

The Economic Burden of Patients With Type 2 Diabetes Hospitalized for Heart Failure

Dana Stafkey-Mailey¹, Rupali M. Fuldeore¹, Sharash Shetty², Anna D. Coutinho¹, Pamela Landsman-Blumberg¹, Stephen D. Sander², Craig I. Coleman³, Angelo Del Parigi²

¹Xcenda, LLC, Palm Harbor, FL, USA; ²Boehringer Ingelheim Pharmaceuticals, Inc., Ridgefield, CT, USA; ³University of Connecticut, Storrs, CT, USA

BACKGROUND

- Incidence of heart failure (HF) among patients with type 2 diabetes mellitus (T2DM) has been estimated to be 2 to 30 cases per 1,000 person-years.^{1,4}
- It is important to characterize the burden of HF hospitalization in order to understand the potential value of new oral anti-diabetic therapies.

STUDY OBJECTIVES

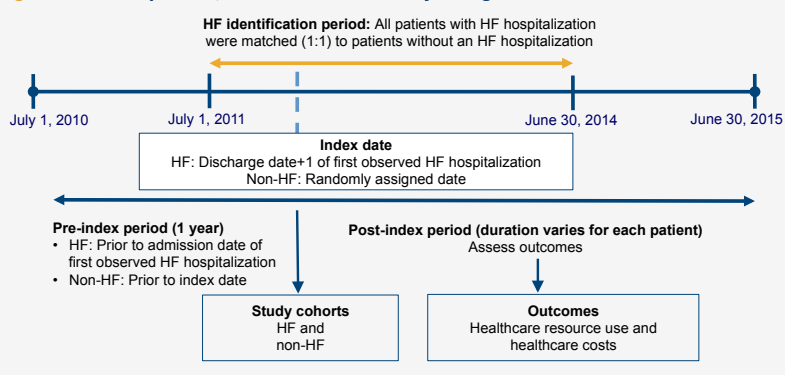
- Among patients with T2DM, determine the direct cost of an HF-related hospitalization.
- Compare healthcare resource utilization and costs of T2DM patients with an HF-related hospitalization to T2DM patients who did not have an HF-related hospitalization.

METHODS

Data Source and Study Design

- IMS LifeLink PharMetrics Plus™ Claims Database.
- Retrospective, matched cohort study design.

Figure 1. Retrospective, Matched Cohort Study Design



Sample/Population Selection

- Target Population: T2DM patients with an HF hospitalization (HF cohort) during the identification period were matched to T2DM patients without an HF hospitalization (non-HF cohort).
- Inclusion:
 - T2DM diagnosis during the pre-index period
 - Aged ≥18 years
 - Continuous plan enrollment during the pre-index period
- Exclusion:
 - Had an HF hospitalization in the pre-index period
 - Missing demographic information (age, gender, geographic region)
 - Diagnosis of pregnancy, gestational diabetes, secondary diabetes, or type 1 diabetes mellitus any time during the pre-index or post-index period
- Stratification:
 - Patients were stratified into low-risk and high-risk groups, based upon the presence of a CV-related hospitalization in the pre-index period
- Matching:
 - HF and non-HF patients were matched (1:1 ratio) separately in the high- and low-risk cohorts using the estimated propensity score (PS)
 - Propensity scores were estimated using a logistic regression model, including: age (continuous); gender; geographic region; plan type; index year; presence of CV conditions or CV hospitalization during the pre-index period; cancer; chronic obstructive pulmonary disease; and CV risk factors (hypertension, dyslipidemia, obesity)

Definitions

- T2DM status: identified during the pre-index period, and defined as having:
 - ≥1 hospitalization with a diagnosis of T2DM in any diagnosis field QR
 - ≥2 medical claims at least 30 days apart within 12 months in the outpatient setting, except lab and radiology, with a diagnosis of T2DM in any diagnosis field QR
 - ≥1 pharmacy claim indicated for T2DM, including a) a non-insulin injectable, or b) an oral anti-diabetic agent,

- except metformin, or c) metformin pharmacy claim without a diagnosis code for pre-diabetes or polycystic ovary syndrome⁵
- HF hospitalization: hospitalization with primary discharge diagnosis for HF (ICD-9-CM: 428.xx, 402.x1, 404.x1, 404.x3).
- CV-related hospitalization: hospitalization with a primary discharge diagnosis for and AMI (ICD-9-CM: 410.xx), unstable angina (ICD-9-CM: 411.1x), stroke (ICD-9-CM: 430.xx-436.xx), arrhythmias (ICD-9-CM: 427.xx, except 427.5) or cardiac arrest (ICD-9-CM: 427.5), or a hospitalization with a revascularization procedure with other primary discharge diagnosis.

Study Outcomes

- All patients were included for analysis of outcomes from the index HF hospitalization, but only those surviving the index HF hospitalization were analyzed for outcomes during the variable post-index period.
- HF hospital characteristics (HF cohort only):
 - Length of stay
 - 30-day all-cause readmission
 - Percentage of patients discharged as deceased
- Healthcare resource utilization:
 - Length of stay per hospitalization
 - Bed-days during the post-index period among patients with ≥1 hospitalization
 - Number of all-cause visits by setting of care (reported per patient per month)
- Healthcare costs in 2015 United States dollars (USD):
 - All-cause costs (reported per patient per month)

Statistical Analysis

- Baseline characteristics: paired t-tests and McNemar's test to account for matching.
- Success of matching: a standardized difference of <10% was indicative of acceptable balance.
- Healthcare resource use and costs: paired t-tests and McNemar's test to account for matching.
- All analyses were conducted separately for low- and high-risk patients, using SAS® version 9.2 (SAS Institute; Cary, NC, USA).

RESULTS (CONTINUED)

Sample Characteristics

- PS matching resulted in a final sample of 10,256 patients (HF=5,128; non-HF=5,128) in the low-risk cohort and 602 patients (HF=301; non-HF=301) in the high-risk cohort.
- After matching, the post-match standardized differences were <10% for all baseline characteristics, with the exception of Charlson Comorbidity Index for the low-risk cohort, whereas only age, gender, and angina were <10% in the high-risk cohort (Table 1).

Table 1. Baseline Demographic and Clinical Characteristics

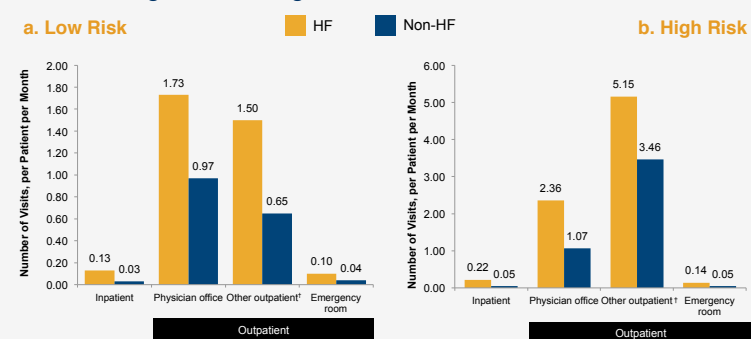
Characteristics During the Pre-index Period	Low Risk			High Risk		
	HF (n=5,128)	Non-HF (n=5,128)	Stand. Diff.	HF (n=301)	Non-HF (n=301)	Stand. Diff.
Age as of index (in years), mean (SD)	64.5 (11.8)	65.3 (11.0)	0.0635	66.7 (10.8)	67.0 (10.1)	0.0320
Male, n (%)	3,002 (58.5%)	3,043 (59.3%)	0.0163	200 (66.4%)	211 (70.1%)	0.0786
Payer type, n (%)						
Commercial/self-insured	4,503 (97.8%)	4,488 (87.5%)	0.0988	261 (86.7%)	263 (87.3%)	0.1364
Medicaid/SCHIP	87 (1.7%)	43 (0.8%)	-	6 (2.0%)	3 (1.0%)	-
Medicare	452 (8.8%)	533 (10.4%)	-	31 (10.3%)	34 (11.3%)	-
Unknown/other	86 (1.7%)	64 (1.2%)	-	3 (1.0%)	1 (0.3%)	-
Type of CVD, n (%)						
Angina (pectoris or unstable)	225 (4.4%)	213 (4.2%)	0.0116	100 (33.2%)	106 (35.2%)	-0.0420
Arrhythmias	1,160 (22.6%)	1,190 (23.2%)	-0.0139	217 (72.1%)	182 (60.5%)	0.2478
Arterial thrombosis & embolism	37 (0.7%)	38 (0.7%)	-0.0023	9 (3.0%)	4 (1.3%)	0.1145
Atherosclerosis & other ischemic heart disease	1,572 (30.7%)	1,586 (30.9%)	-0.0059	263 (87.4%)	241 (80.1%)	0.1990
Cardiac arrest	9 (0.2%)	11 (0.2%)	-0.0088	9 (3.0%)	4 (1.3%)	0.1145
Cardiomyopathy	401 (7.8%)	353 (6.9%)	0.0359	112 (37.2%)	34 (11.3%)	0.6343
Conduction disorders	260 (5.1%)	263 (5.1%)	-0.0027	55 (18.3%)	40 (13.3%)	0.1370
Endocarditis, pericarditis, myocarditis	655 (12.8%)	635 (12.4%)	0.0118	148 (49.2%)	82 (27.2%)	0.4632
HF	940 (18.3%)	840 (16.4%)	0.0515	235 (78.1%)	98 (32.6%)	1.0297
Myocardial infarction	402 (7.8%)	358 (7.0%)	0.0328	182 (60.5%)	149 (49.5%)	0.2217
Other heart disease	348 (6.8%)	327 (6.4%)	0.0165	86 (28.6%)	50 (16.6%)	0.2890
Peripheral vascular disease	407 (7.9%)	399 (7.8%)	0.0058	67 (22.3%)	44 (14.6%)	0.1980
Rheumatic heart disease & fever	182 (3.5%)	162 (3.2%)	0.0217	53 (17.6%)	22 (7.3%)	0.3157
Stroke	539 (10.5%)	528 (10.3%)	0.0070	121 (40.2%)	117 (38.9%)	0.0272
Charlson Comorbidity Index, mean (SD)	1.37 (1.78)	1.10 (1.60)	0.1576	3.01 (1.99)	2.50 (2.01)	0.2553

CVD – cardiovascular disease; HF – heart failure; SCHIP – State Children's Health Insurance Program; SD – standard deviation.

Study Outcomes

- 1.0% (n=49) and 3.0% (n=9) of patients in the low- and high-risk cohorts, respectively, were discharged as deceased.
- 12.8% (n=639) and 22.1% (n=64) of patients in the low- and high-risk cohorts, respectively, had a 30-day all-cause readmission.
- Mean length of stay during index HF hospitalization was 5.40 and 5.30 days in the low- and high-risk cohorts, respectively.

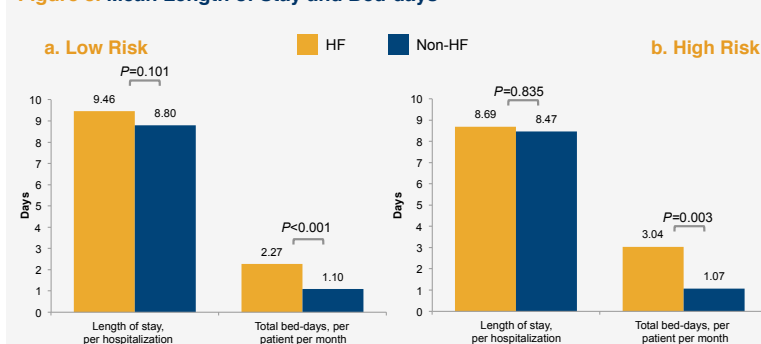
Figure 2. Number of All-cause Healthcare Visits, per Patient per Month by Setting of Care During the Post-index Period*



The average number of visits was higher among the HF cohort compared to the non-HF cohort for all visit types.

*All comparisons between cohorts are significant at P<0.001. †Other outpatient visits may include labs, diagnostics, home health, etc. HF – heart failure.

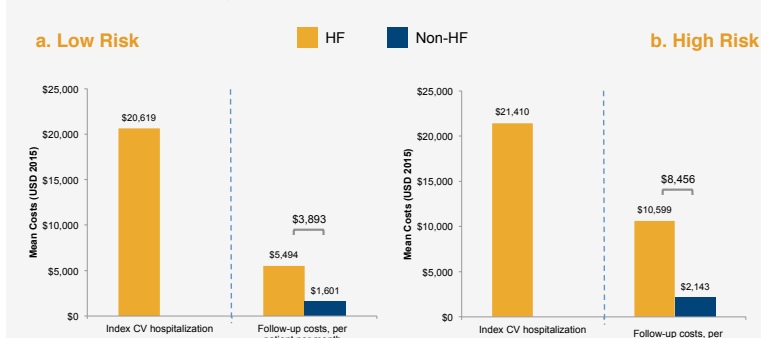
Figure 3. Mean Length of Stay and Bed-days



Patients in the HF cohort had a significantly higher number of bed-days during the post-index period compared to patients in the non-HF cohort among both high- and low-risk patients.

HF – heart failure.

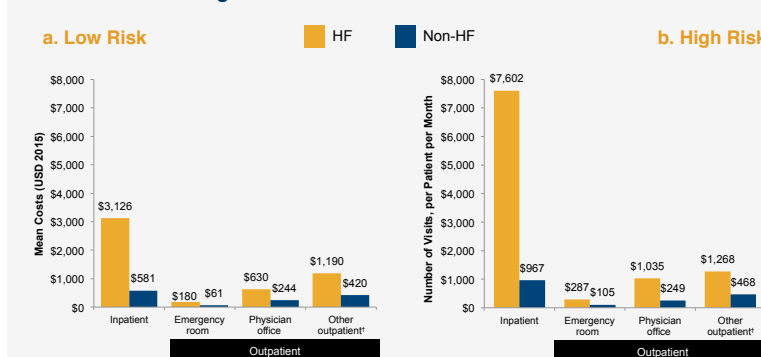
Figure 4. Healthcare Costs During Index Hospitalizations and per Patient per Month During the Post-index Period*



In addition to index hospitalization, post-index mean all-cause costs were 3.4 and 4.9 times higher in the HF cohort compared to the non-HF among low- and high-risk patients, respectively.

*All comparisons were statistically significant at P<0.001. CV – cardiovascular; HF – heart failure; T2DM – type 2 diabetes mellitus; USD – United States dollars.

Figure 5. All-cause Healthcare Costs, per Patient per Month by Settings of Care During the Post-index Period*



Inpatient costs accounted for the largest difference, and were 5.4 and 7.9 times higher in the HF cohort compared to the non-HF cohort among low- and high-risk patients, respectively.

*All comparisons were statistically significant at P<0.001, with the exception of ER costs in the high-risk cohort which was statistically significant at P=0.004. †Other outpatient visits may include labs, diagnostics, home health, etc. HF – heart failure; USD – United States dollars.

LIMITATIONS

- Results may be confounded by missing some important HF risk factors, such as smoking status and obesity.
- Complete cost data were not available for all patients; patients were censored in the event of death, disenrollment, or the end of available data.
- Results of the analysis are primarily generalizable to a commercially insured population.
- The standardized difference was >10% for majority of covariates in the high-risk cohort after matching, thus results may be confounded.
- Only 13.7% of patients in the high-risk cohort experiencing an HF hospitalization were matched; thus, the results may not be representative of all high-risk patients experiencing an HF hospitalization.

CONCLUSION

- An HF-related hospitalization among patients with T2DM costs more than \$20,000, ongoing cost post-discharge ranges from \$4,000 to \$8,000, per patient per month.

REFERENCES

- Chen YT, Vaccarino V, Williams CS, Butler J, Berkman LF, Krumholz HM. Risk factors for heart failure in the elderly: a prospective community-based study. *Am J Med.* 1999;106(6):605-612.
- Iribarren C, Karter AJ, Go AS, et al. Glycemic control and heart failure among adult patients with diabetes. *Circulation.* 2001;103(22):2668-2673.
- Kannel WB, Hjortland M, Castelli WP. Role of diabetes in congestive heart failure: the Framingham study. *Am J Cardiol.* 1974;34(1):29-34.
- Lloyd-Jones DM, Larson MG, Leip EP, Hroskoski MC, O'Connor PJ. Lifetime risk for developing congestive heart failure: the Framingham Heart Study. *Circulation.* 2002;106(24):3068-3072.
- Solberg LI, Engebretson KI, Sperl-Hillen JM, et al. Are claims data accurate enough to identify patients for performance measures or quality improvement? The case of diabetes, heart disease, and depression. *Am J Med Qual.* 2006;21(4):238-245.

FUNDING AND DISCLOSURES

Research and poster development was funded by Boehringer Ingelheim Pharmaceuticals, Inc.

Presented at:
AMCP 2016 Nexus,
October 3–6, 2016,
National Harbor, MD

