PCV102

Prescription Pattern & Physician Propensity for Congestive Heart Failure Treatments in United States & Europe

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Background

- The role of general practitioners (GPs) in managing Congestive Heart Failure (CHF) has been important in reducing mortality and hospitalizations, particularly in stable patients, as these patients drive the majority of CHF-related morbidity and mortality.[1,2]
- CHF treatment is usually initiated by cardiologists, with routine follow-up managed by GPs, indicating a potential gap between physician specialty domains.

Objectives

- To explore prescribing patterns between cardiologists and GPs for CHF patients in the United States (US) and Europe
- To assess factors impacting physicians' prescribing tendencies to inform strategies for improving CHF management by non-cardiologists

Methods

Data Source

- US
  - Patient data were extracted from the HealthVerity Marketplace™ longitudinal ambulatory electronic medical records (EMR) dataset, including 1 electronic medical record source (Private Source [PS] 42) and 1 linked institutional and pharmacy claims data (PS1734) source between Jan 1, 2014 and Jun 30, 2019.
    - HealthVerity™ has the most complete coverage of US healthcare, consumer, and purchase data, with access to over 330 million patients and 30 billion transactions.[3]
    - PS42 is a multispecialty ambulatory EMR of 60 million unique patients; P1734 is an institutional claims source and a provider of claims source data covering 140 million patients (PS34) that has been linked to PS17, a multi-payor pharmacy transaction database.
- Europe
  - Patient data were extracted from The Health Improvement Network (THIN®) UK and France databases between Jul 1, 2016 and Jun 30, 2019.
    - THIN® is an anonymized EMR powered by Cegedim Health Data® division. It is a large European database that collects data at the physician level.
- Data sets were converted into the Observational Medical Outcomes Partnership Common Data Model, v5.
- Analyses were conducted in SHYFT Quantum v7.1.1. Supplemental analyses were conducted using Microsoft SQL Server Studio 2017 and R v3.5.2.

Study Design

- Inclusion/exclusion criteria (Figure 1):
  - ≥6 months continuous activity post-index for EMR data (PS42), continuous enrollment for claims (PS1734)
  - Patients with ≥2 diagnoses of CHF (I50.xx), or ≥1 diagnosis of CHF (I50.xx) and any evidence of CHF treatment based on drug National Drug Code or Anatomical Therapeutic Chemical codes for beta blockers, angiotensin-converting enzyme (ACE) inhibitors, and angiotensin-receptor blockers (ARB), diuretics (furosemide, loop diuretics, other), calcium channel blockers, neprilysin inhibitor (sacubitril/valsartan), and hyperpolarization-activated cyclic nucleotide-gated (HCN) channel inhibitor (ivabradine)
  - Age ≥18 years
  - Index date: earliest diagnosis code for CHF

Figure 1: Study Cohort Selection

	US		France	UK
Database	PS42	PS1734	THIN®	THIN®
Total Population, N	71,364	75,114	61,389	51,718
≥2 diagnoses of CHF or 1 CHF diagnosis and 1 CHF drug, n	9,179	4,718	21,950	20,383
Age ≥18 years, n	9,171	4,718	21,943	20,347
≥6 months continuous activity post-index date, n	8,421	3,598	16,703	18,179
Patients included in the analysis, n	8,421	3,598	16,703	18,179

Study Measures

- Baseline patient characteristics: age, gender, frequency of visits to clinician's office, common cardiovascular comorbidities and treatments
- Cardiac and Comorbid Conditions HF (3C-HF) scores: assessed using baseline characteristics (e.g., comorbidities and treatment history) between start of observation and 90 days post-index to predict patients' 1-year mortality[4,5]
  - Due to limited comorbidity data available in patients aged >70 years, scoring and outcomes assessments were conducted for patients aged <70 years in UK and France.
  - Age was not incorporated in US 3C-HF score calculation.
- Count of per patient visits to the GP or cardiologist office post-index for US and France and count of GP visits only for the UK
- Count of patients receiving prescriptions by specialty and drug class
  - Drug classes: beta blockers, ACE inhibitors, ARB, diuretics (sulfonamide/loop diuretics, other diuretics), calcium channel blockers, neprilysin inhibitor (sacubitril/valsartan), and HCN channel inhibitor (ivabradine)
  - Assessed by specialty cardiology vs. GP (defined as Internal Medicine, Family Practice in US) overall and by line of therapy (lines 1-3 for France, line 1 for US)

Analyses

- Data are reported as mean, median, and standard deviation (SD).
- Propensity score analysis
  - Propensity score distribution for drug class prescribing, at any time post-index
    - By cardiologist vs. GP in US and France
    - By 3C-HF score above and below the median
    - By drug class assessed
  - Propensity score distribution for drug class prescribing, by line of therapy, defined as gap >30 days in persistence
  - Propensity score distribution for drug class prescribing for GPs in the UK

Results

Table 1: Baseline Demographics and Clinical Characteristics by Country

	Country	US claims		France	UK
	Database	PS42	PS 1734	THIN®	THIN®
N		8,421	3,598	16,703	18,179
Age, mean (SD)		70.5 (11.7)	73.8 (11.8)	79.7 (11.8)	77.3 (12.7)
Gender, n (%)					
Male		4,255 (50.4)	1,716 (47.4)	9,308 (55.7)	10,293 (56.6)
Female		4,157 (49.3)	1,765 (49.1)	7,395 (44.3)	7,885 (43.4)
Missing		29 (0.3)	117 (3.5)	–	–
Common cardiovascular comorbidities, n (%)					
Cardiomyopathy		1,563 (18.6)	344 (9.6)	647 (3.9)	317 (1.7)
MI, n (%)		216 (2.6)	135 (3.85)	784 (4.7)	1,129 (6.2)
Type 2 Diabetes		2,239 (26.6)	599 (16.6)	2,352 (14.1)	701 (3.9)
Hypertension		3,224 (38.3)	1,210 (33.6)	6,902 (41.3)	1,269 (7.0)
CKD		1,527 (18.1)	964 (26.8)	199 (1.2)	89 (0.5)
Dyslipidemia		3,794 (45.1)	715 (19.9)	2,100 (12.6)	326 (1.8)
PAD		463 (5.5)	207 (5.8)	383 (2.3)	114 (0.6)
HFrEF		5,716 (67.9)	1,337 (37.2)	161 (1.0)	101 (0.6)
COPD / Asthma		1,338 (15.9)	529 (14.7)	1,787 (10.7)	930 (5.1)
Common cardiovascular treatments, n (%)					
Beta blocker		5,679 (67.4)	2,064 (57.4)	9,451 (56.6)	9,979 (54.9)
ACE inhibitors		3,139 (37.3)	1,175 (32.7)	5,845 (35.0)	8,178 (45.0)
ARB		1,786 (21.2)	796 (22.1)	3,388 (20.3)	2,888 (15.9)
HCN channel inhibitor (ivabradine)		0	0	407 (2.4)	329 (1.8)
Sacubitril/valsartan		0	4 (0.1)	147 (0.9)	81 (0.4)
Calcium-channel blocker		2,578 (30.6)	1,203 (33.4)	3,028 (18.1)	4,308 (23.7)
Diuretics excluding sulfonamides		3,608 (42.8)	1,457 (40.5)	2,571 (15.4)	4,405 (24.2)
Sulfonamides/loop diuretics		4,721 (56.1)	1,604 (44.6)	8,211 (49.2)	8,401 (46.2)
Mean cardiology visit pre-index, n (SD)		1.8	18.0	2.5 (2.1)	–
Mean GP visit pre-index, n (SD)		3.9	10.0	5.5 (5.8)	18.4 (16.7)
3C-HF score, mean (SD)		8.7 (7.1)	11.1 (5.1)	15.8 (4.3)	17.1 (3.8)
3C-HF score, median		12	8	16	17
3C-HF score - above median, n (%)		5,708 (67.8)	1,504 (41.8)	8,958 (54.0)	10,167 (56.0)

CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; HFrEF, heart failure w/ reduced ejection fraction; MI, myocardial infarction; PAD, peripheral arterial disease

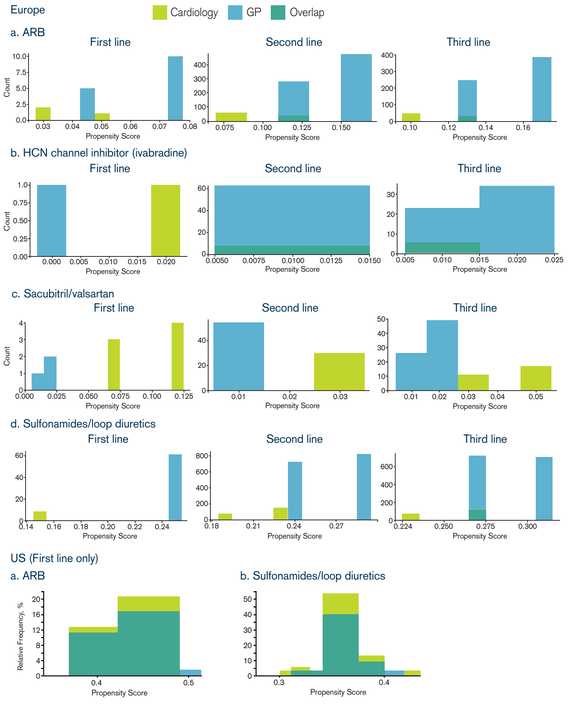
Table 2: Patient Visits Post-index by Specialty, by Country

Practice type	Country	N	Mean
Cardiology	US	5,3284	15.7
	France	3,765	5.5
GP	US	99,592	24.2
	France	12,803	21.3
	UK	18,179	69.7

Table 3: Average Patient Counts by Specialty Visits per Patient, by Drug Class, by Line of Therapy for US and France

Country	US	France			
Treatment type/Line of therapy	1	1	2	3	4
ARB, N	75	35	1,234	972	689
Cardiology, N (%)	8 (11)	3 (16.7)	99 (11.7)	77 (10.9)	47 (9.2)
GP, %	18 (24)	15 (83.3)	750 (88.3)	631 (89.1)	465 (90.8)
Both	2 (3)	0	0	0	0
Sulfonamides/loop diuretics, N	151	152	2,565	2,179	1,671
Cardiology, N (%)	14 (9)	9 (12.9)	225 (12.7)	203 (12.4)	143 (11.1)
GP, %	24 (16)	61 (87.1)	1,543 (87.3)	1,428 (87.6)	1,148 (88.9)
Both	13 (9)	0	0	0	0
HCN channel inhibitor (ivabradine), N	–	6	109	92	72
Cardiology, N (%)	–	1 (50.0)	8 (11.3)	6 (9.5)	3 (6.1)
GP, %	–	1 (50.0)	63 (88.7)	57 (90.5)	46 (93.9)
Both	–	0	0	0	0
Sacubitril/valsartan, N	–	14	121	140	133
Cardiology, N (%)	–	7 (70.0)	30 (35.7)	28 (27.2)	28 (24.8)
GP, %	–	3 (30.0)	54 (64.3)	75 (72.8)	85 (75.2)
Both	–	0	0	0	0

Figure 2: Propensity Score Distribution for Drug Class Prescribing, by Line of Therapy



Summary

- Initial application of inclusion/exclusion criteria of a second diagnosis code or evidence of treatment in US EMR (PS42) and claims (PS1734) sources led to a greater than 7-fold drop in patient population.
  - The declines in France and UK populations, while smaller, were still 3-fold. Results are consistent with known gaps in diagnosis and treatment in CHF.
- Average ages were lower in the US data sources (71-74 vs. 77-80) (Table 1).
  - Both the US outpatient ambulatory EMR (PS42) and the UK GP data sources had relatively lower rates of cardiovascular comorbidity.
  - Cardiologist visits were highest in the US claims data when compared to the French data (could not be assessed in UK data).
- The mean 3C-HF scores ranged from 15.8 in France to 17.1 in the UK and 8.7 - 11.1 in the US (Table 1).
  - Lower US scores were in part driven by absence of age in scoring, and PS42 being an outpatient ambulatory EMR data source.
  - Higher scores in UK and France were largely driven by differences in prescribing of ACE inhibitors, ARB, and beta blockers (data not shown).
- Patient visits to cardiologists in US claims data were significantly higher than in France, both pre- and post-index (Table 2).
  - Within US data, cardiology visits were higher in claims data (PS1734), likely due to EMR data (PS42) being outpatient ambulatory in origin (Table 1, 2).
- Initial examination of prescribing by specialty and drug class showed evidence of prescription by both GPs and cardiologists in the US, whereas in France, prescriptions initiated by one specialty tended to only be prescribed by that specialty (analysis not shown). Specialty could not be assessed in UK.
- Post-index prescribing propensity distributions in the US were virtually identical between GPs and cardiologists for ACE inhibitors, ARB, beta blockers, loop/sulfonamide diuretics, and other diuretics. Rates of neprilysin and HCN channel inhibitor use were too low to assess (data not shown).
  - This pattern persisted in examining post-index first-line therapy only (Figure 2).
- Post-index prescribing propensity distributions in France showed high GP propensity across classes (analysis not shown).
  - When explored by line of therapy, however, first-line neprilysin and HCN channel inhibitor prescribing showed high cardiologist propensity, with GP propensity for these therapies increasing with later line use (Figure 2).
- Within UK GPs, post-index prescribing propensity was higher for beta blockers and loop/sulfonamide diuretics compared to other classes (data not shown).
- Future refinements include further exploration of factors driving prescribing tendency by specialty, in both US and European populations, using multivariate analysis and clustering approaches.

LIMITATIONS

Study Limitations

- Comorbidity capture in patients ≥70 was limited in the UK and France data, limiting score calculations to patients <70 years old. Despite only focusing on patients <70 years of age, robust associations with 3C-HF score and outcomes were demonstrable. US 3C-HF scores did not incorporate age. Future assessments will refine scores to explore impact of age.
- In the UK, data source was for GPs only.

Conclusions

- In both US and France, GPs show comfort with prescribing well-established treatments for CHF.
- In France, for the relatively newer neprilysin and HCN channel inhibitors, propensity in earlier lines is higher for cardiologists, with GP propensity increasing in later lines. GPs in the UK also show comfort with beta blockers and loop/sulfonamide diuretics. Despite this comfort with established treatments, CHF patients in UK and France show lower rates of ACE inhibitor, ARB, and beta blocker utilization than in the US.
- Understanding the role patient demographics and comorbidities play in the observed differences between US and European patients may be useful for assessing patient-level factors influencing prescribing behavior.
- Future applications may help empower GPs to initiate CHF treatment and increase collaboration with cardiologists to enhance patient outcomes.

References

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Disclosures

ER, RB, RA, AG, JR, AS, and BL are employees of Medidata Solutions.

MB provided consultancy to Medidata Solutions.

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