

Incremental Burden of Type 2 Diabetes Mellitus in Patients Experiencing Cardiovascular Hospitalizations

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BACKGROUND

- Cardiovascular disease (CVD) is associated with significant morbidity and mortality, with inpatient CV hospitalizations accounting for 43% of the total economic burden of CVD.^{1,2}
- Patients with type 2 diabetes mellitus (T2DM) have a 2-fold higher risk of having a cardiovascular (CV) hospitalization compared to those without T2DM.³
- It is unclear if T2DM continues to increase the risk of subsequent hospitalization and economic burden following discharge from a CV hospitalization.

STUDY OBJECTIVES

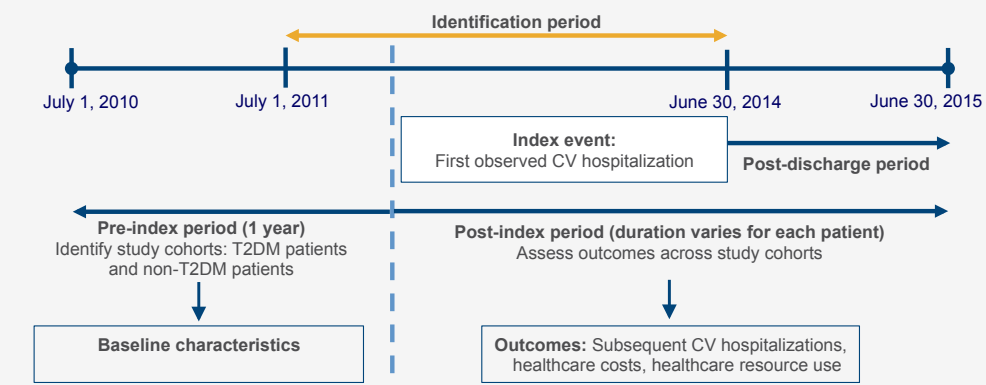
- To evaluate the incremental economic burden of T2DM in patients experiencing CV hospitalizations.

METHODS

Data Source and Study Design

- IMS LifeLink PharMetrics Plus™ Claims Database.
- Study Design: A retrospective cohort design was employed to assess the study objectives.

Figure 1. Retrospective Cohort Study Design



Study Criteria

- Inclusion:
 - Patients with CV hospitalizations, defined as having a primary discharge diagnosis for acute myocardial infarction (MI), unstable angina, stroke, heart failure (HF), cardiac arrest, arrhythmia, or other primary diagnosis with a revascularization procedure
 - ≥18 years of age
 - Continuous health plan enrollment during the pre-index period
- Exclusion:
 - Diagnosis of pregnancy, gestational diabetes, secondary diabetes, or type 1 diabetes mellitus any time during the pre- or post-index period
 - Missing demographic information (age, gender, geographic region)

Exposure Definition

- T2DM status: Identified during the pre-index period, and defined as having:
 - ≥1 hospitalization with a diagnosis of T2DM in any diagnosis field OR
 - ≥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 OR
 - ≥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 syndrome⁴

Study Outcomes

- All patients were included for analysis of outcomes from the index CV hospitalization, but only those surviving the index CV hospitalization were analyzed for outcomes during the post-discharge period.
- Risk of subsequent CV hospitalizations.
- Healthcare resource use:
 - All-cause and CVD-related length of stay per hospitalization, and bed-days per patient
 - Number of all-cause and CVD-related visits by setting of care (reported per patient per month)
- Healthcare costs in 2015 United States dollars (USD):
 - All-cause and CVD-related costs (reported per patient per month) were computed using paid amounts on claims

Statistical Analysis

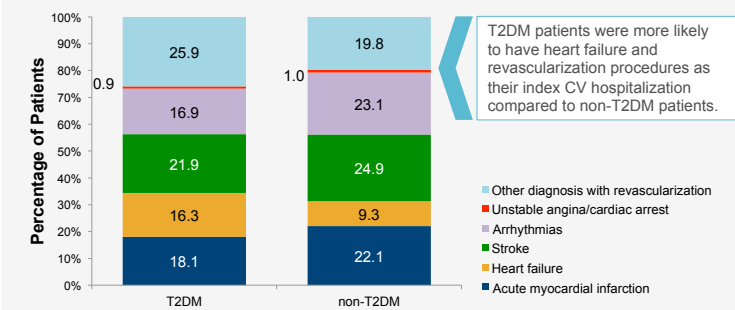
- Baseline characteristics: t-tests and chi-square tests.
- Risk of subsequent CV hospitalizations: Cox proportional hazards models.
- Costs and resource use: Generalized linear models with outcome-appropriate distributions.
- All outcomes were assessed for T2DM vs non-T2DM patients; and multivariate models for all outcomes controlled for the following covariates measured during the pre-index period: age; gender; region; payer and plan type; index year; revascularization procedure; HF, MI, or stroke events; type of CVD condition; Charlson comorbidity index; and other CVD risk factors.
- Statistical analyses were conducted using SAS® version 9.2 (SAS Institute; Cary, NC, USA).

RESULTS

Sample Characteristics

- 316,207 patients met the study criteria, 23% of whom had T2DM.
- T2DM cohort was older and had a higher comorbidity burden vs non-T2DM cohort (Table 1).
- T2DM patients had a higher number of CV disease conditions, with atherosclerosis/ischemic heart disease, arrhythmias, HF, MI, and stroke being most prevalent.
- 1.7% of the patients died during the index CV hospitalization (the same proportion in both cohorts); hence post-discharge outcomes were assessed among the remaining 310,926 patients.

Figure 2. Index CV Hospitalization



Study Outcomes

Figure 3. Adjusted Survival Curve of Risk of Subsequent CV Hospitalization

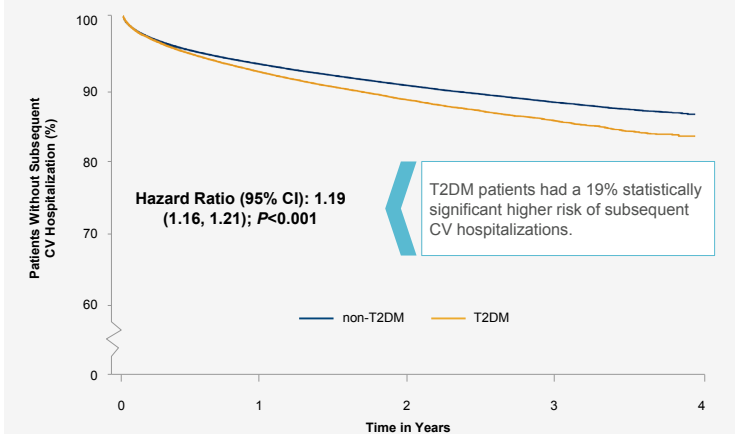


Figure 4. Adjusted Mean Length of Stay and Bed-days

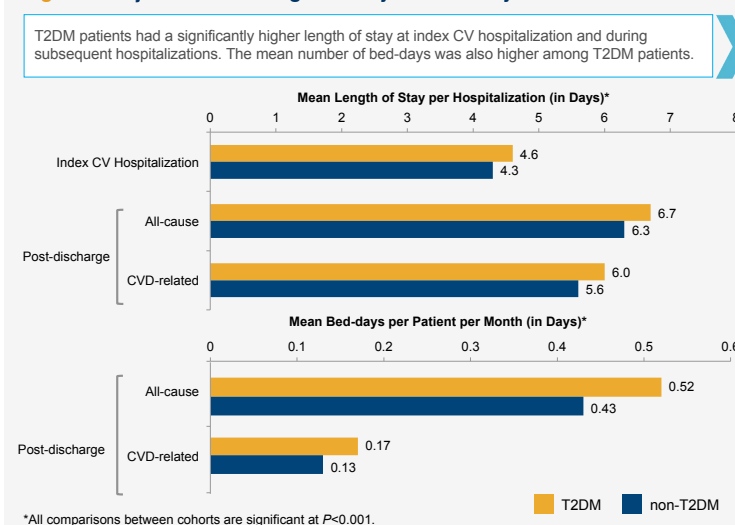


Table 1. Pre-index Characteristics of Patients Experiencing CV Hospitalizations

Characteristics During the Pre-index Period	T2DM Patients (N=71,237)	Non-T2DM Patients (N=244,970)	P-value
Age at index (in years), mean (SD)	65.2 (10.8)	61.9 (12.6)	<0.001
Male, n (%)	46,585 (65.4%)	156,936 (64.1%)	<0.001
Payer type, n (%)			
Commercial	63,222 (88.7%)	224,406 (91.6%)	<0.001
Medicaid/SCHIP	731 (1.0%)	1,832 (0.7%)	-
Medicare	6,621 (9.3%)	16,555 (6.8%)	-
Unknown/other [†]	663 (0.9%)	2,177 (0.9%)	-
Charlson Comorbidity Index,* mean (SD)	1.81 (2.02)	1.20 (1.73)	<0.001
Any CV events, n (%)	4,360 (6.1%)	8,735 (3.6%)	<0.001
Type of CVD, n (%)			
Angina (pectoris or unstable)	9,112 (12.8%)	20,788 (8.5%)	<0.001
Arrhythmias	22,695 (31.9%)	67,462 (27.5%)	<0.001
Arterial thrombosis and embolism	758 (1.1%)	1,705 (0.7%)	<0.001
Atherosclerosis and other ischemic heart disease	36,507 (51.2%)	81,276 (33.2%)	<0.001
Cardiac arrest	335 (0.5%)	932 (0.4%)	<0.001
Cardiomyopathy	6,915 (9.7%)	15,197 (6.2%)	<0.001
Conduction disorders	5,170 (7.3%)	12,378 (5.1%)	<0.001
Endocarditis, pericarditis, myocarditis	12,452 (17.5%)	34,858 (14.2%)	<0.001
Heart failure	15,938 (22.4%)	28,911 (11.8%)	<0.001
Myocardial infarction	11,586 (16.3%)	25,815 (10.5%)	<0.001
Other heart disease	8,770 (12.3%)	19,721 (8.1%)	<0.001
Peripheral vascular disease	7,800 (10.9%)	15,429 (6.3%)	<0.001
Rheumatic heart disease and fever	3,411 (4.8%)	10,014 (4.1%)	<0.001
Stroke	15,084 (21.2%)	40,074 (16.4%)	<0.001
Number of CVD conditions, mean (SD)	2.5 (2.3)	1.7 (2.0)	<0.001
Revascularization procedures, n (%)	13,342 (18.7%)	30,042 (12.3%)	<0.001
Presence of CVD risk factors, n (%)			
Dyslipidemia	57,244 (80.4%)	125,732 (51.3%)	<0.001
Hypertension	59,262 (83.2%)	136,313 (55.6%)	<0.001
Obesity	8,364 (11.7%)	11,931 (4.9%)	<0.001

*Excludes diagnoses of T2DM

Figure 5. Number of Healthcare Visits per Patient per Month

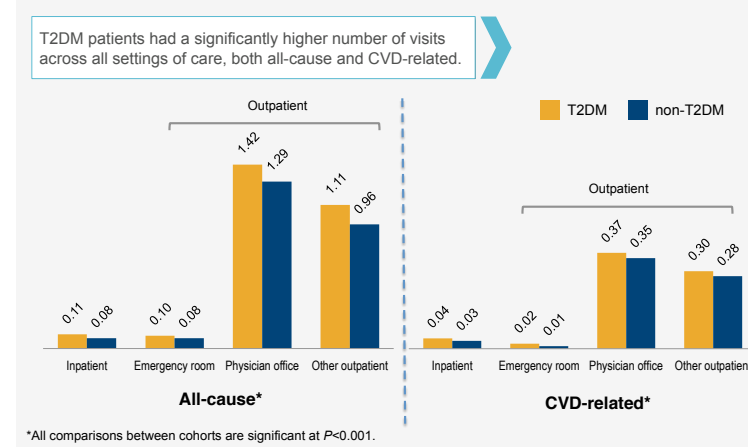
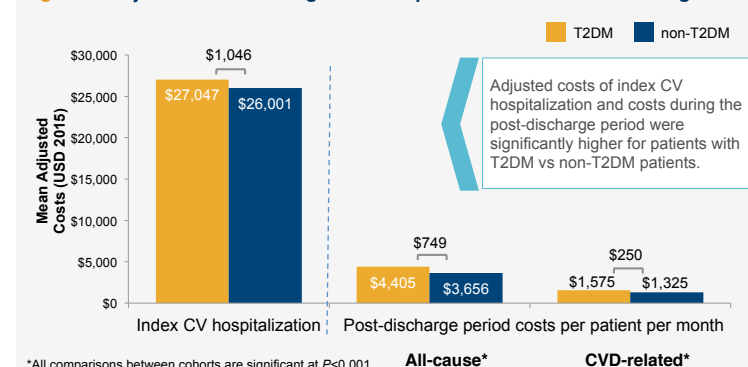


Figure 6. Adjusted Costs During Index Hospitalization and Post-discharge



LIMITATIONS

- Results may be confounded by missing some important CV risk factors, such as smoking status and obesity.
- Since this study had variable follow-up time and censored patients in the event of death, disenrollment, or the end of available data, complete cost data were not available for all patients for estimating total healthcare resource utilization and costs between cohorts.
- Results of the analysis are primarily generalizable to a commercially insured population, which make up approximately 90% of the sample.

CONCLUSION

Among patients experiencing CV events, comorbid T2DM was associated with an increased risk of subsequent CV hospitalizations, along with higher all-cause and CVD-related resource use and costs.

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