GUIDELINE-DIRECTED MEDICAL THERAPY AMONG HEART FAILURE PATIENTS FACILITATED BY NATURAL LANGUAGE PROCESSING OF AMBULATORY ELECTRONIC MEDICAL RECORDS

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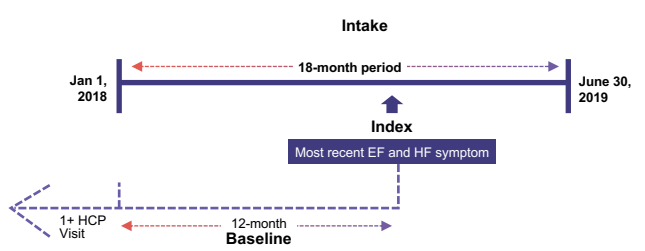
BACKGROUND

- Guideline-directed medical therapy (GDMT) reduces morbidity and mortality in stage C heart failure (HF) with reduced ejection fraction (HFrEF, EF ≤40%)[1] and manages symptoms associated with hypertension, volume overload, and comorbidities in stage C HF with preserved ejection fraction (HFpEF, EF ≥50%).[1,2] Despite these benefits, many patients with HF may not be receiving GDMT possibly because of variations in treatment recommendations or responses according to disease phenotypes.[3]
- We performed a retrospective analysis to determine whether characteristics differ between patients with and patients without evidence of recommended therapeutic or symptomatic guideline-directed medical therapy (i.e., GDMT+ versus GDMT-).

METHODS

- Real-world evidence was generated from de-identified real-world data sourced from a Veradigm ambulatory care electronic health record (EHR). Patients with an ICD-9-CM or ICD-10-CM code for HF were screened for additional criteria.
- Eligible patients had at least one HF symptom and at least one EF measurement during Intake (**Figure 1**). Symptoms and EF were obtained largely from unstructured notes in the EHR using natural language processing (NLP) as described in companion posters.[4,5]

Figure 1 | Study Design



- Patients with HFrEF or HFpEF were stratified into GDMT+ (at least two Class of Evidence I GDMT treatments) and GDMT- cohorts (≤1 Class of Evidence I GDMT treatment) and characterized according to demographics, vitals, clinical laboratory findings, comorbidities, and symptoms of HF.
- Comparisons of categorical and continuous variables were performed using Chi-square tests and simple linear regression (analysis of variance), respectively.

RESULTS

Of 576,850 patients with at least one HF code in the Veradigm EHR anytime to August 2019)

- 306,704 adults (≥18 yrs) with HF were in the EHR database during the intake period (January 1, 2018 to June 30, 2019)
- 27,437 were deemed to have Stage C HF (≥one valid EF measure and ≥one HF-related symptom)
- 17,821 had continuity in the EHR database (one or more provider visits ≥12-months prior to Index)
- 13,753 were eligible for analysis as having either HFrEF or HFpEF.
- Based on EF criteria, 42.1% (5,784) had HFrEF; 57.9% (7,969) had HFpEF (not shown).
- In the GDMT+ and GDMT- cohorts, median age was the same (74 year) as were age and gender distributions. A higher percentage of GDMT+ patients than GDMT- patients had a history of smoking; proportionally more GDMT- patients had never smoked (**Table 1**).

Table 1 | Demographics

VARIABLE	ELIGIBLE	GDMT+	GDMT-	P VALUE
N (% of cohort)	13,753 (100)	7,257 (52.8)	6,496 (47.2)	N/A
Median Age (IQR)	74 (65-82)	74 (65-82)	74 (65-82)	0.828
18-44	347 (2.5%)	168 (2.3%)	179 (2.8%)	
45-64	2,906 (21.2%)	1,549 (21.3%)	1357 (20.9%)	0.226
≥65	10,499 (76.3%)	5,540 (76.3%)	4,959 (76.4%)	
Male	7,537 (54.8%)	4,019 (55.4%)	3,518 (54.2%)	
Female	6,202 (45.1%)	3,233 (44.6%)	2,969 (45.7%)	0.167
Current / History as Smoker	5,658 (41.1%)	3,075 (42.4%)	2,583 (39.8%)	
Never Smoked	8,095 (58.9%)	4,182 (57.6%)	3,813 (60.2%)	0.002

The percentage of patients in the GDMT+ cohort was higher than that in the GDMT- cohort for

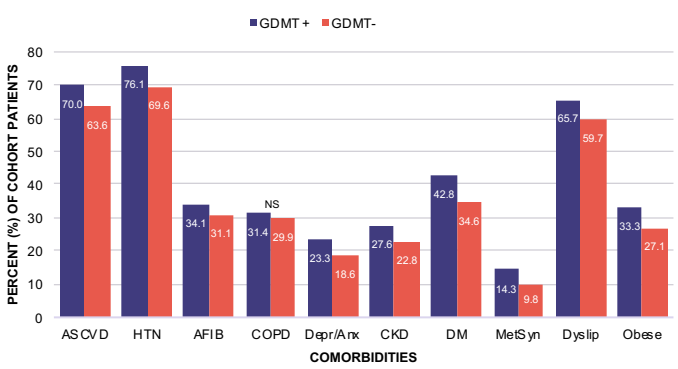
- Mean weight and body mass index (BMI)
- Systolic blood pressure (SBP) ≥140mmHg
- SBP over diastolic BP (SBP/DBP) ≥140/90mmHg
- Mean glycosylated hemoglobin (HbA1c)
- HbA1c >6.5 (41.1% GDMT+ vs 33.4% GDMT-) (not shown)
- Estimated glomerular filtration rate (eGFR) <60mL/ml/1.74m^2
- Triglycerides >70 mg/dL
- Total cholesterol >200 mg/dL
- Low Density Lipoprotein-C (LDL-C) >70 mg/dL
- Mean High Density Lipoprotein-C (HDL-C) (**Table 2**).

Table 2 | Vitals and Laboratory Values

VARIABLE	GDMT+	GDMT-	P VALUE
N (% of cohort*)	7,257 (52.8)	6,496 (47.2)	N/A
Weight, mean (SD)	189.3 (52.6)	184.0 (51.0)	<0.001
BMI, mean (SD)	30.9 (7.6)	30.0 (7.3)	<0.001
SBP ≥140, n (% of reported)	1706 (23.5%)	1323 (20.4%)	<0.001
SBP/DBP ≥140/90, n (% of reported)	374 (5.2%)	273 (4.2%)	0.009
HbA1c, mean (SD)	6.8 (2.8)	6.5 (3.1)	0.036
eGFR <60, n (% of reported)	1,169 (45.3%)	537 (39.3%)	<0.001
Cholesterol >200, n (% of reported)	417 (5.7%)	270 (4.2%)	<0.001
LDL-C >70, n (% of reported)	1,670 (23.0%)	1,029 (15.8%)	<0.001
HDL-C, mean (SD)	48.4 (17.3)	50.6 (15.8)	<0.001

Except for the percentage of patients with COPD, significantly higher percentages of patients in the GDMT+ cohort than in the GDMT- cohort were demonstrated for each of the other comorbidities (**Figure 2**).

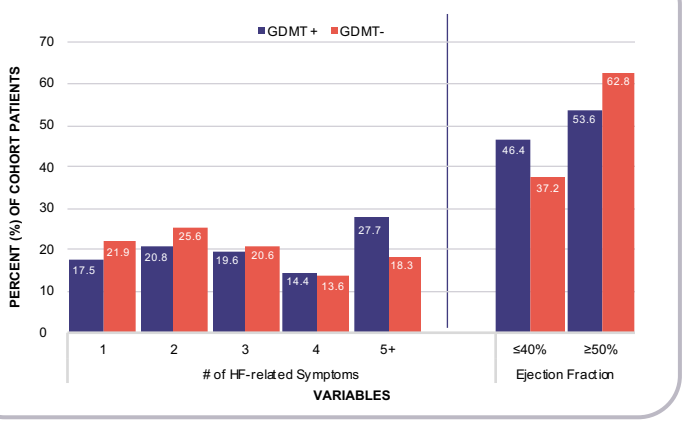
Figure 2 | Comorbidities



Abbreviations: GDMT, guideline-directed medical therapy; NS, no significant difference p>0.05; ASCVD, atherosclerotic cardiovascular disease; HTN, hypertension; AFIB, atrial fibrillation/flutter; Depr/Anx, depression/anxiety; CKD, chronic kidney disease (includes renal insufficiency); DM, diabetes mellitus (type 1 or type 2); MetSyn, metabolic syndrome (dyslipidemia, diabetes, and overweight/obese); Dyslip, dyslipidemia; Obese, overweigh/obese.

A higher percentage of patients in the GDMT- cohort than in the GDMT+ cohort had fewer (<3) symptoms of HF. Nearly equivalent percentages of patients in the GDMT+ and GDMT- cohorts had three or four symptoms. A higher percentage of patients in the GDMT+ cohort than in the GDMT- cohort had five or more symptoms of HF (**Figure 3, left panel**).

Figure 3 | Note-Derived Symptoms and Ejection Fraction



A higher percentage of patients in the GDMT+ cohort than in the GDMT- cohort had EF≤40%; in contrast, a higher percentage of patients in the GDMT- cohort than in the GDMT+ cohort had EF≥50% (**Figure 3, right panel**).

CONCLUSION

De-identified data from structured patient information fields and from unstructured physician notes, available in a large ambulatory EHR, provided a broad clinical view of patient characteristics associated with HF diagnosis and management. The study demonstrates most variables, including comorbidities with the single exception of COPD, differentiated GDMT+ from GDMT- patients. Further study of comorbidities and heart function according to patient phenotype as potential predictors of recommended therapy is warranted for population health insights into patients with HF.

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