diagnoses were evaluated in the six months prior to diagnosis. 1. AF: atrial fibrillation; 2. CAD: coronary artery disease; 3. ACE-i and ARB: ACE-inhibitors and angiotensin receptor blockers; 4. COPD: Chronic Obstructive Pulmonary Disease; 5. CKD: chronic kidney disease; 6. MRAs: mineralocorticoid receptor antagonists; 7. As calculated by Charlson score.
Source: BCG analysis.

Impact of Outpatient Care on the Likelihood of Hospitalization

Because of the critical connection between care patterns and outcomes, we also investigated how outpatient cardiology care affects the likelihood of HF hospitalization in the year after diagnosis. Patients who saw an outpatient cardiologist in the three months following diagnosis were 13% less likely to be hospitalized for HF in the first year, regardless of health status, type of insurance, or hospital density (number of hospitals per Zip3 region). (See Exhibit 5.)

5. For this and other abbreviations, see the sidebar.

Exhibit 5 - Statistically Significant Factors Impacting the Likelihood of Hospitalization Three Months to One Year after HF Diagnosis

Factors	Percent increase or decrease in likelihood (95% confidence interval, upper and lower bounds)
Factors increasing likelihood	
Taking diuretic	47% (41%, 54%)
Black or African American	36% (30%, 42%)
Medicaid	35% (23%, 48%)
Diagnosed with Hypertension	35% (28%, 42%)
Diagnosed with CKD	31% (27%, 36%)
Diagnosed with Diabetes	25% (21%, 29%)
Taking vasodilators	23% (17%, 28%)
Diagnosed with COPD[1]	12% (5%, 20%)
Medicare	11% (5%, 17%)
Diagnosed with AF	7% (3%, 10%)
Comorbidity composite score[3]	1% (0%, 2%)
Factors decreasing likelihood	
Taking beta-blockers	-24% (-27%, -21%)
Taking MRAs[4]	-16% (-20%, -12%)
Seen cardiologist within three months of diagnosis	-13% (-16%, -10%)
Diagnosed with high cholesterol	-12% (-16%, -7%)
Taking ACE-i and ARB	-5% (-8%, -1%)
Diagnosed during Covid	-4% (-7%, -1%)
Age	0% (0%, 1%)

1. As calculated by Charlson score.
Note: Incremental risks presented above can be interpreted as "a HFrEF patient with [comorbidity/intervention] has an [y] percent greater/lesser likelihood of being hospitalized or heart failure in the year post a HFrEF diagnosis when controlling for demographics, insurance, health status, medications/interventions, local hospital density, Zip3 region, and the competing risk of death." Medications and diagnoses were evaluated six months prior to and three months after diagnosis.
Source: BCG analysis.

5

Insurance

The analysis also found a link between insurance status and likelihood of HF hospitalization—which, given the relationship seen between insurance status and outpatient cardiology care, is not surprising. Medicaid patients with HF were three times more likely to be hospitalized than Medicare HF patients. This finding is noteworthy given that Medicaid patients constitute up to 35% of the approximately one million annual HF hospitalizations, and that HF hospitalizations are associated with increased mortality rates[6].

Interestingly, Medicaid patients who were seeing an outpatient cardiologist or who received appropriate therapy, such as beta-blockers, were significantly less likely to be hospitalized than Medicaid patients who did not receive such care. (See Exhibit 6).

6. Katherine M. Osenenko, et al., "Burden of hospitalization for heart failure in the United States: a systematic literature review," JMCP Vol.28 No. 2, January, 2022; Rishi K. Wadhera et al., "Association of the Affordable Care Act's Medicaid Expansion With Care Quality and Outcomes for Low-Income Patients Hospitalized With Heart Failure," Circulation: Cardiovascular Quality and Outcomes, June 26, 2018; Vanessa Blumer et al., "Prognostic Role of Prior Heart Failure Hospitalization Among Patients Hospitalized for Worsening Chronic Heart Failure," Circulation: Cardiovascular Quality and Outcomes, March 29, 2021.

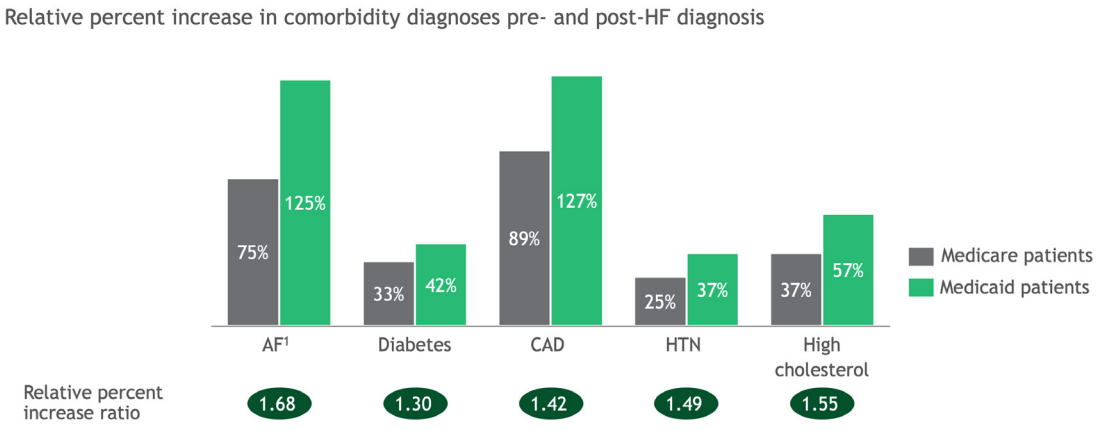
Exhibit 6 - Statistically Significant Factors Impacting a Medicaid Patient's Likelihood of Hospitalization Three Months to One Year after HF Diagnosis

Factors	Percent increase or decrease in likelihood (95% confidence interval, upper and lower bounds)
Factors increasing likelihood	
Taking diuretic	46% (36%, 57%)
Black or African American	33% (25%, 42%)
Diagnosed with CKD[1]	26% (18%, 34%)
Diagnosed with Diabetes	24% (18%, 31%)
Diagnosed with Hypertension	18% (2%, 36%)
Taking vasodilators	12% (4%, 21%)
Male	7% (1%, 13%)
Factors decreasing likelihood	
Seen outpatient clinician within three months of diagnosis	-29% (-36%, -22%)
Taking MRAs[2]	-18% (-24%, -11%)
Taking beta-blockers	-16% (-22%, -11%)
Seen cardiologist within three months of diagnosis	-16% (-21%, -11%)
Diagnosed with high cholesterol	-13% (-20%, -7%)
Seen NP/PA[3] within 3 months of diagnosis	-7% (-13%, 0%)

Note: Incremental risks presented above can be interpreted as "a Medicaid patient with HFrEF with [comorbidity/intervention] has an [y] percent greater/lesser likelihood of being hospitalized or heart failure in the year post a HFrEF diagnosis when controlling for demographics, insurance, health status, medications/interventions, local hospital density, Zip3 region, and the competing risk of death." Medications and diagnoses were evaluated six months prior to and three months after diagnosis.
Source: BCG analysis.

Medicaid patients also were less likely than Medicare patients to be diagnosed with significant cardiac risk factors, such as atrial fibrillation, coronary artery disease, and hypertension, before experiencing HF. (See Exhibit 7.) Given their HF diagnosis, one would have expected these patients to show these risk factors.

Exhibit 7 - Medicaid Patients Are Less Likely than Medicare Patients to be Diagnosed with Comorbidities Before Experiencing Heart Failure



Source: BCG analysis.

Note: The relative percentage increase ratio between Medicaid/Medicare patients for comorbidities diagnosed after HF diagnosis is determined by comparing the percentages of Medicaid patients diagnosed with new comorbidities before and after their HF diagnosis, and then comparing that ratio with the Medicare equivalent. Numbers greater than 1 represent instances of when more Medicaid patients than Medicare patients were diagnosed with new comorbidities after HF diagnosis.

These findings suggest that Medicaid patients have historically been undermanaged, and that Medicaid-related outcomes are modifiable. If this is indeed the case, it will be critical to find ways to expand this big data work so that gaps in care can be identified proactively, and risk factors better managed.

Implications for the Health Care Ecosystem

These findings highlight the strong health inequities that exist in the US and suggest some ways to close these gaps. While improving health equity will require both time and resources, we encourage health care providers, systems, payers, and industry players to consider taking the following actions:

- **Engage in proactive assessment of the current state.** Health care professionals, health care systems, and industry players often have data assets—electronic medical records, claims, and reporting platforms—that can be used to better understand major gaps in care. All these stakeholders should conduct regular reviews that include at least a few key equity metrics.

- **Share the results to spur awareness, discussion, and action.** These findings need to be shared with patients and the broader healthcare ecosystem via bite-sized communications on easily accessible channels Brief email memos, internal presentations, and social media posts (Linked-in or Facebook) work best. The greater the awareness, the greater the likelihood of motivating an individual or organization to seek change.

- **Identify where you and your organization are best positioned to make a difference, prioritizing "quick wins."** There is often no simple solution for macro level disparities in care: they are often multi-factorial requiring significant investment in time and resources to reach the target state. But each organization likely can make a difference by working on what it can manage or support and then by collaborating with others to enhance what they are doing.

For example, Boston Scientific's Close the Gap program has used analyses like these to improve outreach to underserved patients, raise awareness, and make clinical trials more diverse. Pfizer, after identifying large inequities amongclinical trial participants, to launched a series of initiatives to address these inequities across disease areas. And J&J's Janssen is deploying data and AI to diversify clinical trials across diseases.[7]

At the same time, we also must acknowledge the broad health system initiatives taking place. In the US, the CDC is working with hospitals and health systems to prevent over 1 million heart attacks and strokes, with particularly focus on developing scalable ways to improve outcomes in high-risk communities. The CDC is also funding the Well-Integrated Screening and Evaluation for Women Across the Nation (WISEWOMAN) program, which helps uninsured and under-insured low-income women understand and reduce their risk for heart disease and stroke.[8] These programs offer encouragement that change is possible with continued education and effort.

In the end, we all have quick wins to contribute, working within communities where inequalities exist—even if it just means sharing a link.

7. https://www.bostonscientific.com/content/dam/bostonscientific/endo/general/gastro-specialty/ENDO-Close-the-Gap-Fact-Sheet.pdf; Ashley Welch, "Artificial Intelligence is helping revolutionize healthcare as we know it," September 13, 2023; Melina Rottas et al, "Demographic diversity of participants in Pfizer sponsored clinical trials in the United States," https://www.sciencedirect.com/science/article/pii/S1551714421001579.

8. https://www.heart.org/en/get-involved/advocate/federal-priorities/cdc-prevention-programs.

About the Research

Leveraging data from Komodo Health, a US claims provider, BCG analyzed the insurance claims of 98,000 patients diagnosed with HFrEF between 2019 and 2021. These patients had continuous insurance coverage from six months before their diagnosis until a year after their diagnosis or death. We used multivariate and competing risk models clustered by zip codes to understand the impact of insurance while controlling for patient health status and regional differences in cardiologist or hospital density.

It is worth noting the limitations of our analysis. The dataset was under-indexed to Medicare, a key insurance provider of the HF population, so these findings may not be generalizable to the full HF population. Moreover, the Komodo data did not capture all clinically relevant factors, such as ejection fraction or medication adherence, which could have helped refine the view of patient risk and explain the outcomes we observed. We also cannot comment on the quality of provider-patient interactions, which are critical to shaping patient engagement.

Abbreviations:

ACE-i and ARB: ACE-inhibitors and angiotensin receptor blockers

AF: atrial fibrillation

CAD: coronary artery disease

CKD: chronic kidney disease

COPD: chronic obstructive pulmonary disease

HTN: hypertension

MRAs: mineralocorticoid receptor antagonists

About the Authors

Isabel Boero, MD is a principal in the BCG London office with expertise in cardiology, medical affairs, and market development in medtech and biopharma.

Julia Bieniewska, PhD is a senior data scientist in the BCG London office. She works on applying ML and AI to a range of problems, including public health and biopharma topics.

Meenal Pore, PhD is a project leader in the BCG London office. She focuses on biopharma and medtech topics.

Nigel Markey is a partner in the BCG London office. He specializes in applying AI, ML, and GenAI to biopharma R&D.

Chris Meier, PhD is a managing director and partner in BCG's London office. He focuses on health care R&D and is associated with BCG X, the firm's in-house data science unit.

Myrto Lee, PhD is a managing director and partner in the firm's London office. She focuses on biopharma R&D, regulatory, market access, and medical topics.

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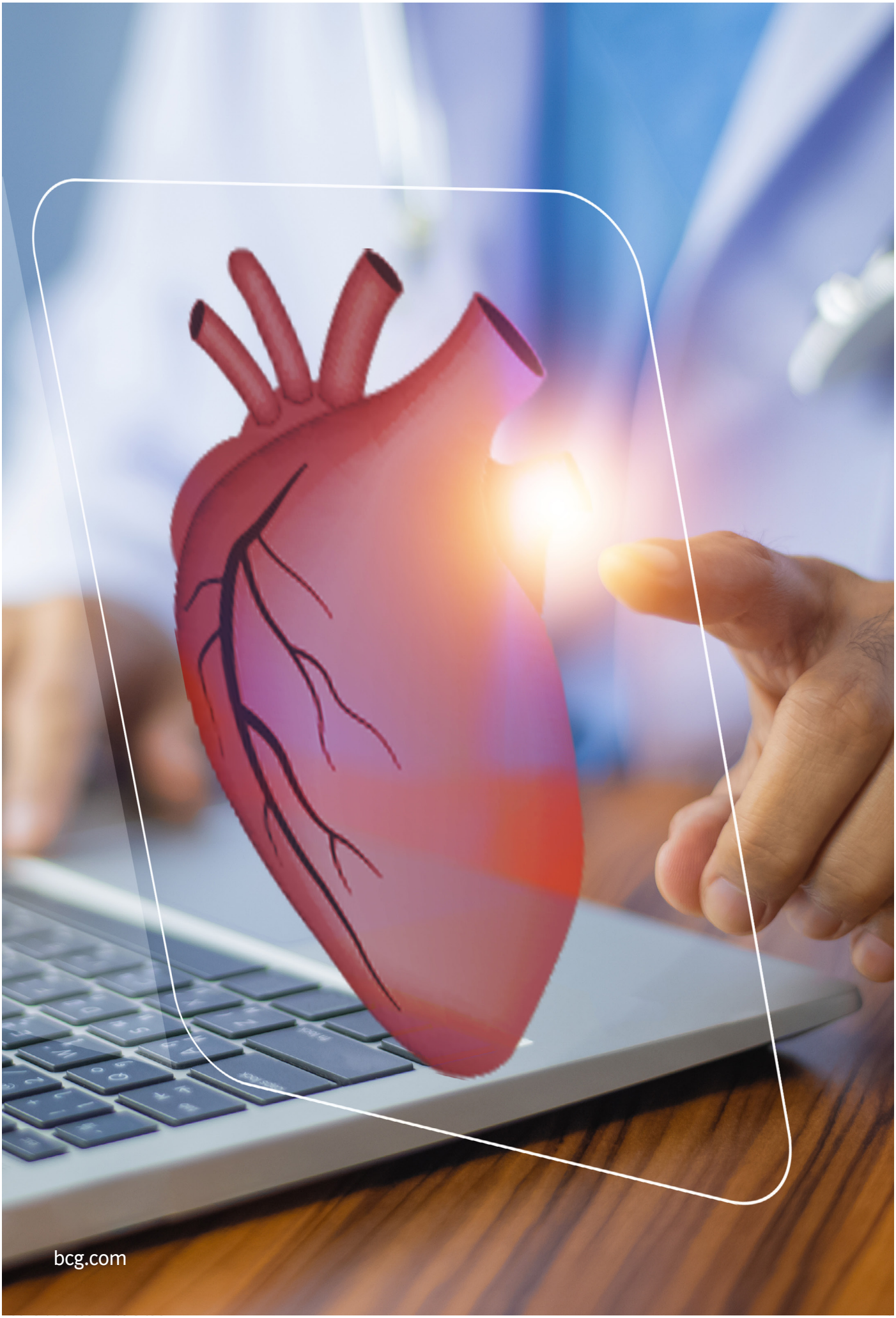

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