Geographic Variation in Statin Use for Complex Acute Myocardial Infarction Patients: Evidence of Effective Care?

John M. Brooks, PhD*
University of Iowa, College of Pharmacy and College of Public Health
115 S. Grand, S515 PHAR, Iowa City, IA 52242
Phone: (319) 335-8763
Fax: (319) 353-5646
john-brooks@uiowa.edu

Elizabeth Cook, M.S.
University of Iowa, College of Pharmacy
115 S. Grand, S553 PHAR
Iowa City, IA 52242
Phone: (319) 384-2815
Fax: (319) 353-5646
elizabeth-cook@uiowa.edu

Cole Chapman, B.S.
University of Iowa, College of Pharmacy
115 S. Grand, S553 PHAR, Iowa City, IA 52242
cole-chapman@uiowa.edu

Puttarin Kulchaitanaroaj , M.S.
University of Iowa, College of Pharmacy
115 S. Grand, S553 PHAR
Iowa City, IA 52242
puttarin@gmail.com

Elizabeth Chrischilles, M.S., PhD
University of Iowa College of Public Health
105 River St., S424 CPHB, Iowa City, IA 52242
Phone: (319) 384-1575
e-chrischilles@uiowa.edu

Stephen Welch, PhD
University of Iowa, College of Pharmacy
115 S. Grand, S553 PHAR, Iowa City, IA 52242
stephen-welch@uiowa.edu

Jennifer Robinson, M.D., M.P.H.
University of Iowa College of Public Health,
105 River St., S455 CPHB,Iowa City, IA 52242
Phone: (319) 384-1563
jennifer-robinson@uiowa.edu
*Corresponding Author

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Brief Title: Variation in Statin Use by Patient Complexity

Abstract

Background: Despite strong evidence to designate statin use for secondary prevention of cardiovascular disease as "effective care" observational studies show that many patients with cardiovascular disease do not receive statins. This suggests that statin prescribing decisions for complex cardiovascular disease patients are preference sensitive.

Objectives: To evaluate local area variation in statin prescribing for subsets of complex patients after acute myocardial infarction to assess whether current statin prescribing patterns fit profiles of either "effective care" or "preference-sensitive care"

Research Design/Subjects: Retrospective cohort study of 124,618 Medicare patients with fee-for service Parts A, B, and D benefits who were hospitalized with AMI in 2008 or 2009 with no evidence of AMI in the past 12 months.

Measures: Patient complexity was defined by the presence of diabetes, heart failure, and chronic kidney disease in the year before AMI admission. Local area practice styles for "no statin", "lower-intensity statins", and "high-intensity statins" were measured using the Driving Area for Clinical Care method. Statin prescribing rates for complex patient subsets were contrasted across patients grouped by local areas practice styles.

Results: Lower statin treatment rates are observed for patients with complex conditions, especially among those with heart failure. However, substantial local area variation in statin prescribing is observed across all complex patient groups.

Conclusion: Despite guidelines promoting the use of statins for secondary prevention for CVD patients, substantial local area variation suggests that patient and provider beliefs and preferences weigh heavily in statin prescribing decisions.

Introduction

Given the strength of evidence from numerous randomized controlled trials (RCTs), statin use for the secondary prevention of future cardiovascular events for patients with cardiovascular disease (CVD) has been designated as "effective care".[1,2] Effective care is defined by the Dartmouth Atlas as "services of proven effectiveness that involve no significant tradeoffs – all patients with specific medical needs should receive them." [3,4] Effective care is characterized by strong evidence that provides little clinical discretion so that non-medical factors should have little influence on treatment choice.[4,5] Clinical guidelines also appear to support the effective care categorization of statin use for patients with CVD.[6,7] In fact, it is thought that most patients will need a high-intensity statin to achieve their cholesterol goals.[8-15]

However, it is not clear whether the designation of statins as effective care **for all CVD patients reflects the practice beliefs of providers**. CVD patients discharged from hospitals that *promoted guideline care* had statin discharge prescribing rates ranging from 77 to 90%.[16-18] Only 54% of a sample of Medicare beneficiaries filled a statin prescription within the 30 days after an acute myocardial infarction (AMI) discharge,[19] and only 52% of patients 65 and older in a managed care plan filled a statin prescription within 90 days after an AMI discharge.[20] In addition, substantial geographic variation in statin spending per Medicare beneficiary was found.[21] Lack of awareness of the clinical evidence does not appear to be a source of this apparent statin underuse as 96% of physicians identify **a low density lipoprotein cholesterol (LDL-C)** of less than 100 mg/dl as the treatment goal for high-risk patients.[22]

Dartmouth provides a contrasting "preference sensitive" category of medical care in which treatment decisions involve tradeoffs across outcomes.[4,5] It may be that the benefits and adverse-effect risks of statins are heterogeneous across patients and that providers believe that the risks of adverse effects from statins may outweigh statin benefits for many CVD patients. RCTs provide some evidence of heterogeneous statin effects across patients. Absolute CVD benefits from statin therapy vary with patient age and **are thought to vary with the** presence of diabetes (more benefit), heart failure (little or no benefit), and chronic kidney disease (variable benefit).[23-28] While the statin adverse-effect risks found in RCTs are considered small relative to statin benefits,[29,30] it has been suggested that favorable patient selection in RCTs resulted in adverse-effect risk estimates that are lower than what occurs in practice.[31-34] Statin adverse-effects have been shown to vary with statin intensity, patient age, gender, weight, health behaviors, comorbidities, and concomitant drug use.[32,35-41] Given these potential trade-offs, in its recommended approach for patient-centered care, the American Geriatrics Society Expert Panel on the Care of Older Adults with Multimorbidity used statins as an example of a "preference sensitive decision" that may "confer long-term benefits but cause short-term harm".[42]

Given that complex CVD patients are often underrepresented in RCTs[43,44] we theorized that greater CVD patient complexity implies greater evidence uncertainty and the more that statin use is considered preference-sensitive by providers. Our objective was to assess whether local area statin prescribing patterns for complex patients discharged with acute myocardial infarction (AMI) fit profiles of either "effective care" or "preference-sensitive care". **Complex AMI patients were defined here using**

combinations of conditions suggested to affect statin effectiveness: diabetes, heart failure (HF), and chronic kidney disease (CKD).[23-28] We hypothesized that with evidence less certain for complex AMI patients, statin prescribing rates after AMI will be lower for complex patient and that geographic variation in statin use will increase with patient complexity. We also theorized that, with higher adverse-effect risks, prescribing rates for high-intensity statins will fall with patient complexity. This study was approved by the University of Iowa Institutional Review Board.

Methods

Data and Sample

All Medicare claims files, enrollment information, and Part D prescription drug events were obtained from the Chronic Condition Data Warehouse (CCW www.ccwdata.org) for patients hospitalized with an AMI in 2008 and 2009 using the CCW definition of AMI (an inpatient stay with the primary diagnosis code 410.x1 at any time during the year). The acute hospital admission date for each AMI served as the *index date* for the AMI. The length of stay for each AMI was based on all Medicare institutional claims (acute, long term care hospital, inpatient rehabilitation facility, critical-access hospital, and short-term nursing facility) with overlapping admission and discharge dates following the initial acute hospital AMI admission. The institutional stay discharge date was the day the patient was discharged home. We excluded AMIs if the patient (1) did not survive the AMI institutional stay; (2) had an AMI within 12 months prior to the index date; (3) was less than 66 years old at the index date to ensure at least one year of Medicare eligibility prior to the index date; (4) did not have continuous

Medicare Parts A and B enrollment during the 12 months prior to the index date; (5) was not continuously enrolled in Medicare Part D during the 6 months to the index date; and (6) **did not have continuous Medicare Parts A, B and D enrollment during period from the discharge date to the minimum of the patient death month or 12 months after discharge.** To ensure a consistent statin measurement period after discharge we further excluded patients who used hospice or skilled nursing care; were readmitted to inpatient care; or died during the 30 days after the institutional stay discharge date.[45] Finally, because we use driving times between ZIP codes to define local areas driving times have inconsistent meaning for geographically non-contiguous areas (e.g. islands not connected by bridges), we restricted our sample to patients living in the continental U.S. at AMI admission. The final cohort was 124,813 patients.

Patient Complexity

We define AMI patient complexity using combinations of diabetes, chronic kidney disease (CKD), and heart failure (HF) diagnosed before the index AMI. **Earlier studies suggested these conditions are associated with statin effectiveness.[23-28] We modified the validated Chronic Condition Data Warehouse (CCW) definitions of these conditions to accommodate our 1-year look back period rather than the 2-year period specified by CCW.** The diagnosis codes used to identify each condition can be found in the online, supplemental digital content Appendix. To identify CKD we searched for at least one Medicare inpatient, skilled nursing facility or home health claim or two hospital outpatient or physician claims with the relevant diagnosis codes in any position on the claims. To identify HF and diabetes, we searched for at least one inpatient, hospital outpatient or physician claim with relevant diagnosis codes in any

position on the claim. Patients were then stratified into eight complex combinations given these diagnoses before AMI index - (1) no prior HF, CKD or diabetes; (2) HF only; (3) CKD only; (4) diabetes only; (5) HF and CKD only; (6) HF and diabetes only; (7) CKD and diabetes only; (8) All three prior conditions.

Measures of Statin Intensity Prescribing Intent

Our measurement goal was to assess prescribing intent by statin intensity for each patient at AMI discharge. High-intensity statins were defined as those that can lower LDL-C by 50% or more: *atorvastatin 40,80mg; and rosuvastatin 20,40mg.* Lower-intensity statins were defined as those that lower LDL-C less than 50%: *atorvastatin 10, 20mg; fluvastatin 20,40,80mg; lovastatin 10,20,40,80mg; rosuvastatin 10; pravastatin 10,20,40,80mg; rosuvastatin 5mg; simvastatin 5, 10,20,40,80mg.*[10] To measure prescribing intent we used (1) Part D claims during 30 days after the AMI discharge date; and (2) estimates of statins available to the patient at home at AMI discharge based on previous prescription dates and days supplied on Part D claims. **Two binary treatment variables (lower and high) were specified for each patient. If a patient's first statin prescription after discharge was a high-intensity statin or if a patient filled two or more lower-intensity statin prescriptions *of the same drug* within 2 days of the first statin prescription with doses summing to high (e.g. two atorvastatin 20mg prescriptions), the patient was assigned lower = 0 and high = 1.** All other statin prescription combinations during the 30 days after AMI discharge resulted in lower = 1 and high = 0. It was also possible that a patient was prescribed a statin on AMI discharge but had sufficient statins at home to cover the first 30 days after

AMI discharge. To account for this, if a patient had no statin prescriptions in the 30 days after discharge and had at least 30-days of a high-intensity statin at home, the patient was assigned lower = 0 and high = 1. Likewise, if a patient had no statin prescriptions in the 30 days after discharge and had at least 30 days of a lower-intensity statin at home at the patient was assigned lower = 1 and high = 0. All other patients were assigned as "no statin" or lower = 0 and high = 0.

Local Area Practice Style Measures of Statin Intensity

We measured local area statin practice style as the average *intent* of physicians in the local area around each patient resident ZIP code to prescribe statins by intensity at AMI discharge. Because discharge prescribing intent is less clear for patients with statins available at home on discharge, we used only the patients with no statins at home on their AMI discharge date (N=79,285) in our measures. Practice styles were measured at the patient ZIP code-level using the driving area for clinical care (DACC) method.[46] The DACC method creates "local areas" around each patient residence ZIP code by consecutively adding patients from the next closest ZIP codes based on driving times between zip codes until a threshold number of patients have been reached.[46] Local area practice style measures based on the DACC method have explained a larger portion of treatment variation than other local area definitions and effectively balanced measured covariates.[46-48] We used a local area size threshold of 100 patients. For the patients in the local areas around each ZIP code using the DACC method, *area treatment ratios* (ATR) for "no statin", "lower-intensity statins" and "high-intensity statins" were estimated. Each ATR was calculated as the ratio of the number of patients in the local area around a ZIP code that received the respective statin intensity after AMI over

the sum across these patients of their predicted probabilities of receiving that statin intensity after AMI. Probabilities were assigned to each patient of receiving no statins, a lower-intensity statin, and a high-intensity statin based their baseline covariates using a multinomial model of statin intensity choice. **The multinomial model specified measures for patient demographics; baseline comobidities for both the year prior to the AMI admission and during the index AMI stay including conditions described as statin side effects (myopathy, rhabdomyolysis, renal events, and hepatic events)**; medications used during the 180 days prior to the AMI admission; AMI diagnosis-type on admission; procedures during the AMI stay; complications during the AMI stay; the number days of the AMI institutional length of stay spent in intensive care and critical care; other medications filled immediately post discharge (beta blockers, renin-angiotensin system antagonists); Part D variables including premium levels, benefit phase at AMI index date and beneficiary accumulated total and out-of-pocket drug costs prior to AMI index; whether patients were Medicaid dual-eligible in their AMI index month; patient low-income status, and socioeconomic characteristics for each patient residence zip code (per capita income, poverty rate, education level, English speaking percentage, rural/urban residence, life expectancy). Full definitions of these variables are included in the online, supplemental digital content Appendix. A ZIP code with an ATR greater than 1 for a specific statin intensity had a local area practice style in which that statin intensity was used at a rate higher than average given the baseline characteristics of the patients in the local area. A ZIP code with an ATR less than 1 had a local area practice style in which the respective statin intensity was used less than average.

Analysis

Patients in our full sample (N=124,813) were assigned the ATR values for no-statin, lower-intensity statins, and high-intensity statins based on their residence ZIP code. We then stratified our sample by patient complexity based on combinations of prior CKD, HF and diabetes. For each complex patient combination we estimated treatment rates by statin intensity. Patients were grouped based on the quintiles across the full sample of each statin-intensity specific ATR. We then estimated treatment rates by statin intensity for each complex patient combination across ATR quintiles and report the range in variation in statin treatment rates across quintiles by statin intensity.

Results

Table 1 contains the characteristics of our sample by available statin-intensity after AMI discharge. Statins were not available to 38% of patients in our sample, a lower-intensity statin was available to 50%, and a high-intensity statin was available to 12%. Patients with a statin available after discharge tended to be younger; had fewer comobidities (lower Charlson score); were more likely free of the 3 complex conditions (heart failure, CKD, diabetes); had fewer conditions before AMI or during their AMI stay that are considered statin adverse-effects; appeared to have more severe AMIs as indicated by a higher percentage of patients having an anterior wall AMI, a lower percentage having a non-ST elevation AMI, and higher percentage having cardiac

catheterization during their AMI stay; and were less likely to live in a low income ZIP Code. In addition, patients with a history of statin use were more likely to have statins available after discharge.

Table 2 shows the distribution of patient characteristics after grouping patients by the high-intensity statin area treatment ratio (ATR) associated with their residence ZIP code. **The percentage of patients that had a high-intensity statin available after AMI discharge varied from 6% to 20% across the quintiles. The ZIP code with the highest high-intensity ATR had a high-intensity statin treatment rate of 33% whereas the local areas around 73 ZIP codes had high-intensity statin treatment rates of zero. Trends in the measured covariates remained across the patients grouped by quintiles of the high-intensity statin ATR, but these differences are small relative to the covariate differences when patients were grouped by available statin intensity in Table 1.[49] Similar findings of smaller covariate variation were observed when patients were grouped by the "no statin" and low-intensity statin ATRs (not shown).** "No statin" treatment rates ranged from 21% to 69% across the ZIP codes with the minimum and maximum "no statin" ATRs, respectively, and low-intensity statin treatment rates ranged from 15% to 61% across ZIP codes with the minimum and maximum low-intensity statin ATRs, respectively. Figures 1 and 2 contain maps of the northeastern portion of the United States showing the quintile groups of the high-intensity ATR and no-statin ATRs, respectively. These maps illustrate substantial with-region variation in local area statin practice styles. Average "no statin" treatment rates in Figure 2 were 32% in the white areas (1st quintile) and 44% in the dark green areas (5th quintile).

Table 3 shows the percentages of patients with statins available after AMI discharge for the full sample, the sample stratified by whether patients had each prior complex condition (CKD, heart failure, and diabetes); and the sample stratified into complex combinations. Table 3 also shows the range in treatment rates between the first and fifth quintiles by statin intensity for each respective ATR-based local area practice measure. While 61.9% of our sample had a statin available after AMI discharge, rates were lower for patients with prior complex conditions. Nearly 70% of patients without heart failure, diabetes, or CKD before AMI had a statin available after discharge, whereas, only 56.6% of patients with heart failure, 57.2% of patients with CKD, 61.5% of patients with diabetes had a statin available after discharge. Comparing rates across complex combinations shows lower statin rates occur mainly for patients with prior heart failure or CKD. Specifically, patients with both prior heart failure and CKD had the lowest percentage of statin availability after AMI discharge (52.6%), followed by patients with HF only (56.5%), and patients with all 3 prior conditions (56.5%). Patients with only diabetes before AMI had statin availability rates similar to patients with no prior conditions (68.5%). Patients with heart failure and CKD also had the lowest high-intensity statin treatment rate (9.3%) and patients with no prior conditions and patients with only prior diabetes had the highest high-intensity statin treatment rates (14.1% and 14.0%, respectively).

Substantial geographic variation in statin availability existed across all complex combinations after AMI discharge, but the extent of geographic variation was not consistent across the complex combinations. For both the low-intensity statin and high-intensity statin ATRs, the largest rate difference across quintiles was for patients with no

prior heart failure, CKD, or diabetes (18 percentage points). Geographic variation in statin use was lowest in more complex patient groups. For example, patients with all 3 prior complex conditions had the lowest rate difference in lower-intensity statins across local area quintiles (11 percentage points) and the second lowest rate difference in high-intensity statins across quintiles (11 percentage points). Patients with prior HF and CKD only had lowest had the lowest rate difference in high-intensity statins across quintiles (10 percentage points).

Discussion

Our objective was to assess whether local area statin prescribing patterns for complex patients discharged with acute myocardial infarction (AMI) fit profiles of either "effective care" or "preference-sensitive care".[4,5] Close to 62% of the Medicare patients in our sample had a statin available during the 30-days after discharge for AMI. This percentage ranged from 69.8% for patients without heart failure, diabetes and CKD, to little more than half (52.6%) for patients with previous heart failure and CKD. Given that most providers are aware of the cholesterol reduction goals for high-risk CVD patients,[22] these rates suggest that both perceived benefits and risks associated with statins are being incorporated into prescribing decisions. Our finding of lower statin rates for more complex patients supports this idea as statin adverse-effect risks have been shown to increase with patient complexity.[32,35-41] **It is noted that prior diabetes had little effect on statin rates is consistent with studies suggesting that statin benefits are enhanced for diabetic patients.[23-25]** In addition, substantial geographic variation in

statin availability after AMI was found across the entire sample and within each complex combination. These results suggest that differences exist across local areas in either the beliefs on relationships between statins and outcomes or in the preferences that providers and patients have over the outcomes associated with statin use. Interestingly, the extent of geographic variation in statin use was lower for more complex patients. There appears to be more agreement across local areas in the lower statin treatment rates for more complex patients than the higher statin treatment rates for the less complex patients.

The ability to make inferences on variation in provider beliefs in this study is limited by the inability of our measures to differentiate between physician and patient choices. The measures used here reflect both physician prescribing behavior and the willingness of patients to fill statin the prescriptions they received. Our statin use measures understate the prescribing intent of physicians to the extent that prescriptions are unfilled by the patient. **In addition, it also is possible that the geographic variation in statin use we found could be partially attributable to geographic variation in unmeasured conditions like patient frailty.**

Statin rates that diminish with patient complexity and the substantial local area variation in statin rates suggest that providers consider statins to be more “preference–sensitive care” than “effective care” for secondary prevention of cardiovascular disease. Local area variation in statin use exists across all groups of complex AMI patients. However, our results do not say whether current statin utilization rates represent a correct balancing of statin benefits and risks across complex AMI patients. Further research is needed to assess whether many complex AMI patients in areas with low

statin utilization rates are missing benefit opportunities or, in contrast, whether many complex AMI patients in areas with high statin utilization rates and suffering adverse side effects with little benefit gain. In context of statin use for secondary prevention of cardiovascular disease for complex patients, this question is analogous to the question stated many years ago by John Wennberg, “Which rate is right?”.[50]

Table 1: Characteristics of Medicare AMI Patients 2008-2009 by Intensity of Initially-Prescribed Statin[a]					
		Intensity of Initially-Prescribed Statin Availability After AMI Discharge			
	Total Population	None	Lower	High	P-value[h]
N	124,813	47,566	62,316	14,931	
Treatment					<0.0001*
No Statin %	38	100	0	0	
Lower-Intensity Statin[a] %	50	0	100	0	
High-Intensity Statin[a] %	12	0	0	100	
Age					<0.0001*
66-75 %	41	33	44	52	
76-85 %	39	39	39	37	
86+ %	21	28	17	12	
Gender					<0.0001*
Male %	43	40	45	49	
Female %	57	60	55	51	
Charlson Score[b]					<0.0001*
0 %	33	28	36	38	
1+ %	67	72	64	62	
Complex Patient Combinations[c]					<0.0001*
No Prior Heart Failure, CKD or Diabetes %	25	20	28	30	
Heart Failure only %	16	19	15	14	
CKD only %	5	5	5	5	

Diabetes only %	12	10	13	14	
Heart Failure and CKD only %	10	12	9	8	
Heart Failure and Diabetes only %	12	13	12	11	
CKD and Diabetes only %	5	5	5	5	
Heart Failure, CKD and Diabetes %	15	17	14	13	
Arterial Wall AMI[d] %	6	4	7	9	<0.0001*
NSTEMI AMI[e] %	76	80	74	70	<0.0001*
Catheterization During Index Stay %	59	44	67	75	<0.0001*
Statin Rx in 180 Days Prior to Index AMI %	47	26	60	59	<0.0001*
Conditions Related to Statin Side-Effects					
Pre-Index AMI[f] %	23	26	21	19	<0.0001*
During Index AM[f]I %	20	23	18	17	<0.0001*
Low Income Zip Code[g] %	50	51	49	46	<0.0001*

a. Based on highest statin intensity in 30 days post-index stay discharge or intensity of available 30-day supply available prior to discharge.
b. Klabunde CN et al. Development of a comorbidity index using physician claims data. Journal of Clinical Epidemiology, 200 Dec; 53(12) 1258-67.
c. HF: Heart Failure: CKD: Chronic Kidney Disease. See Appendix for CKD, HF, and diabetes ICD-9 codes
d. ICD-9 codes 410.0 410.1
e. ICD-9 410.7x
f acute renal failure/acute tubular necrosis ICD-9 584.xx; acute glomerulonephritis ICD-9 580.xx. Myopathy: ICD-9-CM 728.89, 729.1, 359.4,359.8, 359.9, 710.4, 728.9, 729.8X, E942.2; CPT codes 82550, 82552, 82554, 80012, 80016, 80018, or 80019. Acute/sub-acute necrosis of liver ICD-9 570.xx; hepatitis ICD-9 573.3x; other disorders of liver ICD-9 573.8x, 573.9x.
g. Percentage of low income residents was above median in 2000 for beneficiary zip code.
h. Pearson Chi-Square statistic calculated by estimating the expected number of observations in each cell of an R-by-C table, and comparing these values with the observed number of observations in each cell of the table. The p-value is estimated using the Chi-Square distribution with (R-1)*(C-1) degrees of freedom.
* $p < .05$

Table 2: Characteristics of Medicare AMI Patients 2008-2009 by Local Area High-Intensity Prescribing Style							
		Quintile of High-Intensity Statin Area Treatment Ratio **(Higher Area Treatment Ratio (ATR)→)**					
	Total Population	1st	2nd	3rd	4th	5th	P-value[h]
N	124,813	24,693	24,691	24,693	24,692	24,694	
High-Intensity Statin Average Area Treatment Ratio	1	0.36	0.67	0.93	1.24	1.84	<0.0001*
Treatment							
No Statin %	38	40	39	39	38	36	<0.0001*
Lower-Intensity Statin[a] %	50	54	52	50	48	45	<0.0001*
High-Intensity Statin[a] %	12	6	9	11	14	20	<0.0001*
Age							
66-75 %	41	41	42	41	41	39	<0.0001*
76-85 %	39	39	38	39	38	40	0.0609
86+ %	21	20	20	20	21	22	<0.0001*
Sex							
Male %	43	44	44	43	43	42	<0.0001*
Female %	57	56	56	57	57	58	<0.0001*
Charlson Score[b]							
0 %	33	36	34	33	33	31	<0.0001*
1+ %	67	64	66	67	67	69	
Complex Patient Combinations[c]							<0.0001*
No Prior Heart Failure, CKD or Diabetes %	25	27	25	25	24	23	
Heart Failure only %	16	17	16	16	16	16	0.0775
CKD only %	5	5	5	5	5	5	0.3946
Diabetes only %	12	12	12	11	12	11	0.5881
Heart Failure and CKD only %	10	9	10	10	10	11	0.0015*
Heart Failure and Diabetes only %	12	11	12	12	12	13	<0.0001*
CKD and Diabetes only %	5	5	5	5	5	5	0.3813

Heart Failure, CKD and Diabetes %	15	14	15	15	16	16	<0.0001*
Arterial Wall AMI[d] %	6	6	6	6	6	6	<0.0269*
NSTEMI AMI[e] %	76	74	75	76	76	78	<0.0001*
Catheterization During Index Stay %	59	62	60	60	58	56	<0.0001*
Statin Rx in 180 Days Prior to Index AMI %	47	45	47	47	47	50	<0.0001*
Conditions Related to Statin Side-Effects							
Pre-Index AMI[f] %	23	22	23	23	23	24	<0.0001*
During Index AM[f]I %	20	18	20	20	20	21	<0.0001*
Low Income Zip Code[g] %	50	52	50	51	50	46	<0.0001*

a. Based on highest statin intensity in 30 days post-index stay discharge or intensity of available 30-day supply available prior to discharge.
b. Klabunde CN et al. Development of a comorbidity index using physician claims data. Journal of Clinical Epidemiology, 200 Dec; 53(12) 1258-67.
c. HF: Heart Failure: CKD: Chronic Kidney Disease. See Appendix for CKD, HF, and diabetes ICD-9 codes
d. ICD-9 codes 410.0 410.1
e. ICD-9 410.7x
f acute renal failure/acute tubular necrosis ICD-9 584.xx; acute glomerulonephritis ICD-9 580.xx. Myopathy: ICD-9-CM 728.89, 729.1, 359.4,359.8, 359.9, 710.4, 728.9, 729.8X, E942.2; CPT codes 82550, 82552, 82554, 80012, 80016, 80018, or 80019. Acute/sub-acute necrosis of liver ICD-9 570.xx; hepatitis ICD-9 573.3x; other disorders of liver ICD-9 573.8x, 573.9x.
g. Percentage of low income residents was above median in 2000 for beneficiary zip code.
h. Cochran-Armitage test of trend in characteristic value across patients grouped into quintiles based on local area high-intensity practice style measure. For example, the p value for Age 76-85 tests whether a linear trend in the percentage of patients in this age group exists across quintiles of the high-intensity ATR-based patient groups
* $p < .05$

Table 3: Geographic Variation in Statin Intensity Treatment Rates for Medicare AMI Patients post-Discharge by Patient Complexity

	N	% No Statin (1^{st}–5^{th} quintile range)[a]	% Lower-Intensity Statin (1^{st} – 5^{th} quintile range)[b]	% High-Intensity Statin (1^{st} – 5^{th} quintile range)[c]
Full Sample	124,813	38.1 (32 - 44)	49.9 (43 - 57)	12.0 (6 - 20)
Patients with Prior Condition				
Prior HF	66,644	43.4 (36-49)	46.1 (40-53)	10.5 (6-17)
Prior Diabetes	54,125	38.6 (33-44)	49.5 (43-55)	12.0 (7-19)
Prior CKD	43,690	42.8 (36-49)	46.5 (41-53)	10.7 (6-17)
Complex Combinations				
No HF, CKD or D	31,170	30.2 (24 - 37)	55.7 (47 - 65)	14.1 (6 - 24)
HF only	20,451	43.4 (35 - 51)	46.2 (39 - 55)	10.3 (5 - 18)
CKD only	6,597	37.8 (33 - 44)	50.4 (43 - 57)	11.9 (6 - 21)
D only	14,364	31.4 (26 - 38)	54.5 (46 - 62)	14.0 (8 - 23)
HF and CKD only	12,470	47.4 (39 - 54)	43.3 (38 - 51)	9.3 (5 - 15)
HF and D only	15,138	40.1 (34 - 45)	48.7 (43 - 55)	11.3 (7 - 18)
CKD and D only	6,038	36.4 (32 - 43)	51.2 (45 - 58)	12.4 (8 - 20)
HF, CKD, and D	18,585	43.5 (38 - 49)	45.7 (40 - 51)	10.8 (6 - 17)

a. No statin area treatment rate (ATR) quintiles.
b. Low-intensity statin area treatment rate (ATR) quintiles.
c. High-intensity statin area treatment rate (ATR) quintiles.
HF: heart failure; CKD: chronic kidney disease; D: diabetes

Figure 1: Northeastern United States High-Intensity Statin Area Treatment Ratios by ZIP Code.

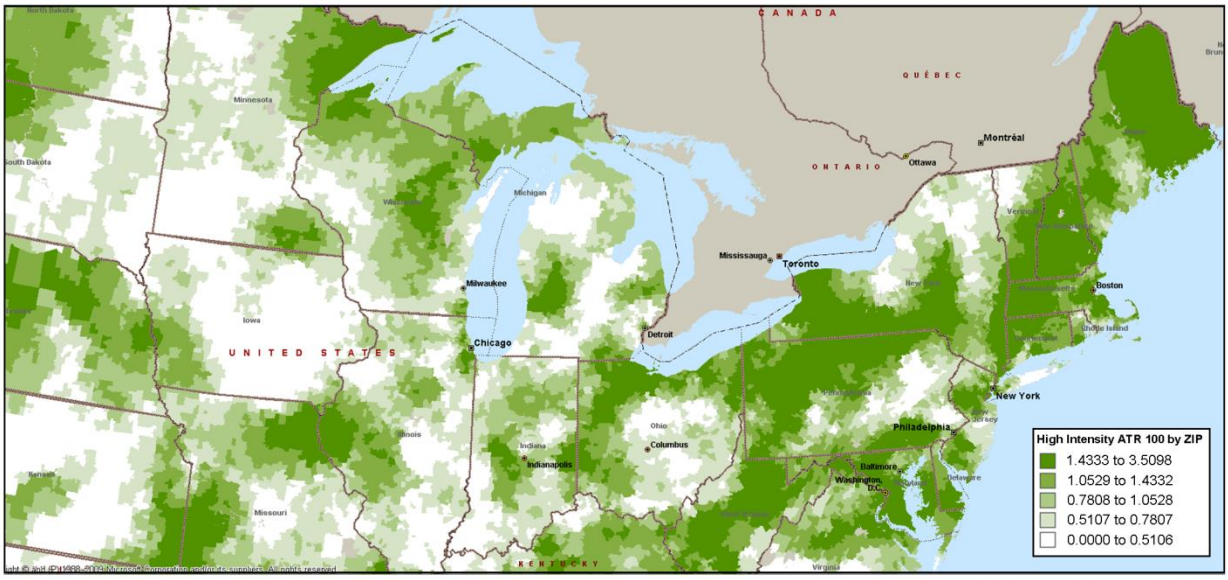
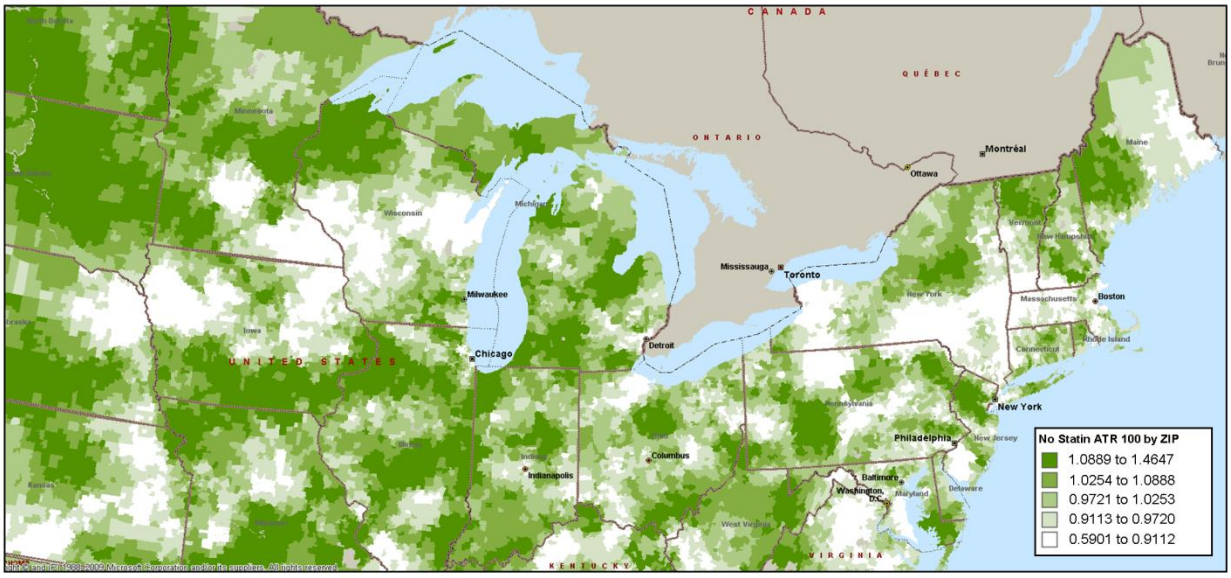


Figure 2: Northeastern United States "No Statin" Area Treatment Ratios by ZIP Code.



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