

Version 2018-05-09

INSIDE Dyslipidemia Management

INspiring System Improvement with Data-Driven Excellence



THE UNIVERSITY OF
CHICAGO

 American Diabetes Association.



INSIDE Dyslipidemia Management

Program Goals

Benchmark current lipid management and goal attainment for high-risk CV patients

Identify and prioritize specific clinical process/management challenges that affect goal attainment

Systematically make clinical changes to improve goal attainment processes and outcomes

Measure the results and share best practices via educational workshops, online CME and publications

Clinical Sites & QI Team Leaders

University of Chicago Lipid Clinic

- Michael H. Davidson, MD (PI)
- Karen Wickens, RN

University of Chicago Section of Cardiology

- Amita Singh, MD
- Luke Laffin, MD
- Lane Benes, MD

Chief Medical Information Officer

- David Liebovitz, MD

NorthShore Department of Medicine

- Divisions of Cardiology and Endocrinology
- David Davidson, MD (PI)

ADA Quality Improvement Services

- Roy Furman, MD, PhD
- Elise Furman, RN, MEd, MBA

INSIDE Program Features



Diabetes
INSIDE™



Continuous Improvement Cycles



Population
Health Data
Science

Local Disease
Registries

Visualized QI
Metrics



Care System
Redesign

QI Training,
Coaching &
Facilitation

Shared
Learning



Healthcare
Provider
Support

Professional
Development

Standards of
Care



Patient Self-
Management
Support

Patient
Education

Community
Integrated
Health



Recognition &
Dissemination

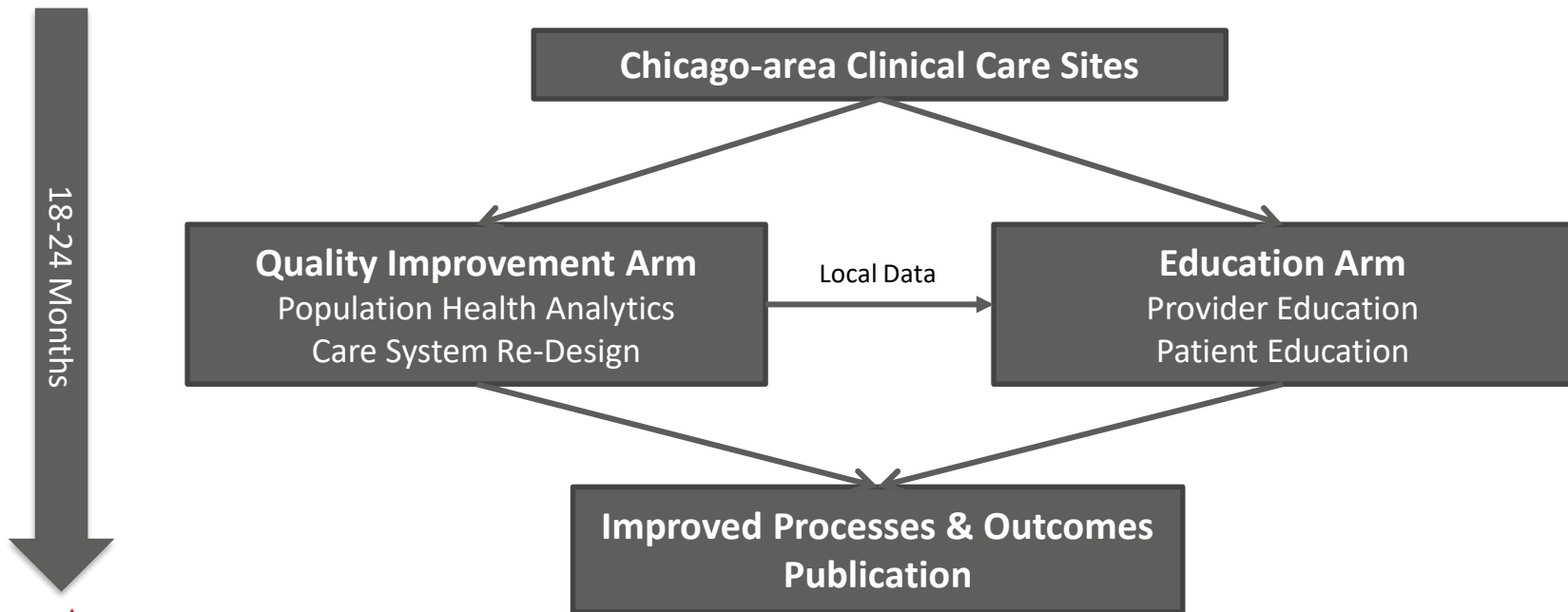
Diabetes
Excellence
Designation

Publication in
ADA Journals &
Sci Sessions

Advocacy

Program Design at a Glance

INSIDE Dyslipidemia Management is based on ADA's successful Diabetes INSIDE program that has improved diabetes care processes at health systems across the US since 2012





Quality Improvement Arm at University of Chicago



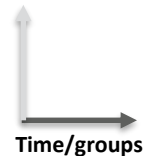
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Goals of Quality Improvement in Population Health

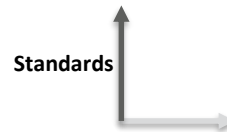
Reducing clinical variation

- In processes over time
- In outcomes between rational subgroups



Achieving clinical guideline standards

- For all patients
- Safely and appropriately



Baseline Data – Demographics

Total N=20,871; Mean Age=64	N	%
Gender		
Male	10,658	51.1%
Female	10,213	48.9%
Race		
African American	9,978	46.9%
White	9,750	46.7%
Asian/Mideast Indian	643	3.1%
Other	419	2.0%
American Indian or Alaskan Native	81	0.4%
CVD/CV Risk Diagnoses		
Hypertension	10,781	49.0%
Dyslipidemia	7,632	34.7%
Coronary Artery Disease	6,681	30.4%
Diabetes/prediabetes	1,658	7.5%
Peripheral Vascular Disease	955	4.3%

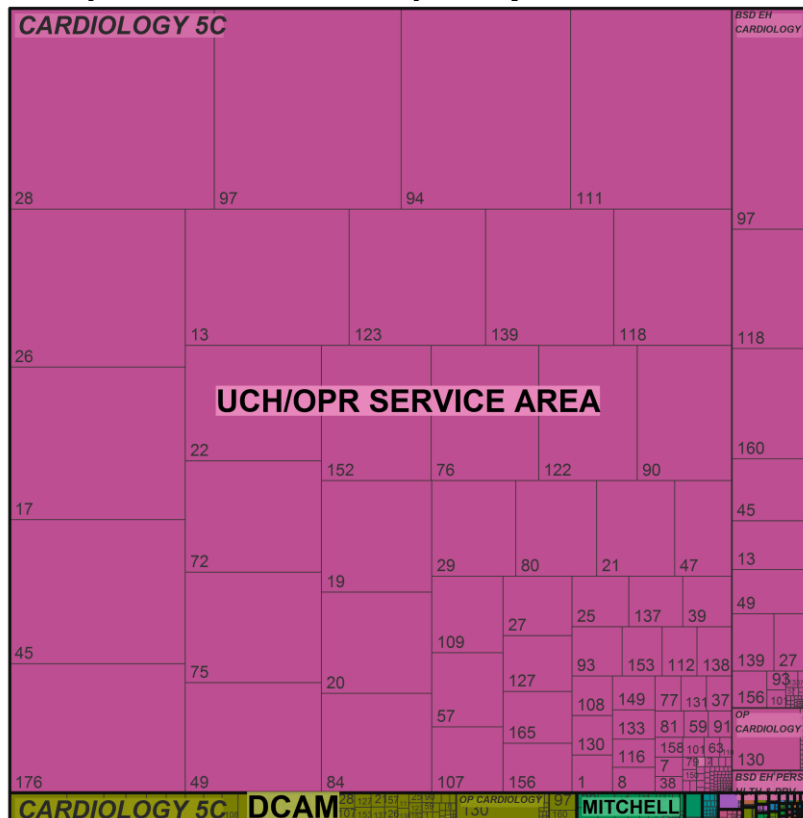
Patient selection is visit-level data for all adults following ICD-9 or ICD-10 codes for major cardiovascular disease, dyslipidemia, diabetes, hypertension, or smoking history

Adults	18-89 yo	
ICD 9 code	Condition	ICD 10 code
250	diabetes mellitus	E10-E14
272	lipid metabolism disorders	E78
305.1	nondependent tobacco use disorder	F17
401-405	hypertensive disease	I10-I15
410-414	ischemic heart disease	I20-I25
415-417	diseases of pulmonary circulation	I26-I28
424	other diseases of endocardium	I34-I36
425	cardiomyopathy	I42
426	conduction disorders	I44
427.5	cardiac arrest	I46
429	ill-defined complications of heart disease	I47-I51
430-438	cerebrovascular disease	I61-I67, I69, G45
440-448	diseases of arteries, arterioles, and capillaries	I70-I77
451	phlebitis and thrombophlebitis	I80
V12.5x	personal history of unspecified circulatory disease	Z86.7
V15.1	personal history of surgery to heart and great vessels	
V15.82	history of tobacco use	Z87.891
V17.3	family history of ischemic heart disease	Z82.49
V17.4x	family history of other cardiovascular diseases	Z82.41, Z82.49
V18.0	family history of diabetes mellitus	Z83.3

Joshy G, Korda R, Abhayaratna W, Soga K, Banks E. Categorising major cardiovascular disease hospitalisations from routinely collected data. *Public Health Research & Practice*. 2015;25(3). doi:[10.17061/phrp2531532](https://doi.org/10.17061/phrp2531532)

Visit Distribution by Location, Department, Provider

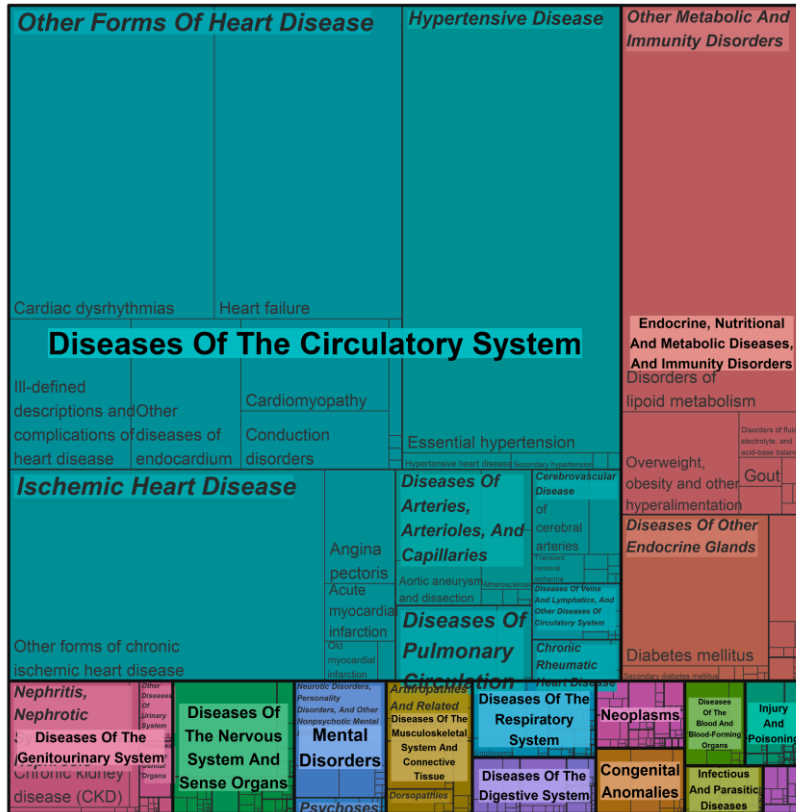
608,517 visits for 21,986 patients with 177 providers over 5.2 years; mean age=64



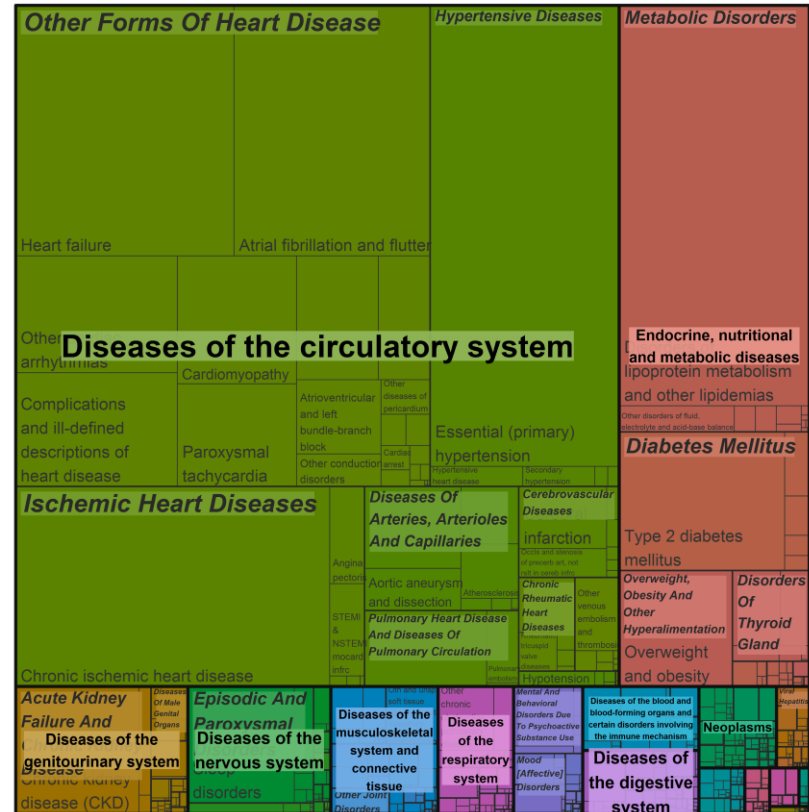
Treemap displaying hierarchical (tree-structured) patient data as a set of nested rectangles. Each rectangle has an area proportional to the specified dimension of the data.

Distribution of ICD 9/10 Diagnoses

608,517 visits for 21,986 patients with 177 providers over 5.2 years; mean age=64



ICD 9

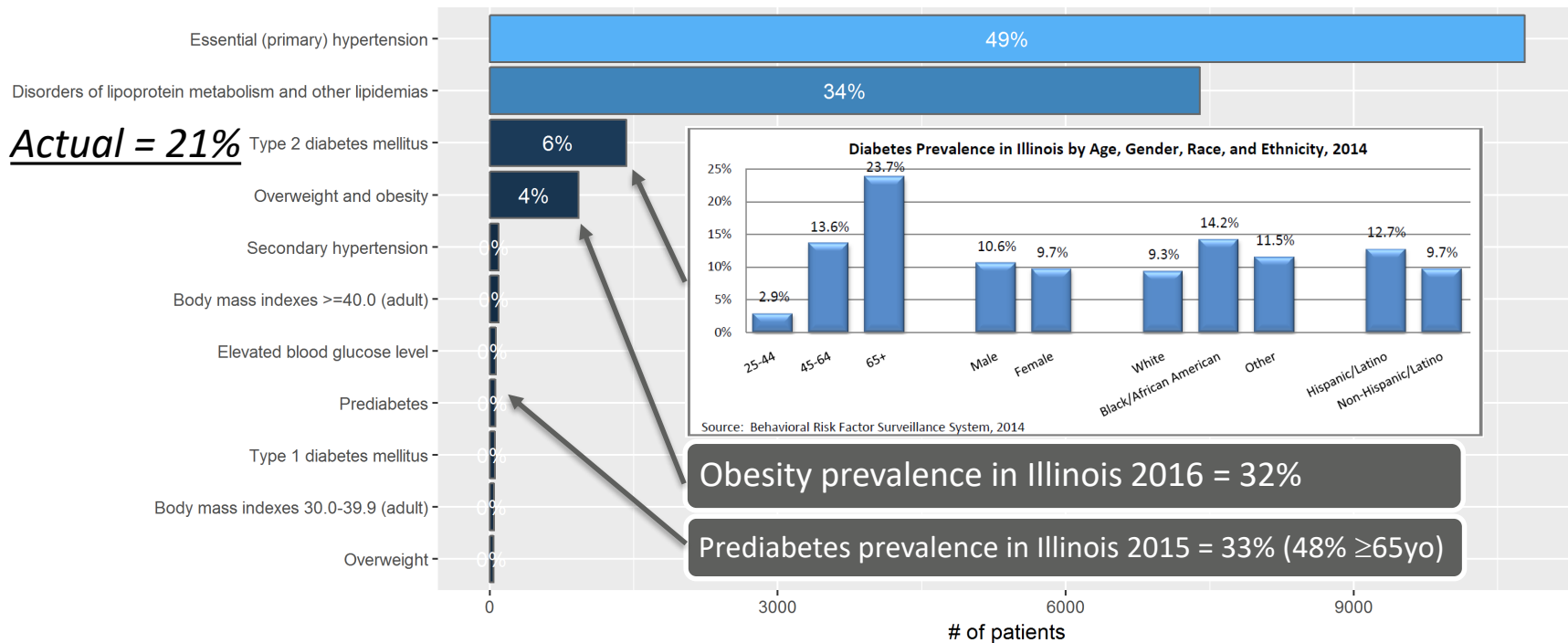


ICD 10

Cardiovascular Risk Factor Diagnoses (ICD 10)

21,983 patients; mean age=64

Obesity, prediabetes, diabetes underdiagnosed as risks



Baseline Data - Rx Frequencies

953,675 prescriptions for 20,230 patients using 1,427 drugs over 5.2 years; mean age=64



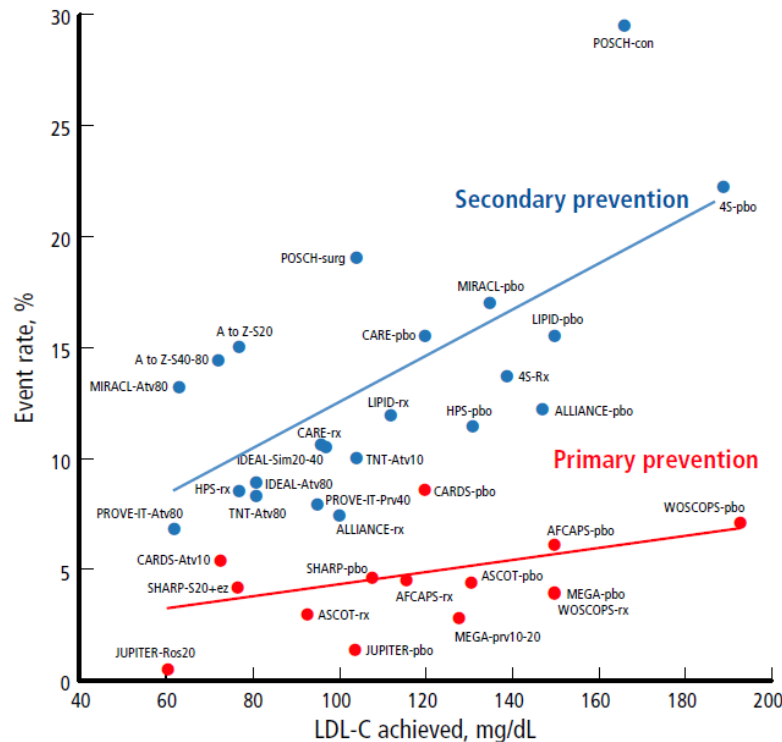
Treemap displaying hierarchical (tree-structured) patient data as a set of nested rectangles. Each rectangle has an area proportional to the specified dimension of the data.

Baseline Data – Demographics

953,675 prescriptions for 20,230 patients using 1,427 drugs over 5.2 years; mean age=64
EHR data gaps in structured fields

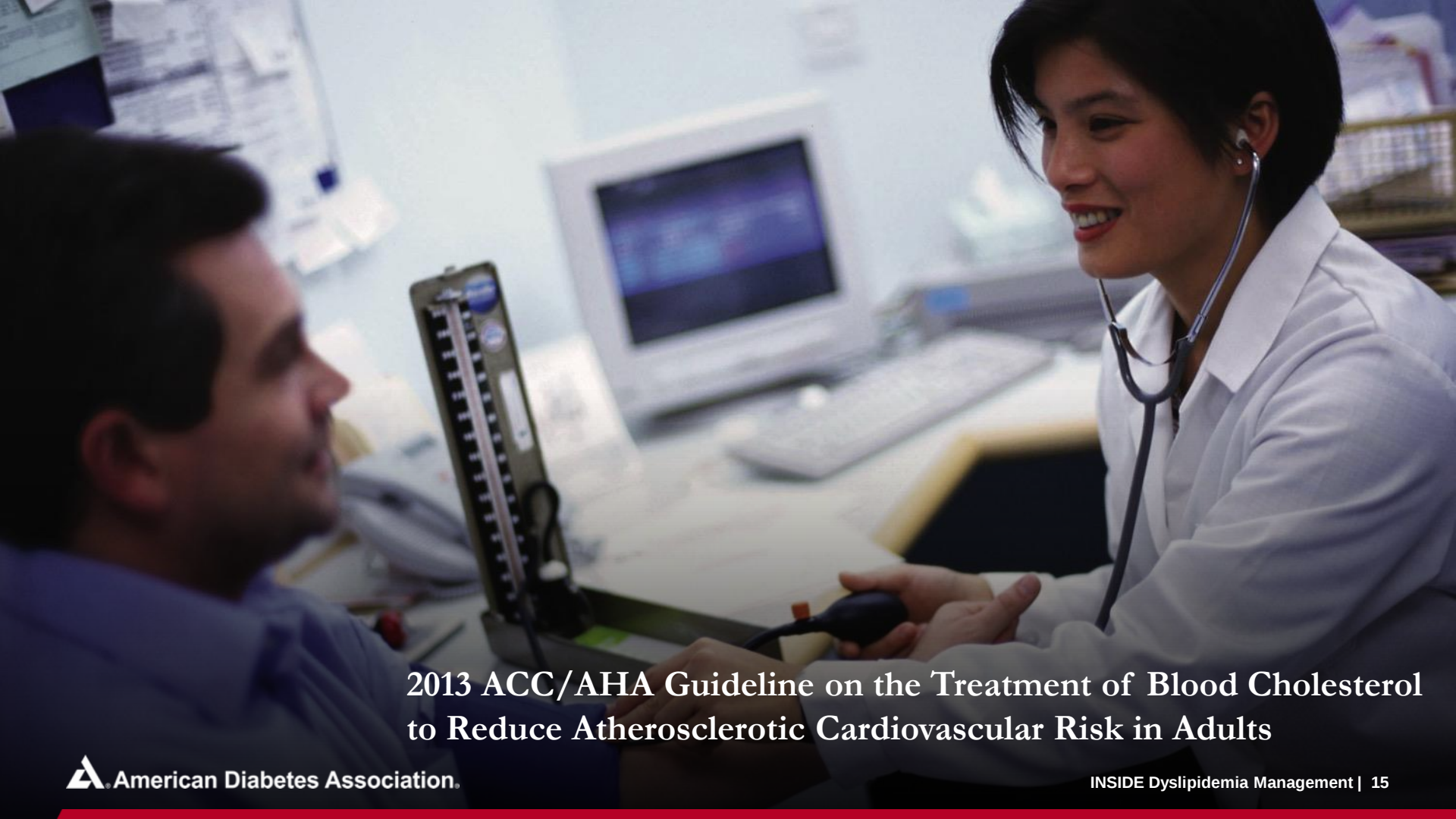
Category	Patients	With Known Risks	And LDLC
On any Rx	20,219	16,464	8,939
On lipid Rx	15,262	11,169	5,659
On statin Rx	14,096	10,911	5,521
On PCSK9 Rx	112	55	25

LDLC Levels vs Rates of Coronary Events



1. Raymond C, Cho L, Rocco M, Hazen SL. New cholesterol guidelines: Worth the wait? *Cleveland Clinic Journal of Medicine*. 2014;81(1):11-19. doi:[10.3949/ccjm.81a.13161](https://doi.org/10.3949/ccjm.81a.13161)

2. Cholesterol Treatment Trialists' (CTT) Collaboration. Efficacy and safety of more intensive lowering of LDL cholesterol: a meta-analysis of data from 170 000 participants in 26 randomised trials. *Lancet*. 2010;376(9753):1670-1681. doi:[10.1016/S0140-6736\(10\)61350-5](https://doi.org/10.1016/S0140-6736(10)61350-5)

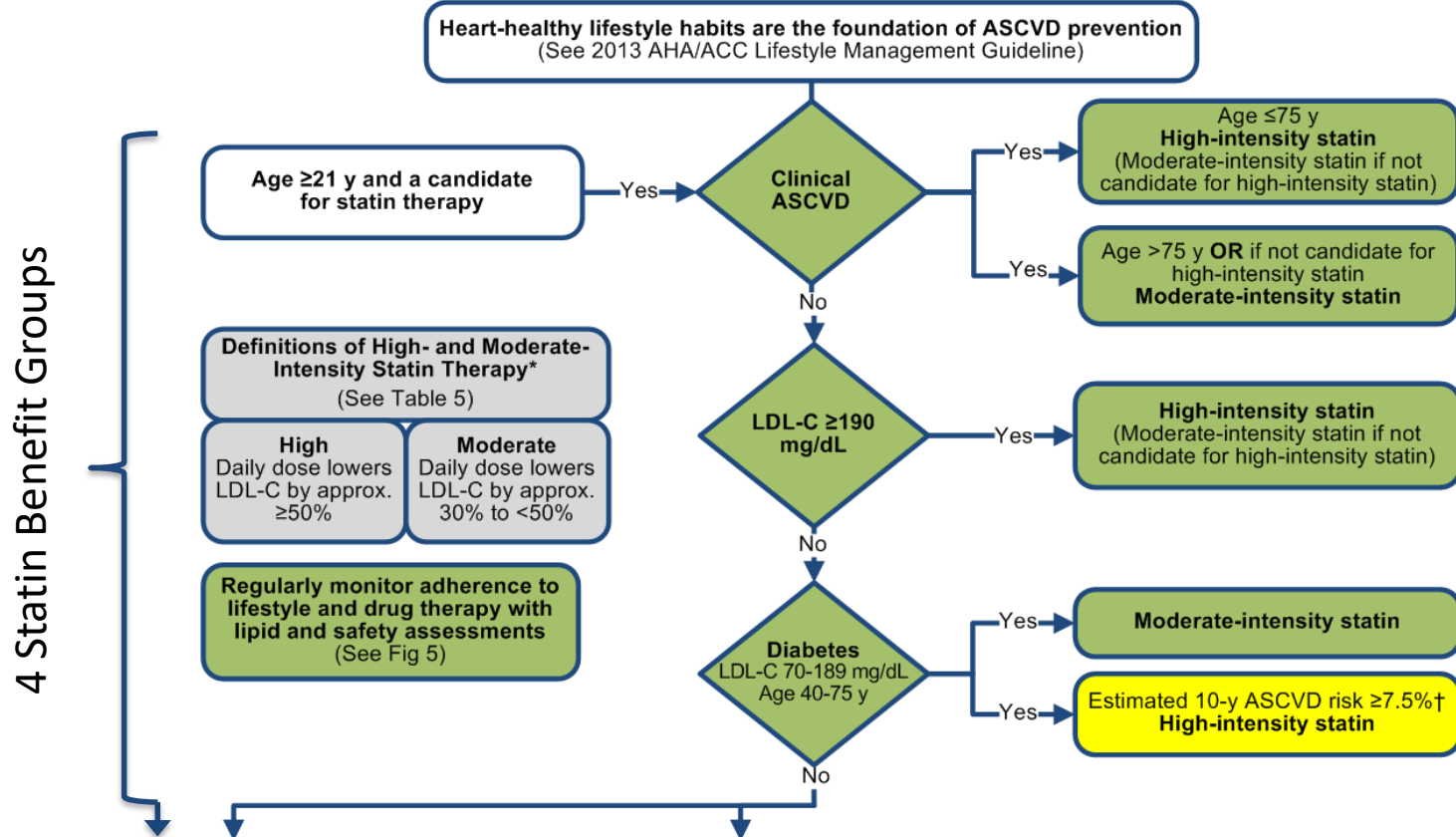


2013 ACC/AHA Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults

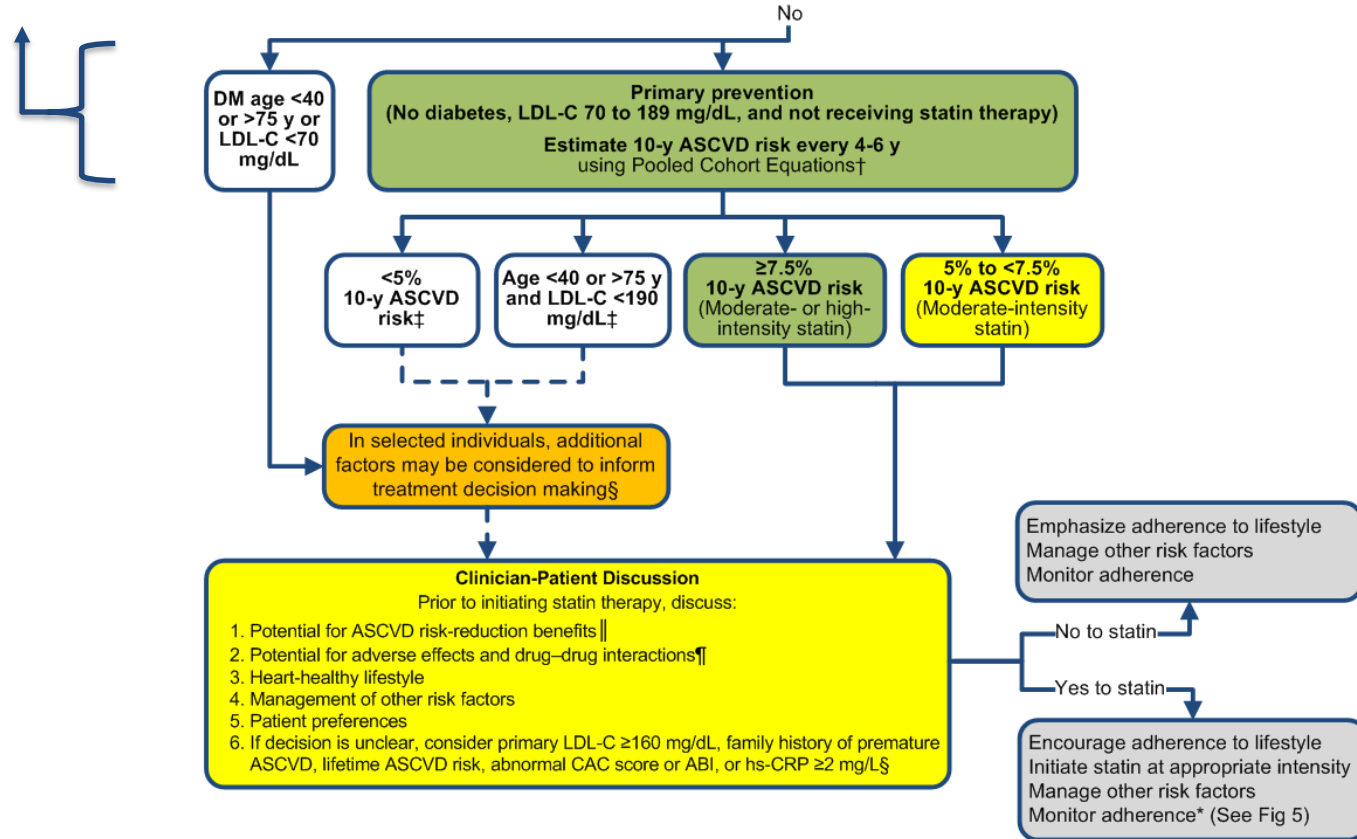
Dyslipidemia Guidelines

2013 ACC/AHA Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults

Summary of Statin Initiation Recommendations to Reduce ASCVD Risk (Revised Figure)



Summary of Statin Initiation Recommendations to Reduce ASCVD Risk (Revised Figure)

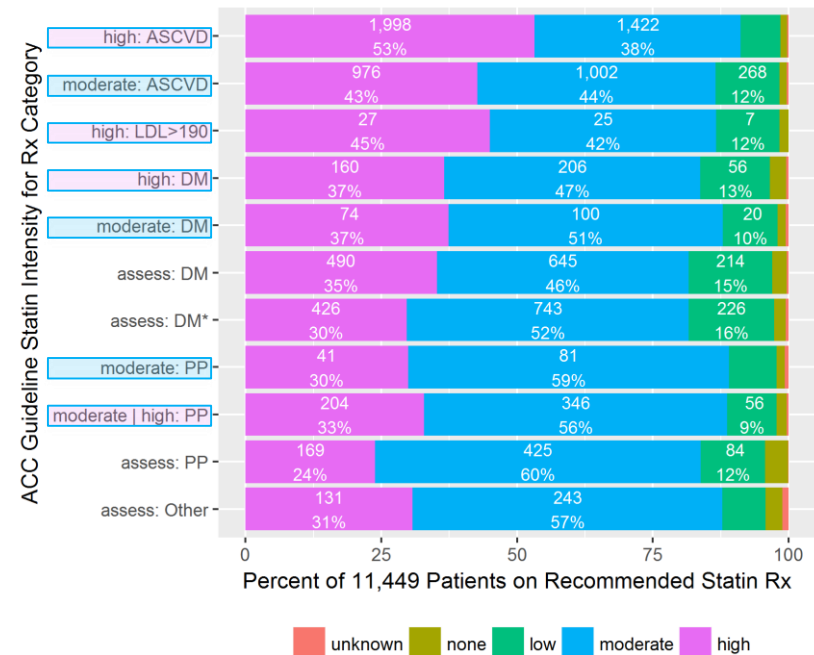
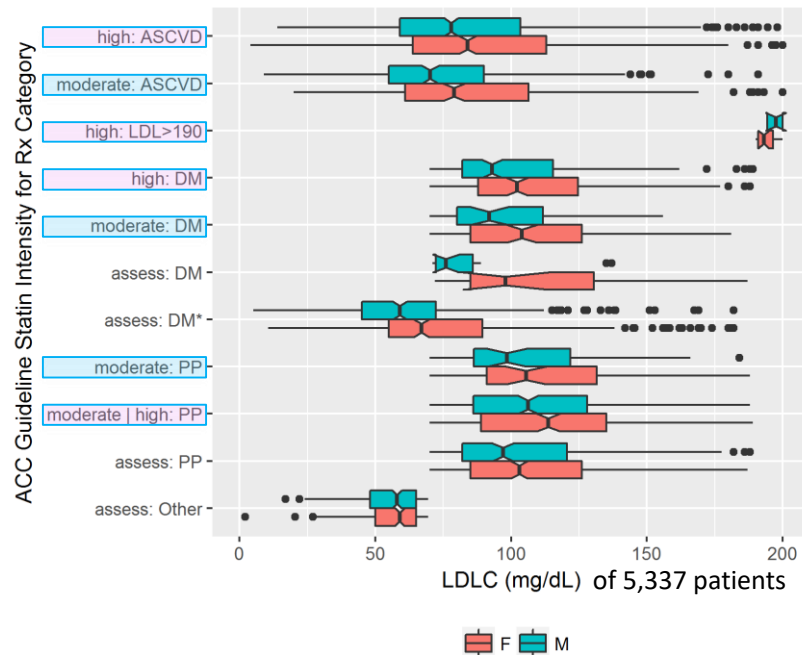


Clinical Outcomes

2013 ACC/AHA Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults

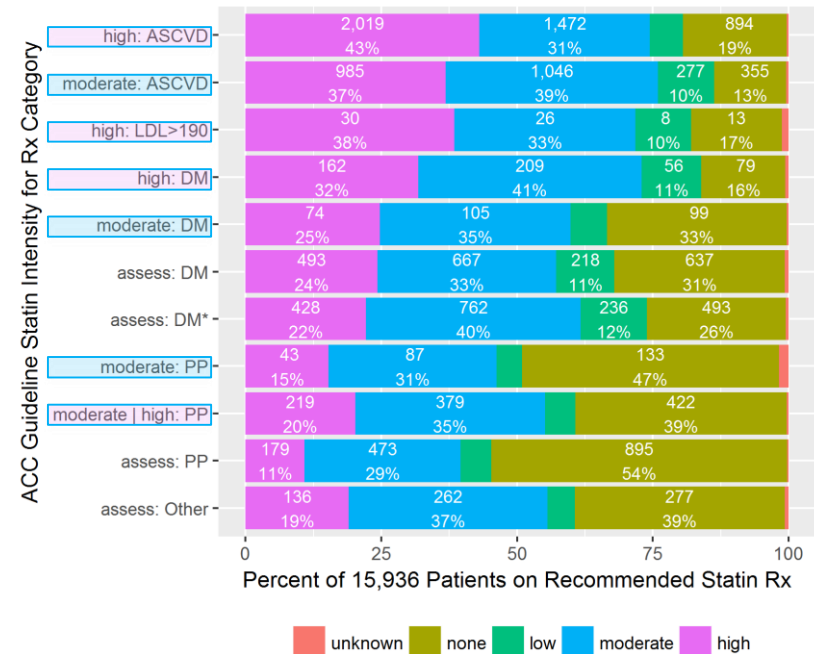
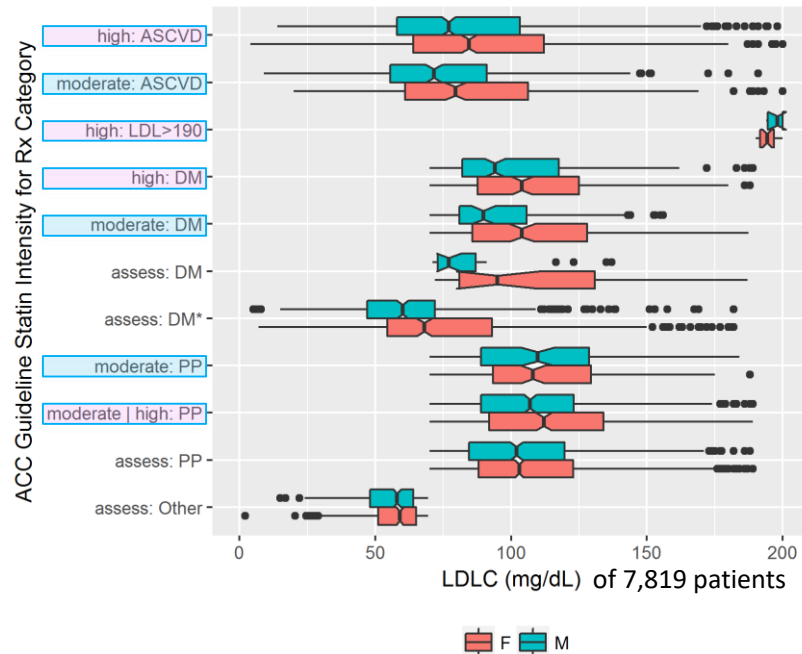
LDLC and Statin Prescribing by AHA/ACC Guidelines

Only includes patients on lipid-lowering drugs



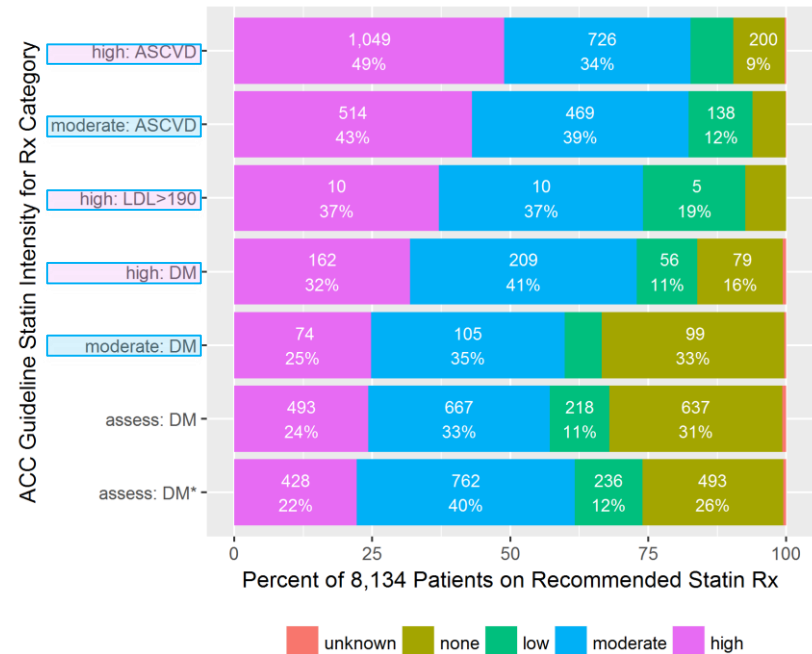
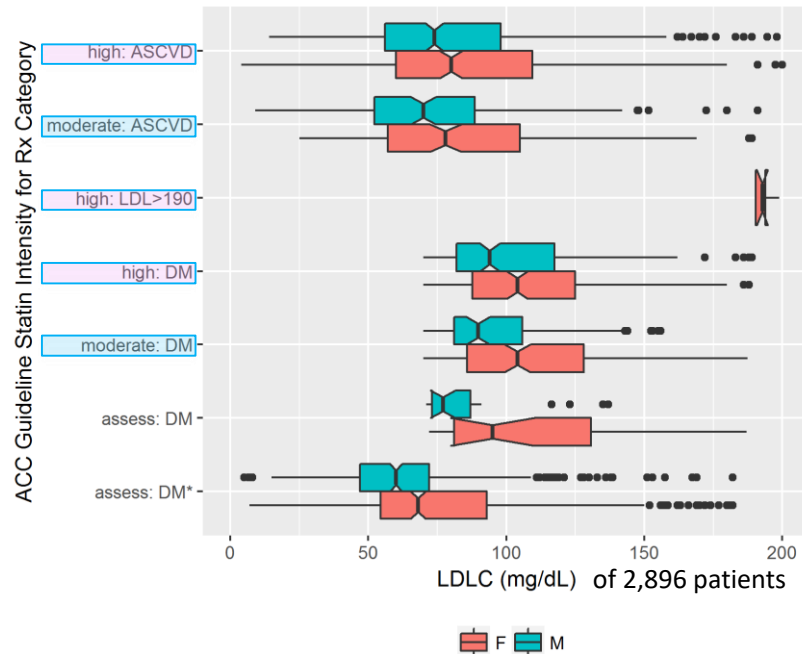
LDLC and Statin Prescribing by AHA/ACC Guidelines

Patients with any prescriptions



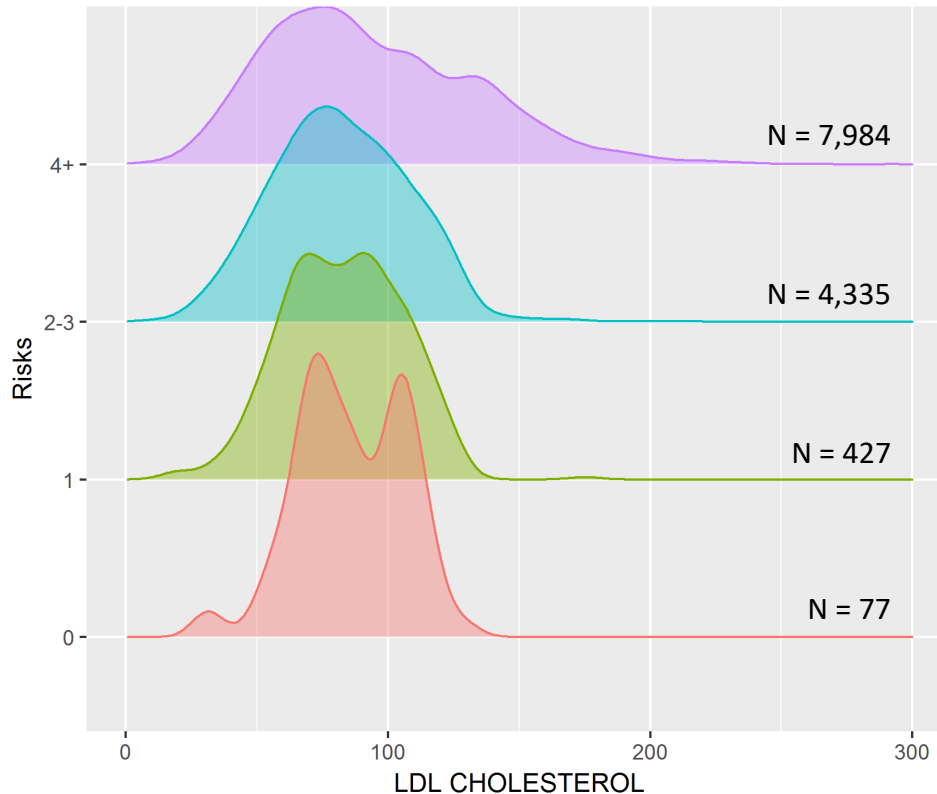
LDLC and Statin Prescribing by AHA/ACC Guidelines

Only includes patients with diabetes

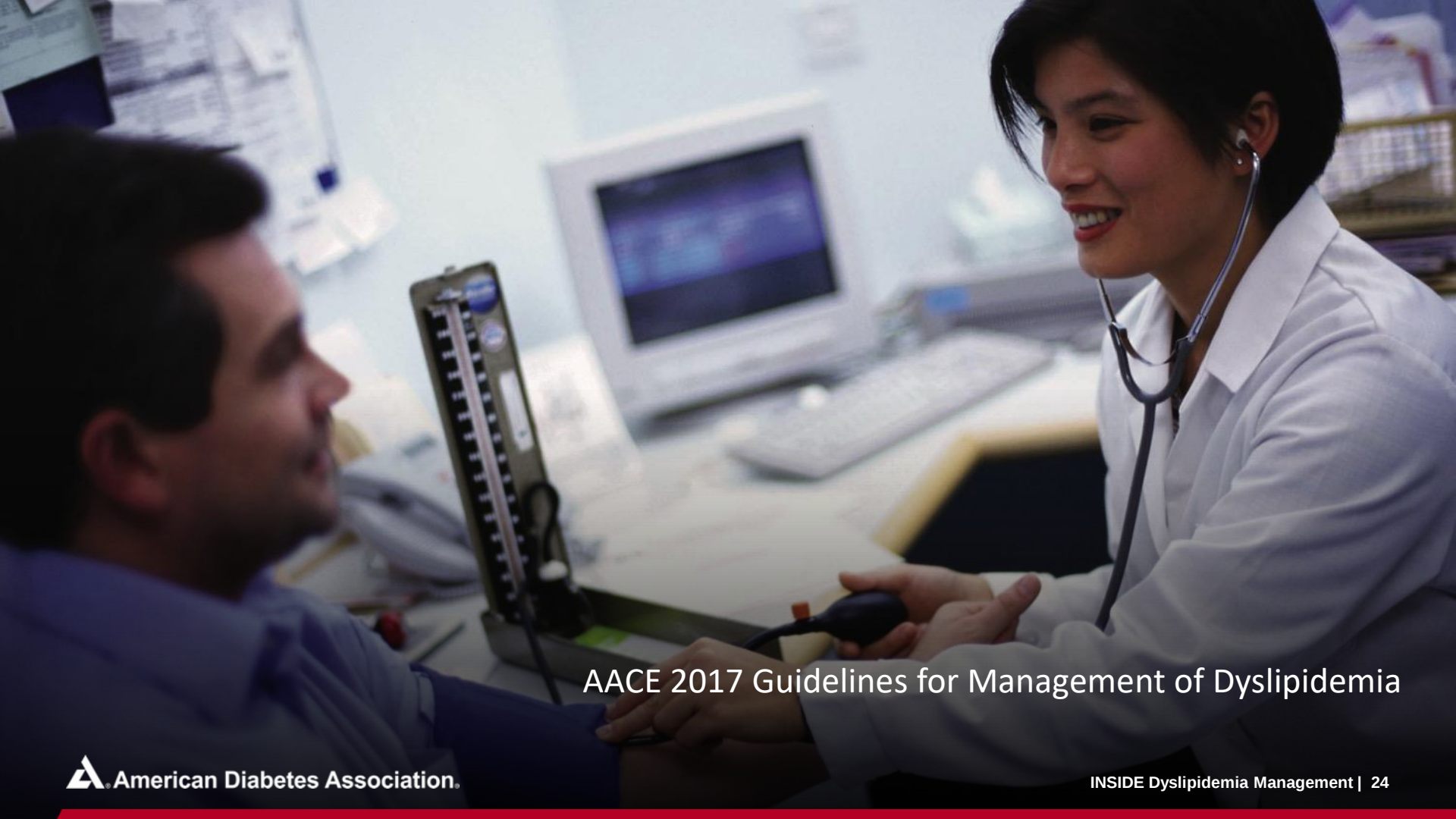


Baseline Data – LDLC Distribution by # of Risk Factors

N=12,823 patients



Density distribution of LDLC values stratified by number of ASCVD risk factors.



AACE 2017 Guidelines for Management of Dyslipidemia

Dyslipidemia Guidelines

AACE 2017 Guidelines for Management of Dyslipidemia

AACE 2017 Guidelines for Management of Dyslipidemia

Major Atherosclerotic Cardiovascular Disease Risk Factors

Major risk factors	Additional risk factors	Nontraditional risk factors
Advancing age	Obesity, abdominal obesity	Lipoprotein (a)
Total serum cholesterol	Family history of hyperlipidemia	Clotting factors
Non-HDL-C	Small, dense LDL-C	Inflammation markers (hsCRP; Lp-PLA2)
LDL-C	Apo B	Homocysteine levels
Low HDL-C	LDL particle concentration	Apo B4 isoform
Diabetes mellitus	Fasting/post-prandial hypertriglyceridemia	Uric acid
Hypertension	PCOS	TG-rich remnants
Chronic kidney disease	Dyslipidemic triad	
Cigarette smoking		
Family history of ASCVD		

AACE 2017 Guidelines for Management of Dyslipidemia

Atherosclerotic Cardiovascular Disease Risk Categories and LDL-C Treatment Goals

Risk category	Risk factors/10-year risk	Treatment Goals		
		LDL-C (mg/dL)	Non-HDL-C (mg/dL)	Apo B (mg/dL)
Extreme risk	- Progressive ASCVD including angina in patients after achieving LCL-C <70 mg/dL - Established clinical cardiovascular disease in patients with DM, CKD 3/4, or HeFH - History of premature ASCVD (<55 male, <65 female)	<55	<80	<70
Very high risk	- Established or recent hospitalization for ACS, coronary, carotid or peripheral vascular disease, 10-year risk >20% - Diabetes or CKD 3/4 with 1 or more risk factor(s) - HeFH	<70	<100	<80
High risk	≥2 risk factors and 10-year risk 10-20% - Diabetes or CKD 3/4 with no other risk factors	<100	<130	<90
Moderate risk	≤2 risk factors and 10-year risk <10%	<100	<130	<90
Low risk	0 risk factors	<130	<160	NR

AACE 2017 Guidelines for Management of Dyslipidemia

Lipid Goals for Patients at Risk for Atherosclerotic Cardiovascular Disease

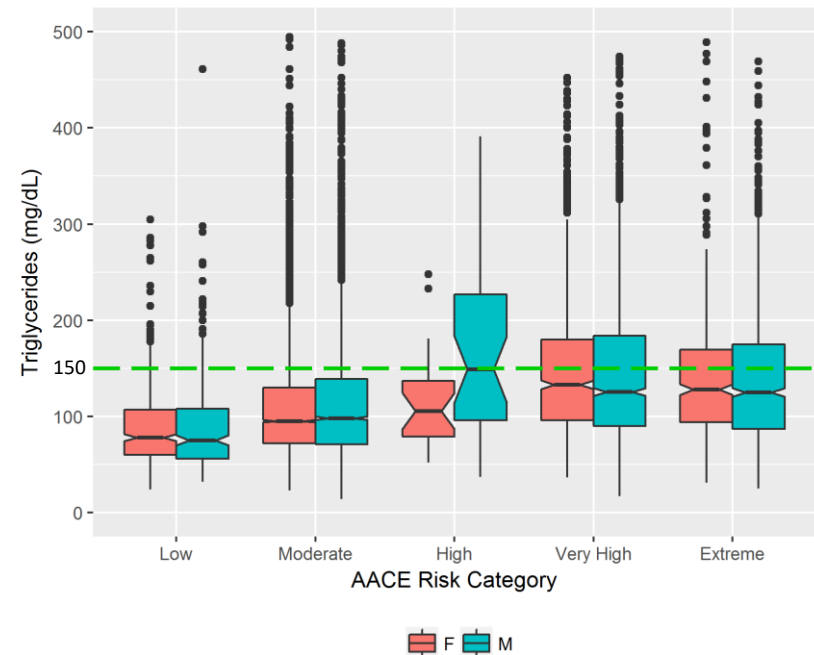
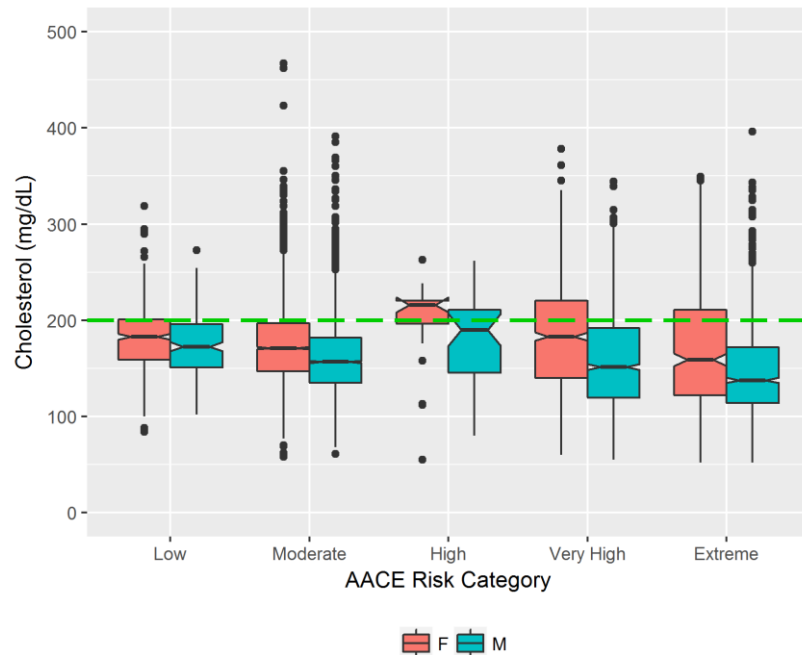
Lipid parameter	Goal (mg/dL)
TC	<200
LDL-C	<130 (low risk) <100 (moderate risk) <100 (high risk) <70 (very high risk) <55 (extreme risk)
Non-HDL-C	30 above LDL-C goal; 25 above LDL-C goal (extreme risk patients)
TG	<150
Apo B	<90 (patients at high risk of ASCVD, including those with diabetes) <80 (patients at very high risk with established ASCVD or diabetes plus ≥ 1 additional risk factor) <70 (patients at extreme risk)

Clinical Outcomes

AACE 2017 Guidelines for Management of Dyslipidemia

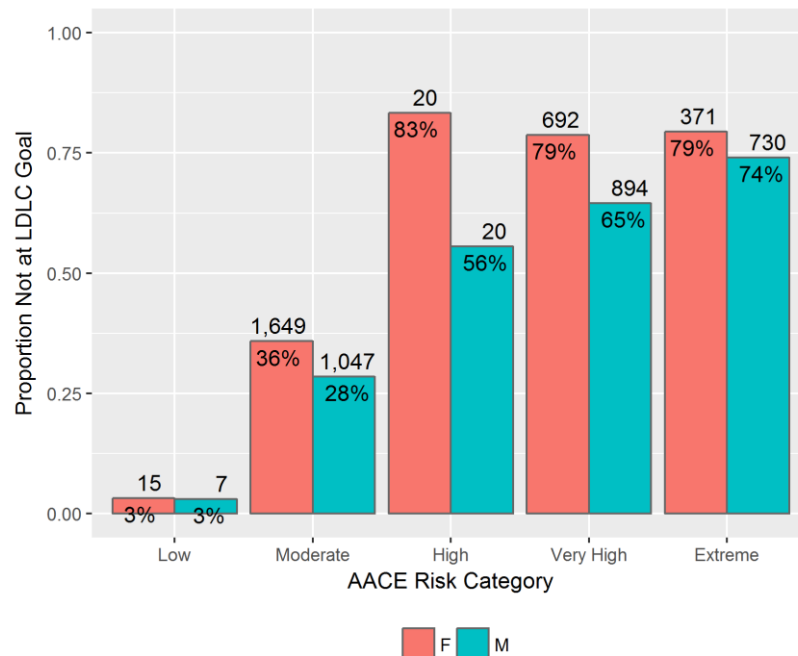
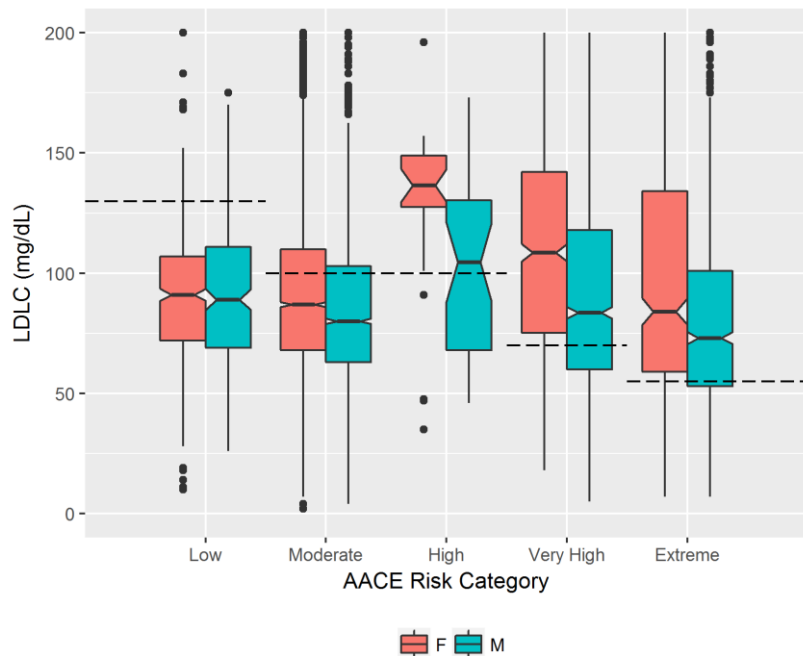
Baseline Data – Cholesterol and Triglycerides Stratified

Most recent labs for 12,921 patients grouped by AACE risk category and gender



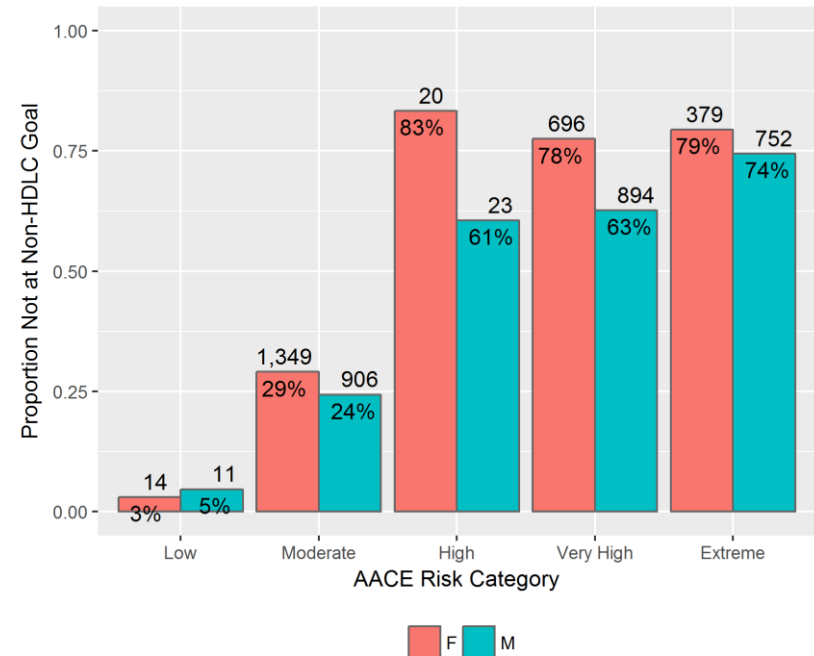
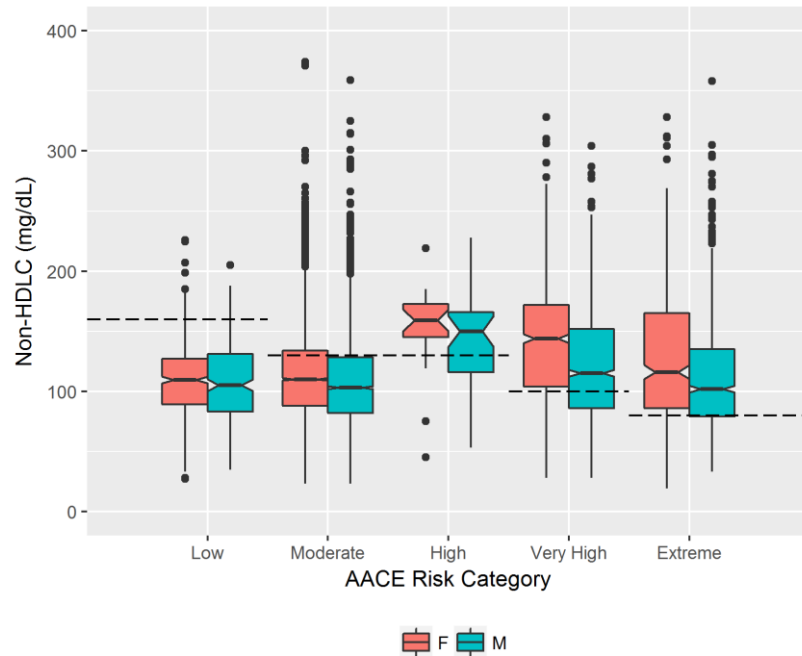
Baseline Data – LDLC Stratified

Most recent labs for 12,750 patients grouped by AACE risk category and gender



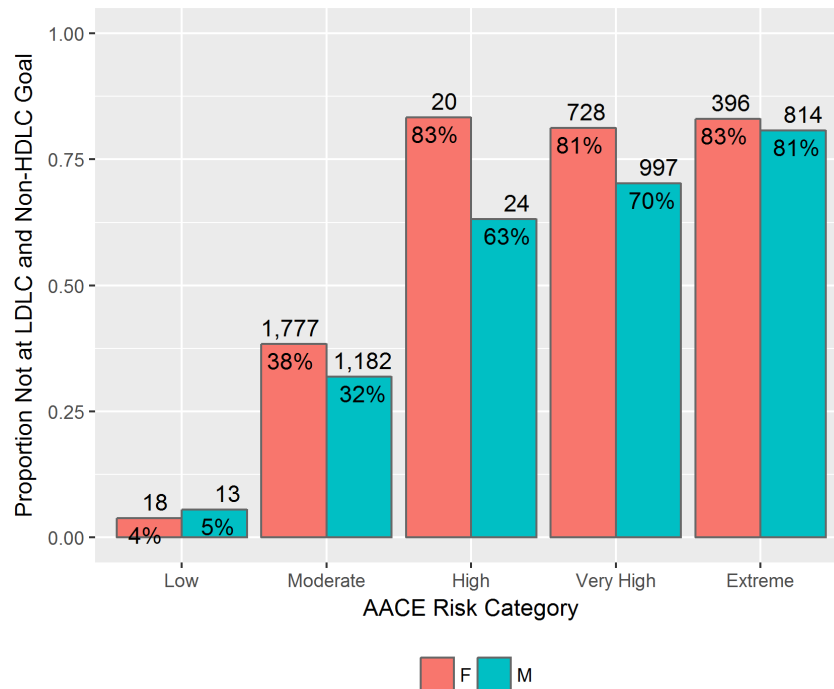
Baseline Data – Non-HDLC Stratified

N=5,183 patients, mean interval = 2.1 years (6 days to 5.1 years)



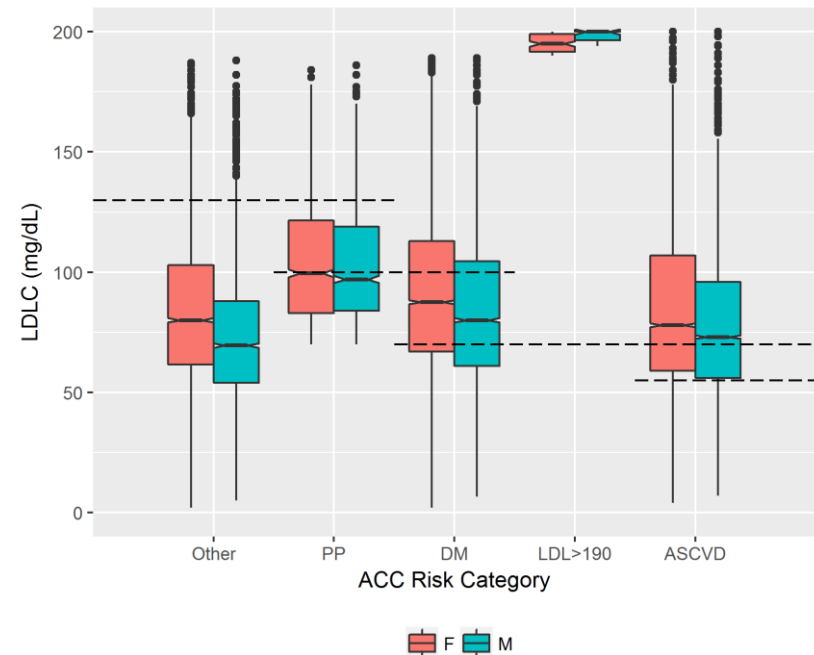
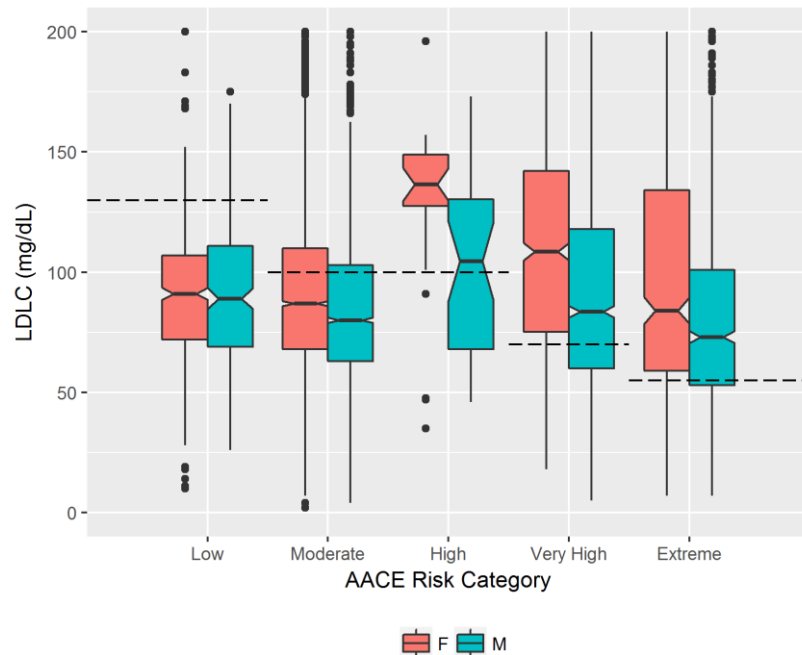
Baseline Data – Composite AACE Lipid Goals

N=5,183 patients, mean interval = 2.1 years (6 days to 5.1 years)



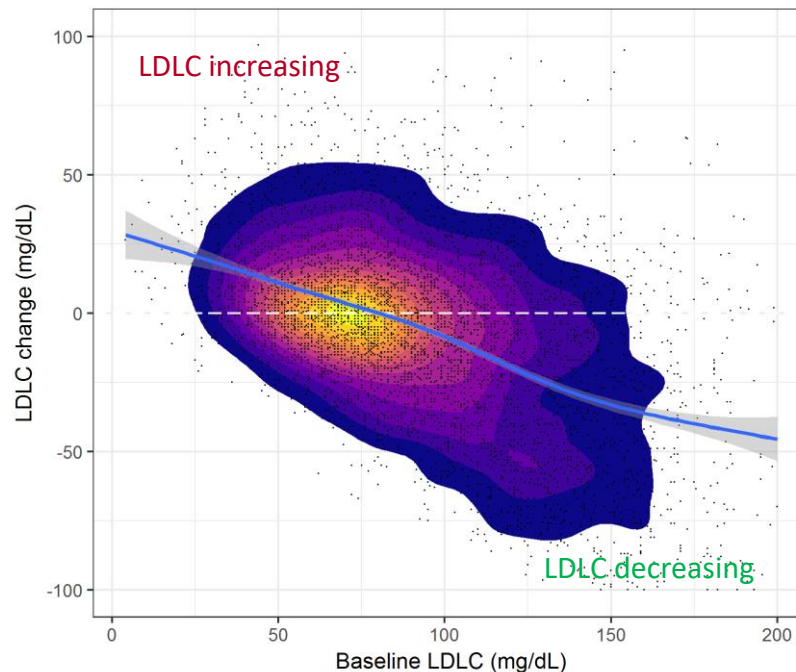
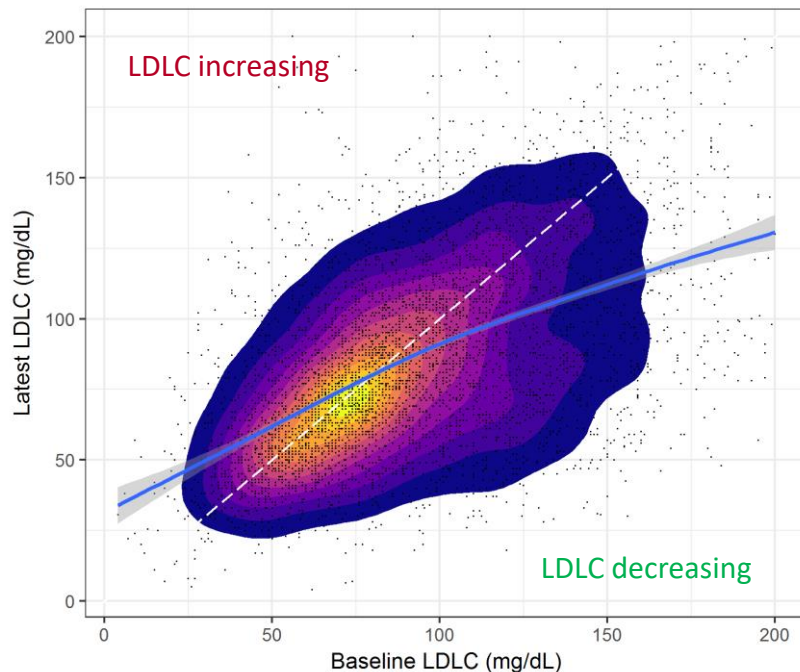
Baseline Data – LDLC Guideline Outcomes Compared

Most recent labs for 12,750 patients grouped by guideline risk category and gender



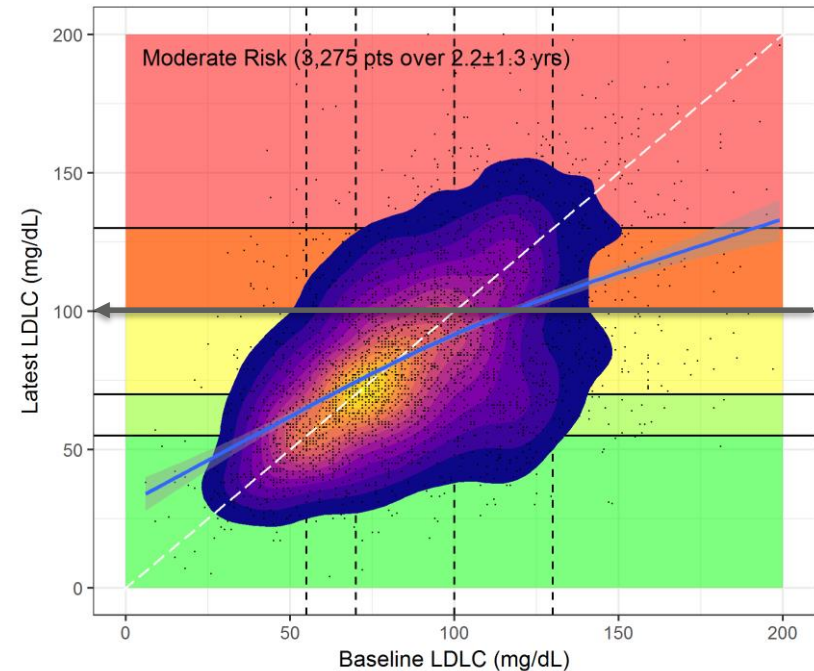
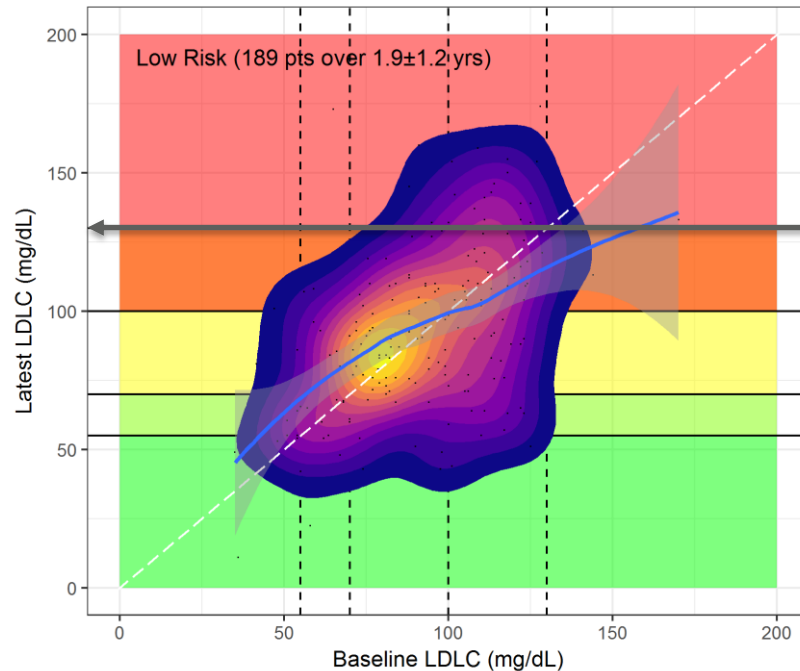
Baseline Data – Evolving Individual LDLC Change

N=5,125 patients, mean interval = 2.1 ± 1.3 years (6 days to 5.1 years)

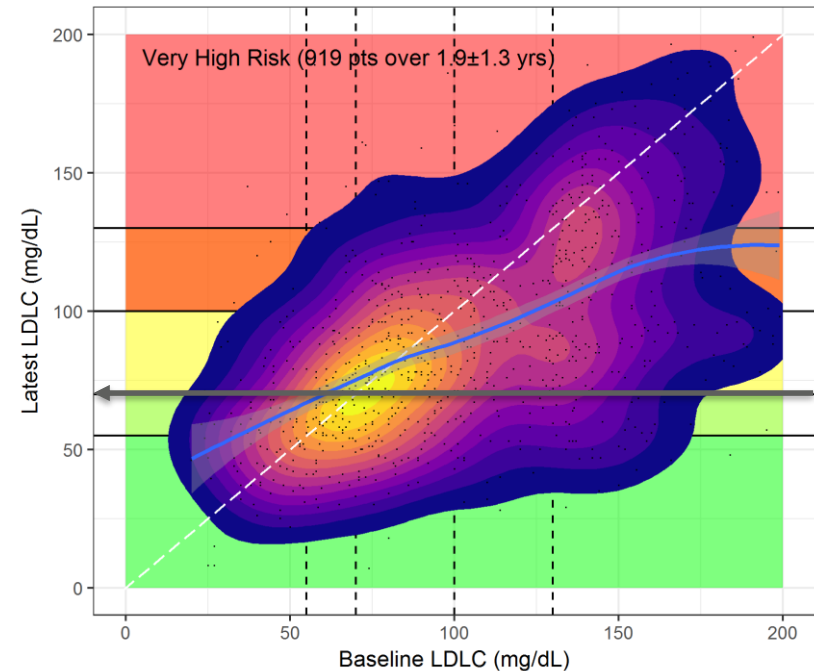
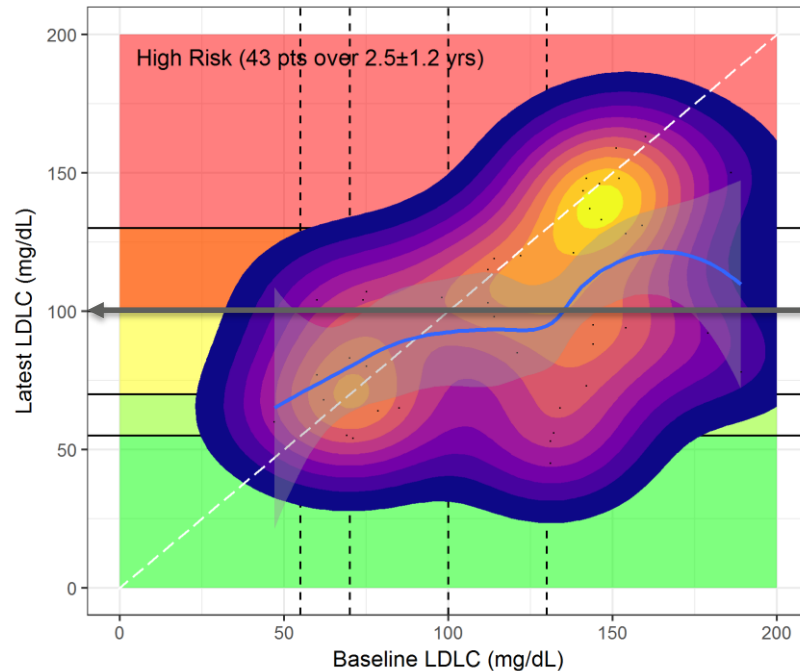


Baseline Data – Evolving Individual LDLC Change

Stratified by AACE Risk Categories: Low and Moderate

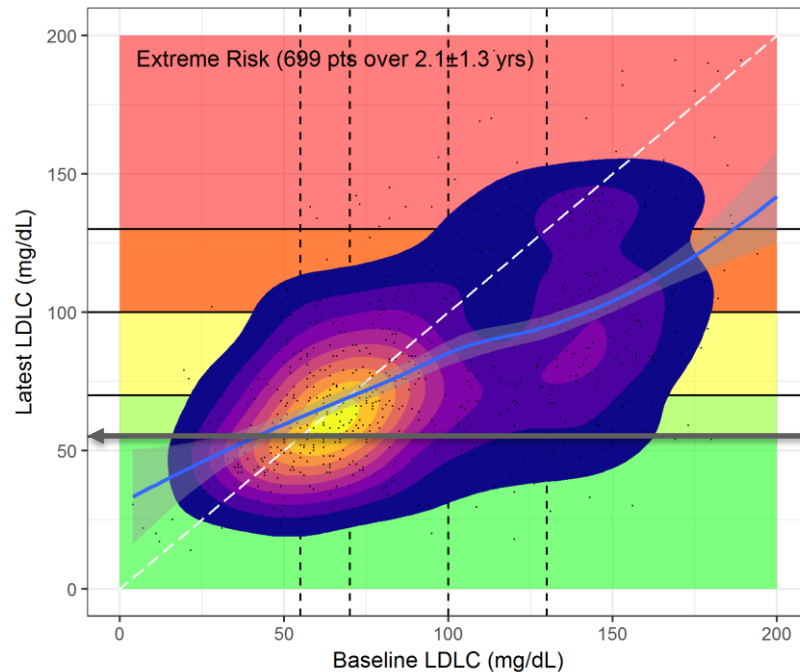


Baseline Data – Evolving Individual LDLC Change Stratified by AACE Risk Categories: High and Very High



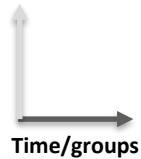
Baseline Data – Evolving Individual LDLC Change

Stratified by AACE Risk Categories: Extreme



Quality Improvement

Reducing clinical variation and achieving guideline standards



Quality Management in Population Health

Planning, assuring, controlling, improving

Clinical variation



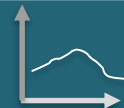
- Are population clinical outcomes stable and predictable?
- Do patient subpopulations have similar outcomes?

Clinical goals



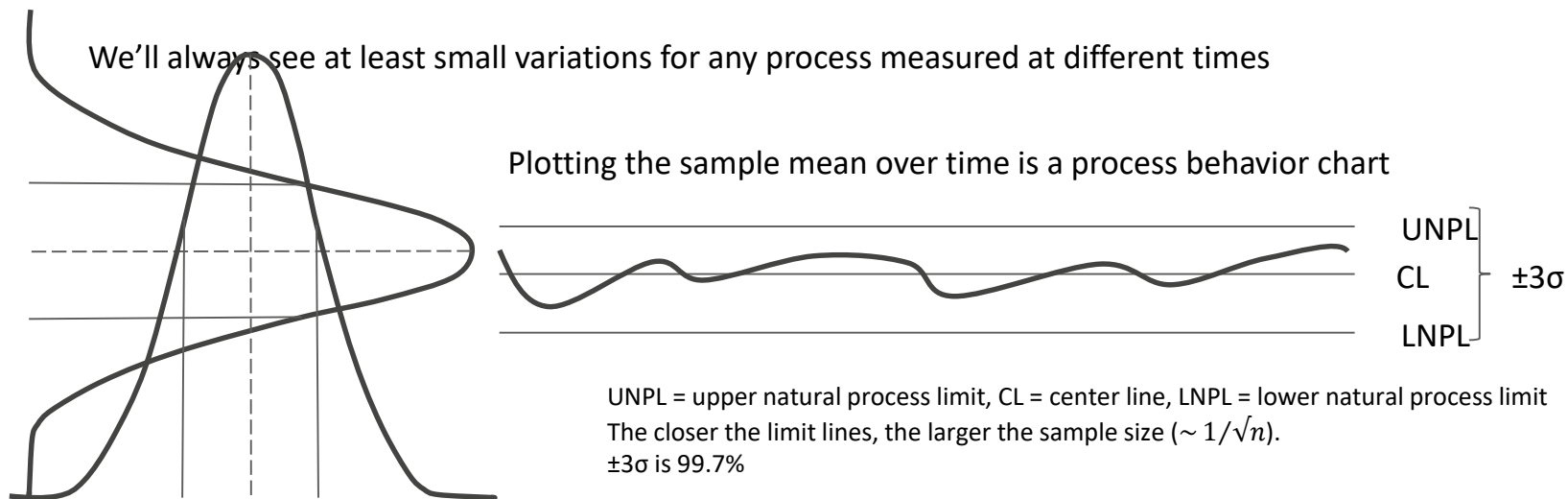
- Do process and clinical outcomes achieve clinical standards?

Clinical change



- Have prior interventions affected outcomes?
- Has patient population changed over time?

Process Behavior (Control) Charts Illustrated



A reliable, repeatable process is “predictable” and randomly varies minimally about the mean over time within natural process limits.

Statistical Significance with Control Charts

Simple visual alternative to T-tests, p-values, and other analytical tests

By Time

- **Within control limits**
 - Mean and control limits analogous to statistical error of the mean
 - Runs ≥ 7 points above/below mean statistically significant
 - Patterns and monotonic trends may be statistically significant
 - Otherwise due to random variation
- **Outside control limits**
 - Any point is statistically significant

Rational Subgroup

- **Within control limits**
 - Groups do not have statistically significant between-group variation
- **Outside control limits**
 - Group has statistically significant variation

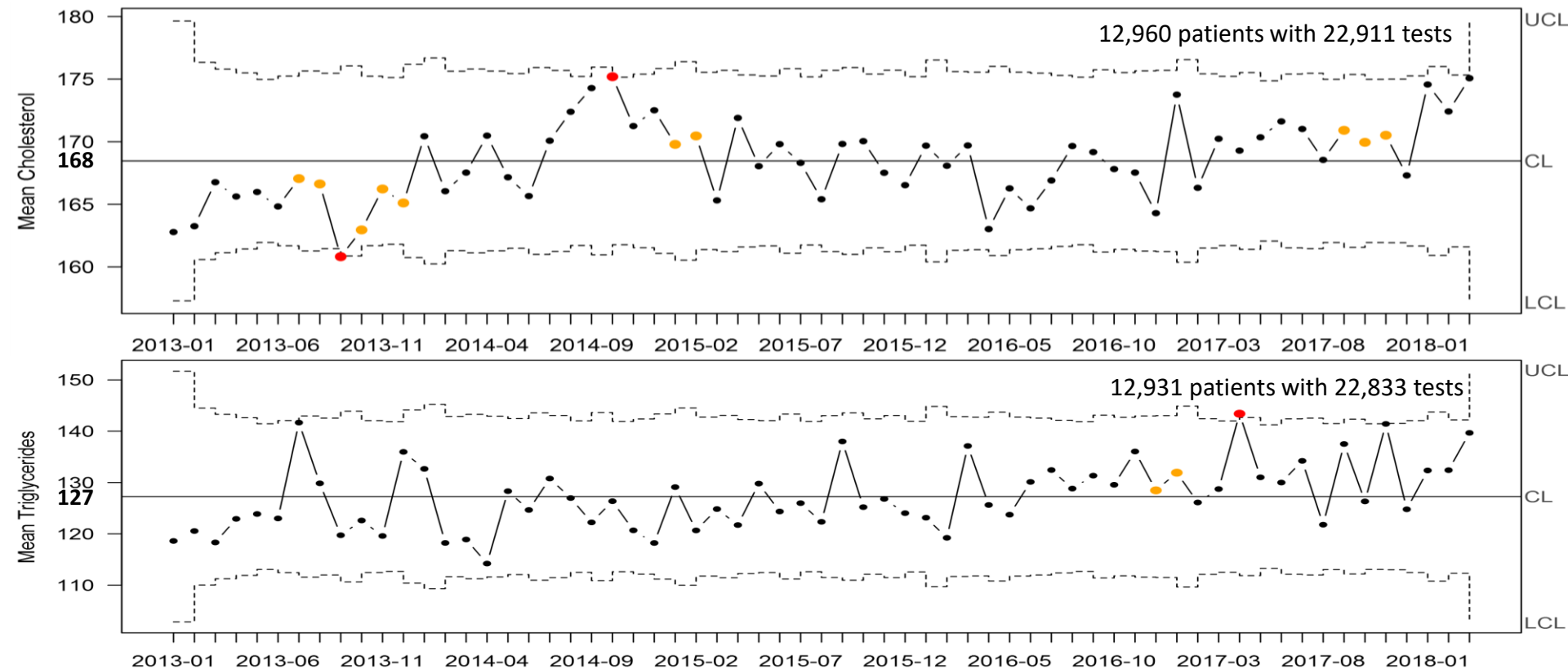
Population Lipid Outcomes

Are population lipid profiles stable over time?

Have prior awareness, education, or quality programs varied lipid outcomes?

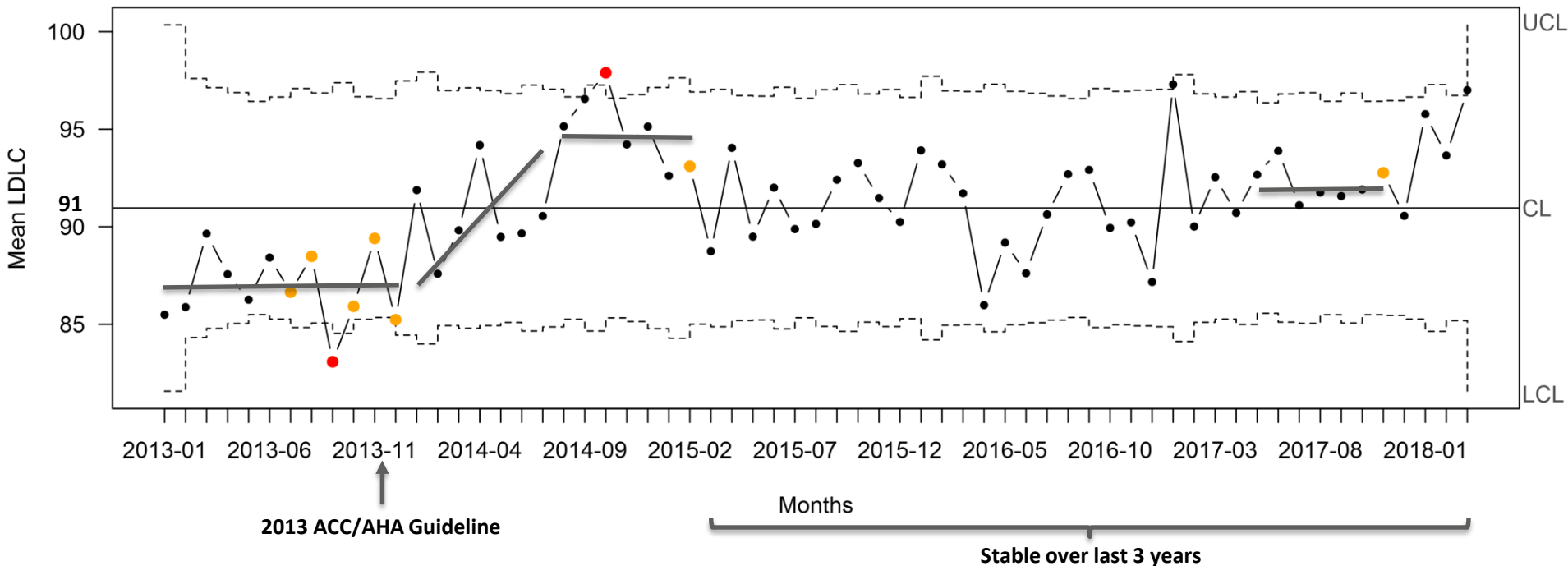
Does diagnosis affect lipid levels?

Population Cholesterol and Triglyceride Variation Over Time



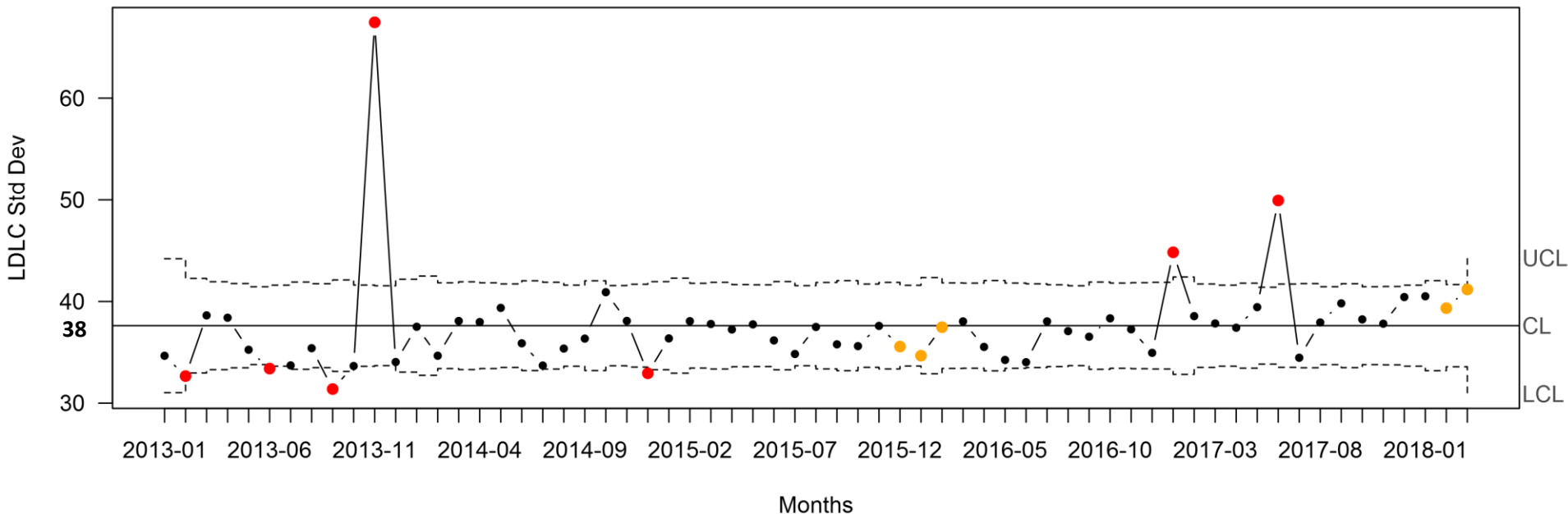
How Does Population LDLC Vary Over Time at U of C?

12,828 patients with 22,529 LDLC tests over 5.1 years



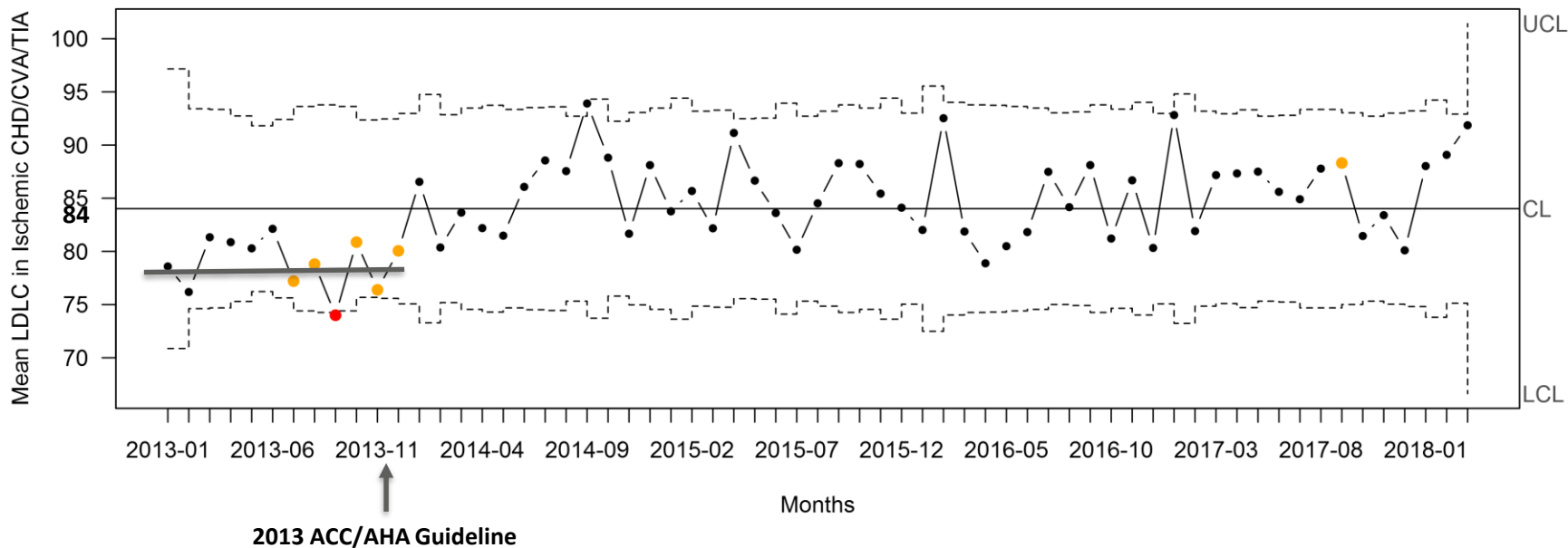
Population LDLC Standard Deviation Consistent Over Time

12,828 patients with 22,529 LDLC tests over 5.1 years



Mean LDLC Variation Over Time in ICHD/CVA/TIA

Stage A: LDLC in Ischemic CHD/CVA/TIA (N=8,719) (4,907 patients)

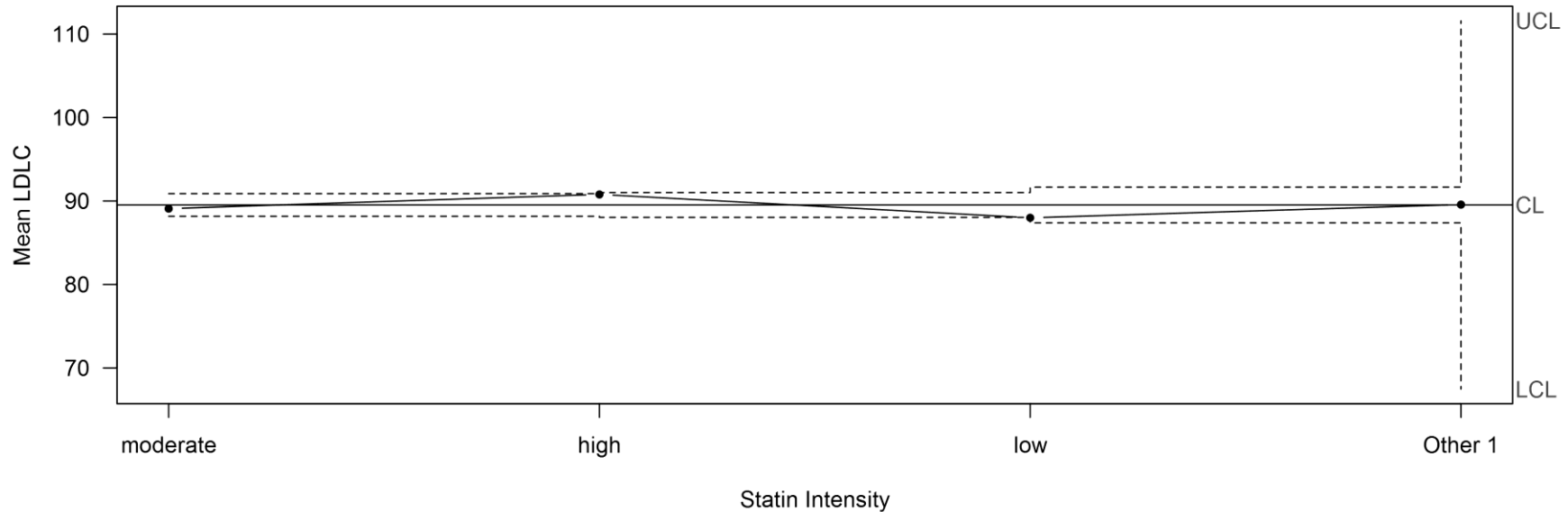


Population Lipid Outcomes

How does medication choice and intensity affect lipid levels?

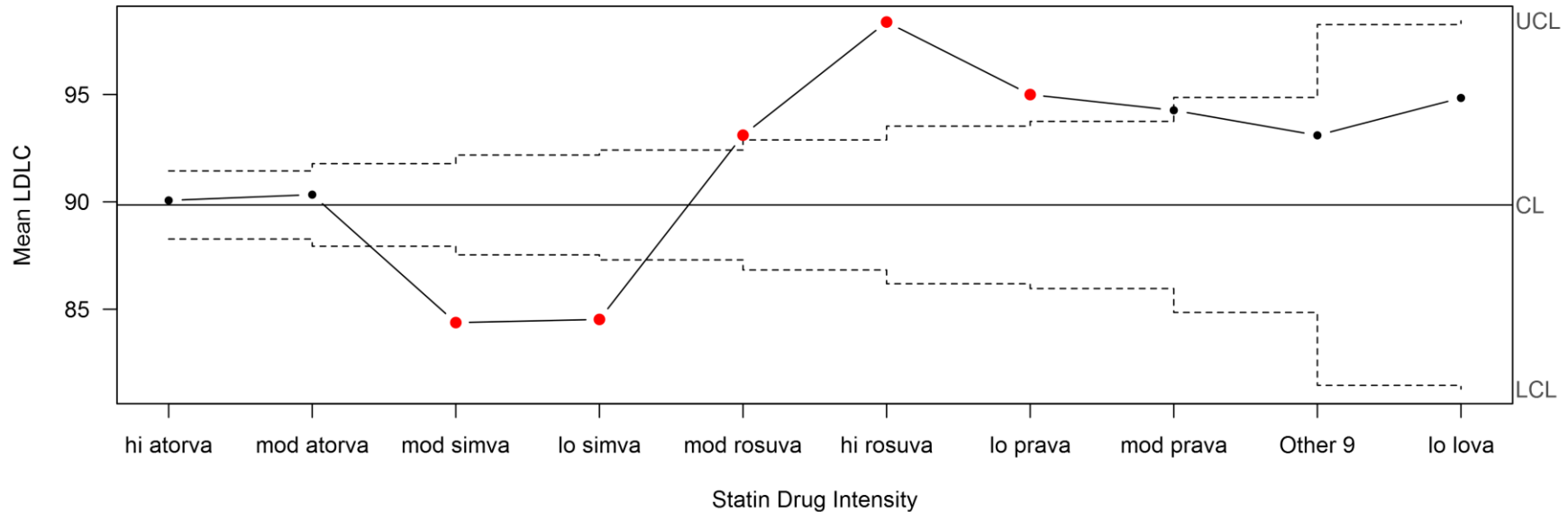
Statin Intensity Does Not Affect Population Mean LDLC

Stage A: LDLC by Statin Intensity (N=17,197) (8,127 patients)



LDLC Varies with Selection of Statin and Intensity

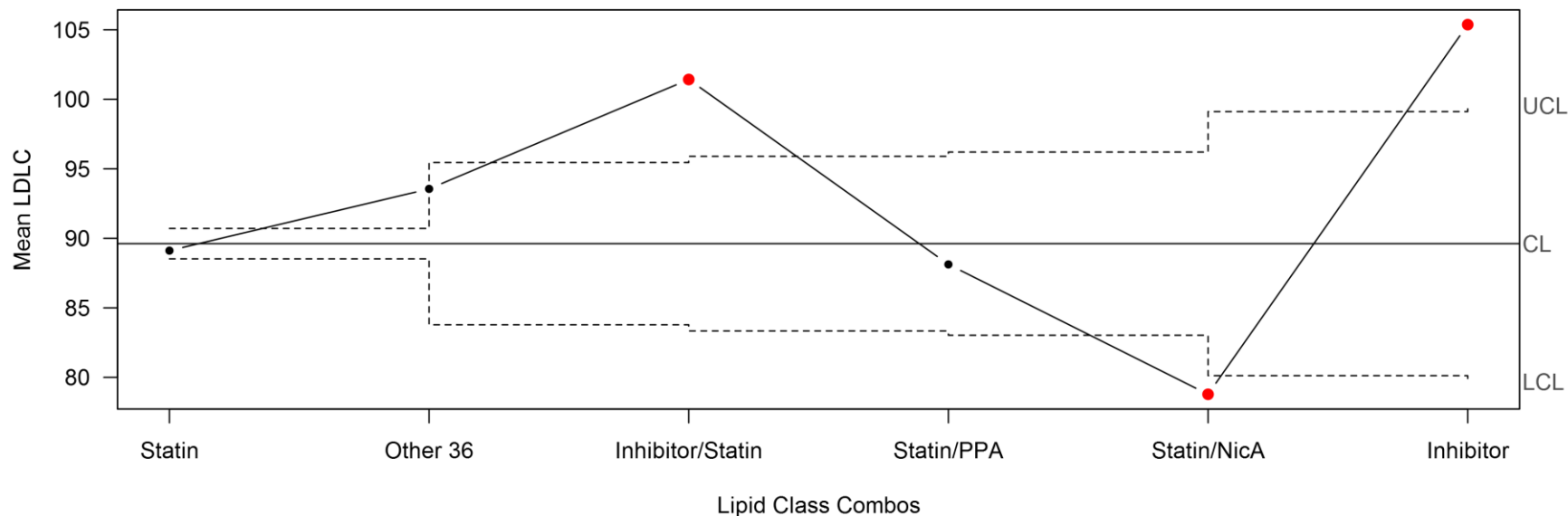
Stage A: LDLC by Statin Drug Intensity (N=18,669) (8,127 patients)



Statins used: atorvastatin, fluvastatin, lovastatin, pitavastatin, pravastatin, rosuvastatin, simvastatin

LDLC Varies with Drug Class Combinations

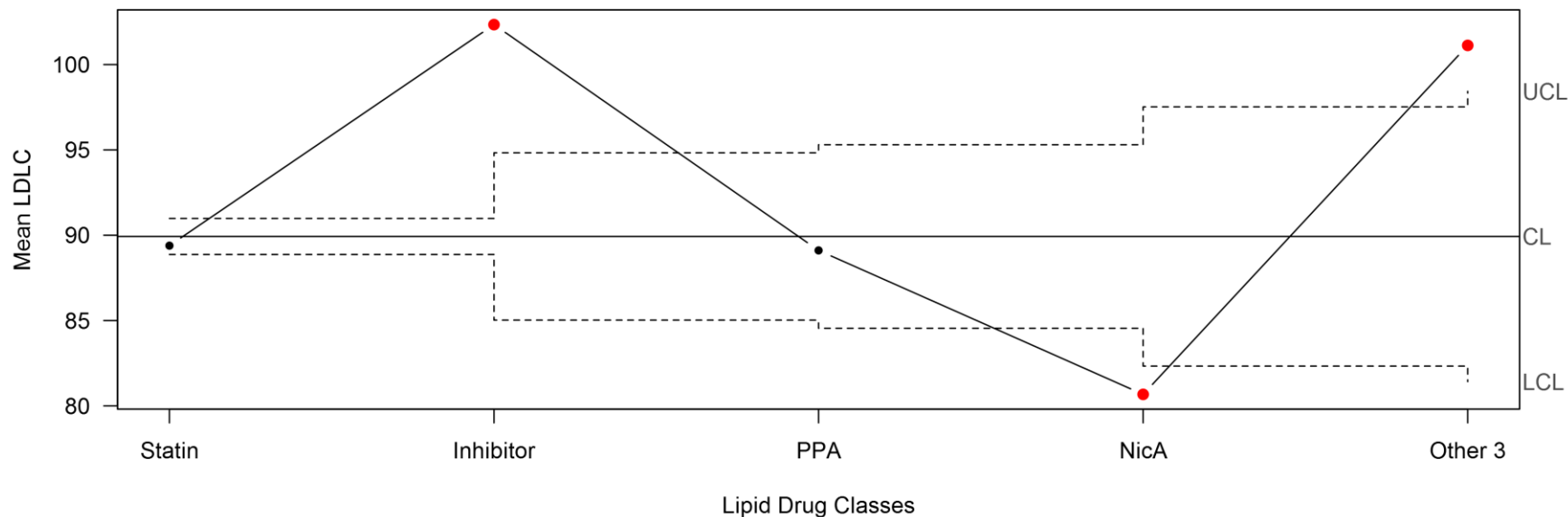
Stage A: LDLC by Lipid Class Combos (N=13,189) (8,318 patients)



Classes: Statins, PCSK9s, cholesterol inhibitors, PPAR-alpha agonists, nicotinic acids, bile acid sequestrants, omega-3 fatty acids

LDLC Varies with Drug Class

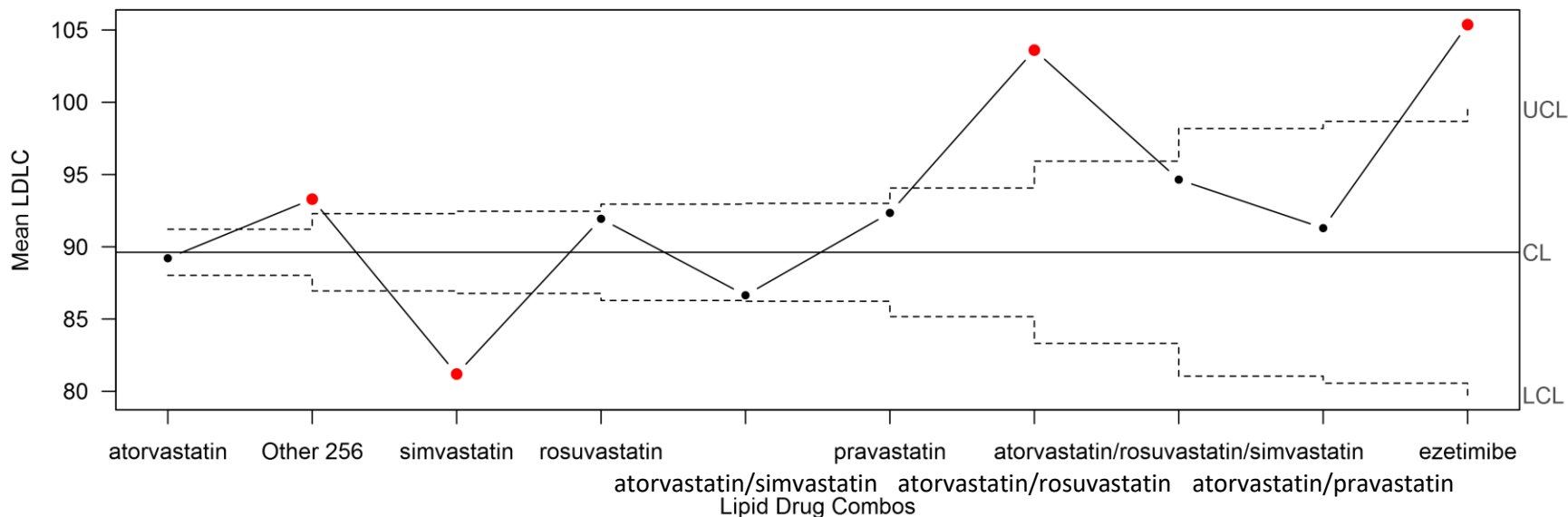
Stage A: LDLC by Lipid Drug Classes (N=14,330) (8,318 patients)



Classes: Statins, PCSK9s, cholesterol inhibitors, PPAR-alpha agonists, nicotinic acids, bile acid sequestrants, omega-3 fatty acids

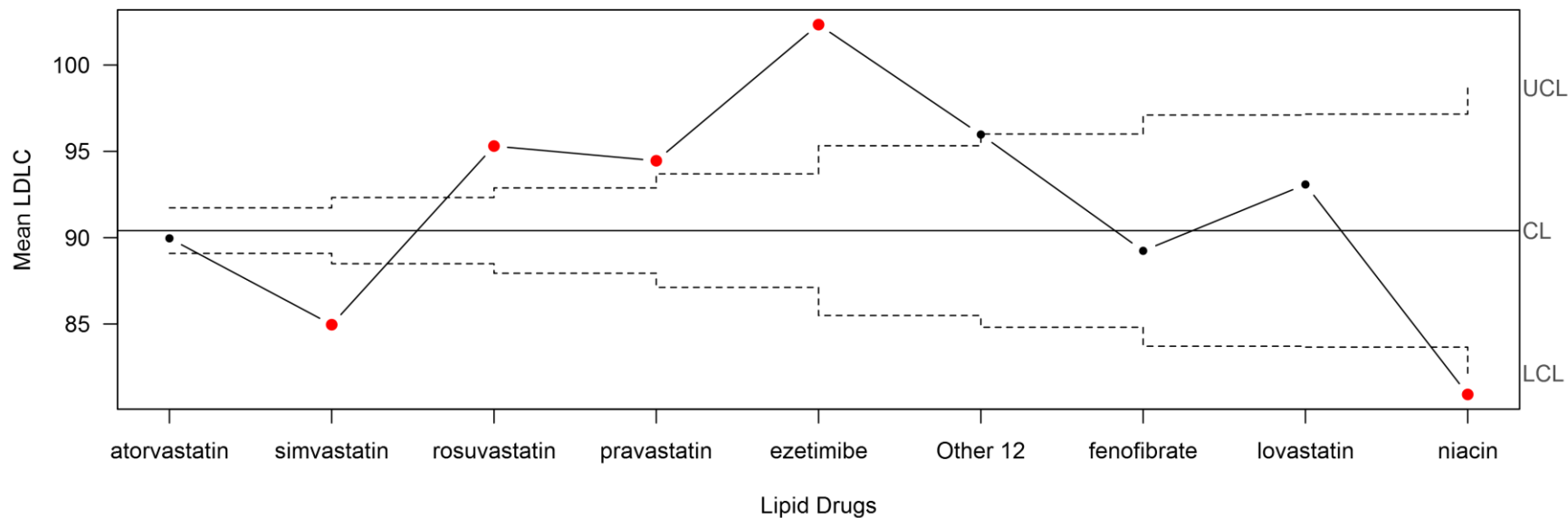
LDLC Varies with Drug Combinations

Stage A: LDLC by Lipid Drug Combos (N=13,189) (8,318 patients)



LDLC Varies with Drug Treatment

Stage A: LDLC by Lipid Drugs (N=17,724) (8,318 patients)

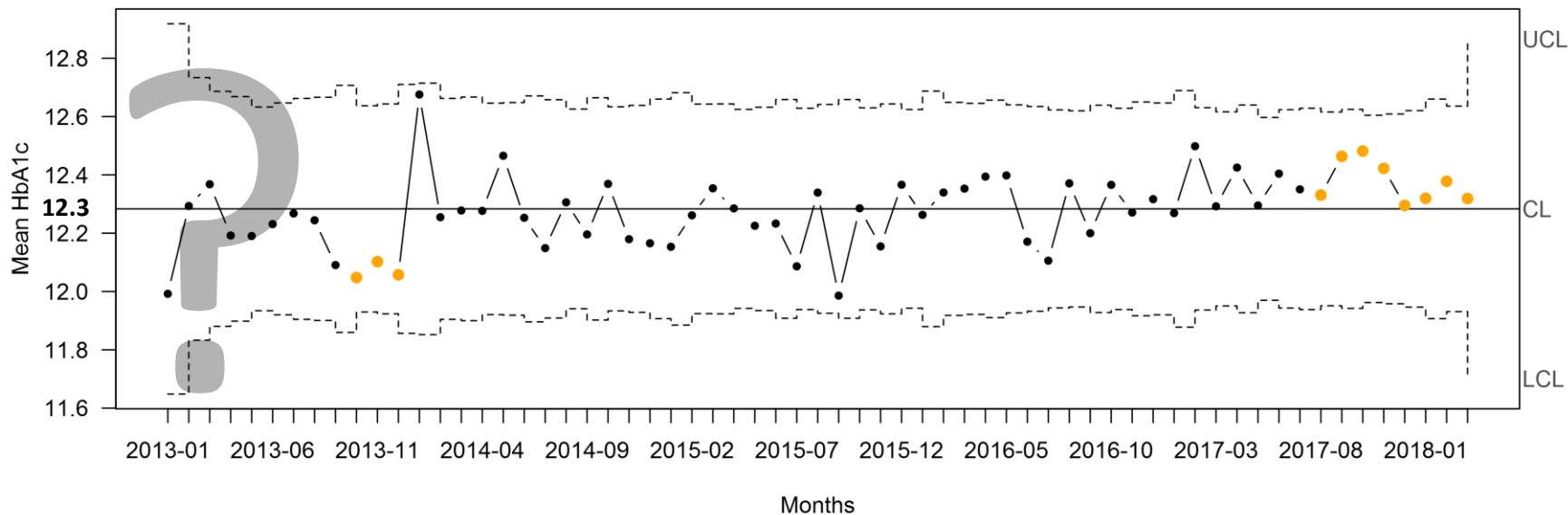


Diabetes

How is diabetes and cardiovascular risk being managed?

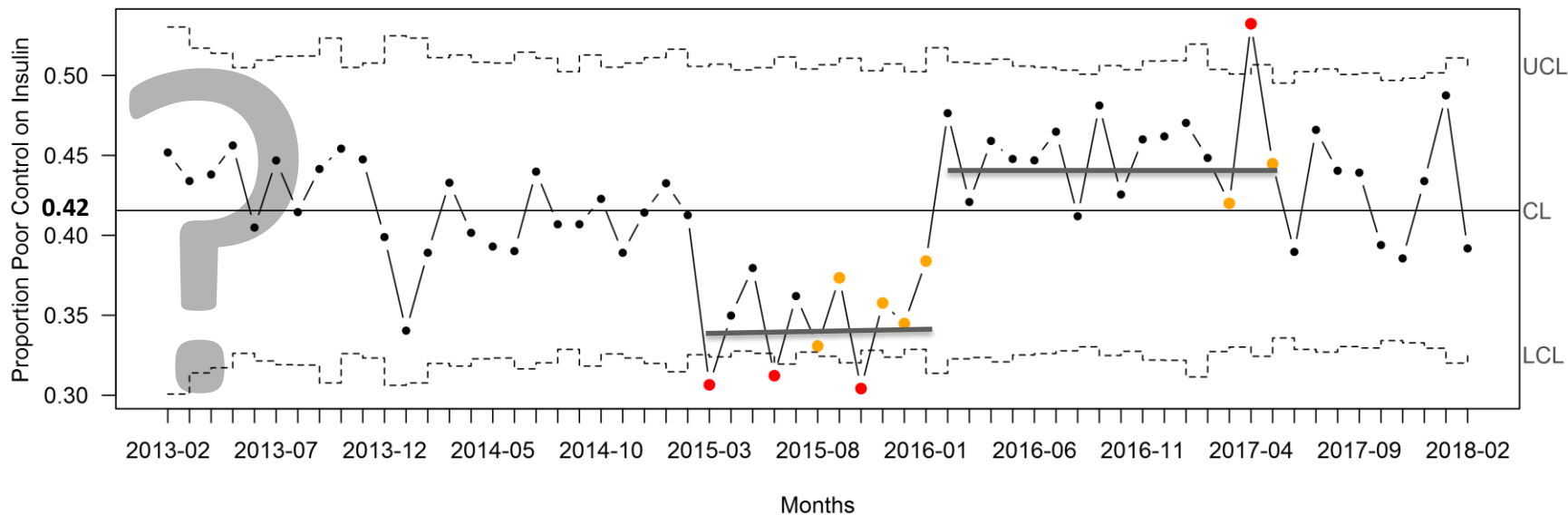
Mean HbA1c Variation Over Time

Stage A: HbA1c (N=16,949) (11,211 patients)



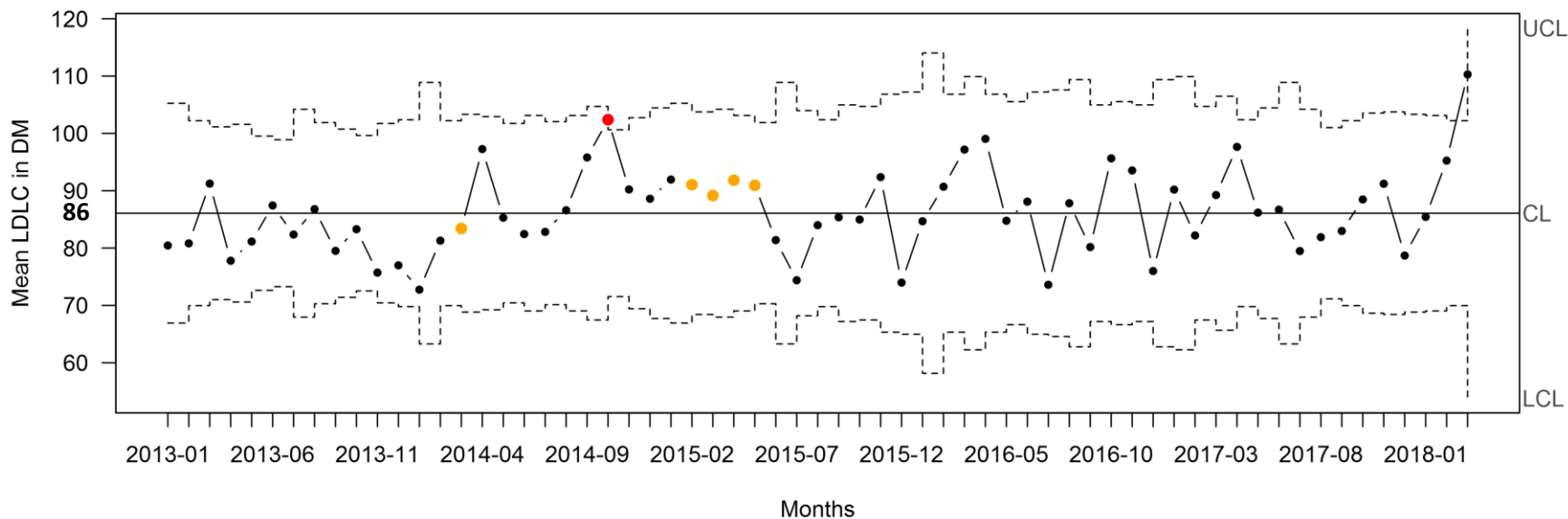
Proportion with Poor HbA1c Control on Insulin

Stage A: Poor Control on Insulin (N=15,725) (11,211 patients)



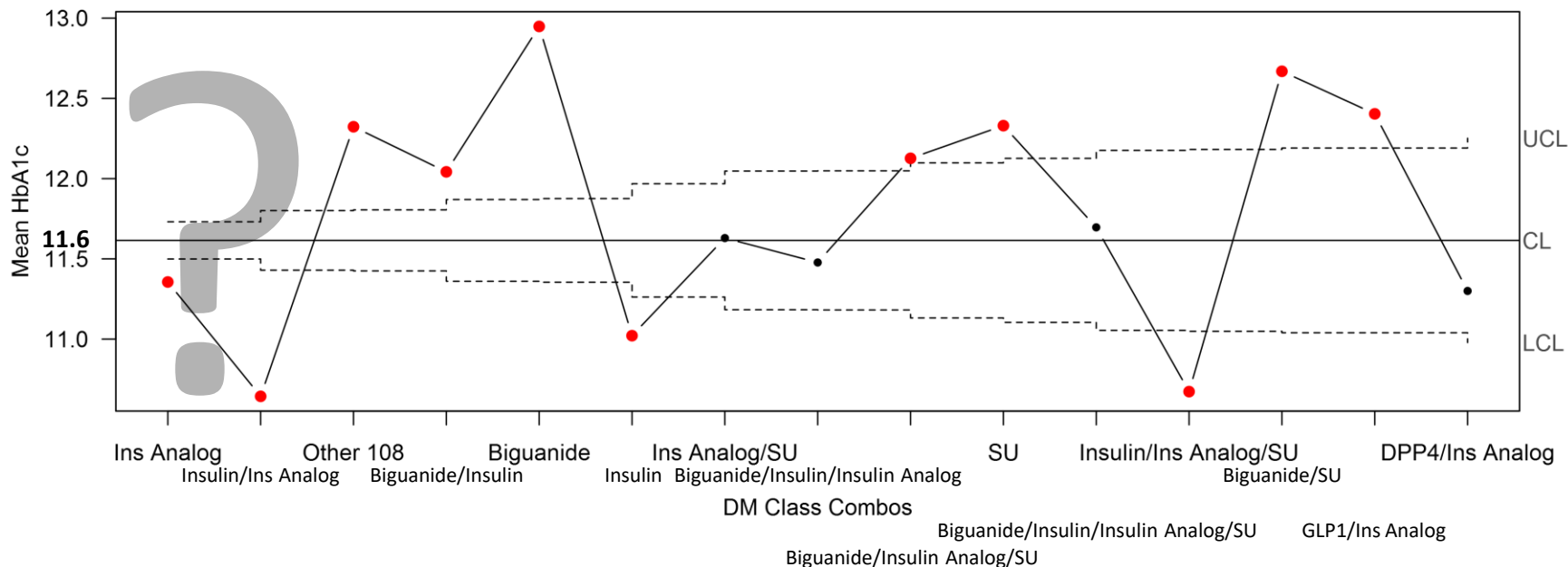
LDLC Variation Over Time in Diabetes

Stage A: LDLC in DM (N=2,507) (1,812 patients)



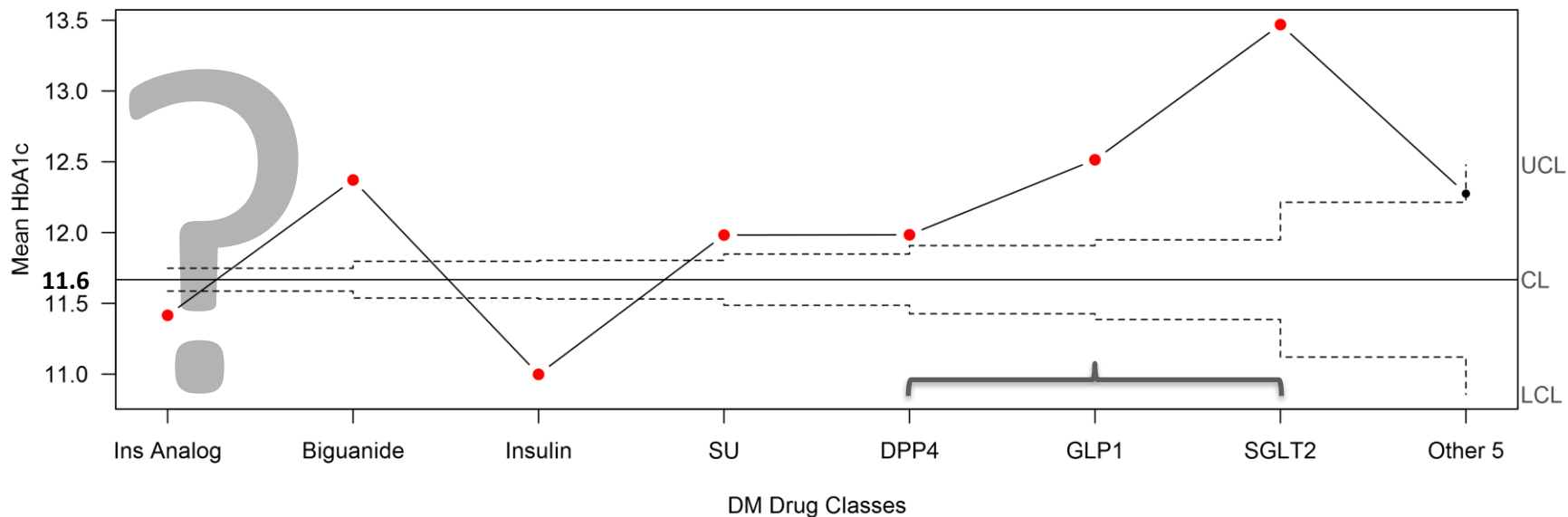
HbA1c Varies with Drug Class Combos

Stage A: HbA1c by DM Class Combos (N=6,247) (4,517 patients)



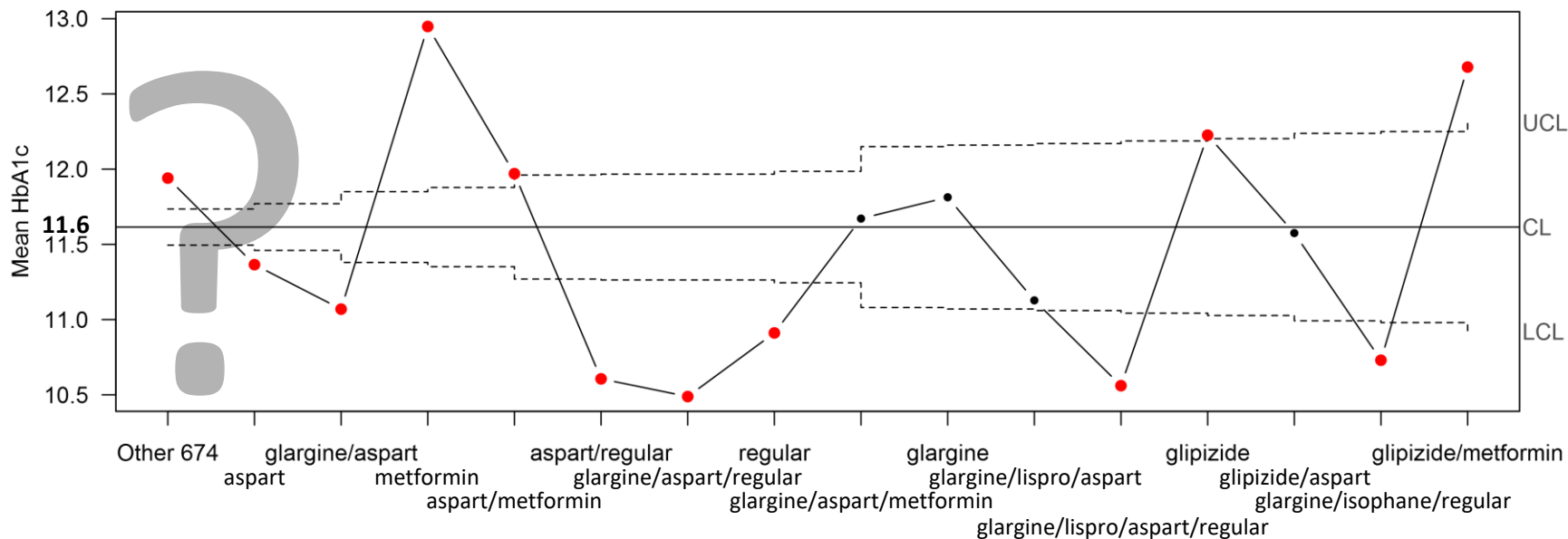
HbA1c Varies with Drug Classes

Stage A: HbA1c by DM Drug Classes (N=10,878) (4,517 patients)



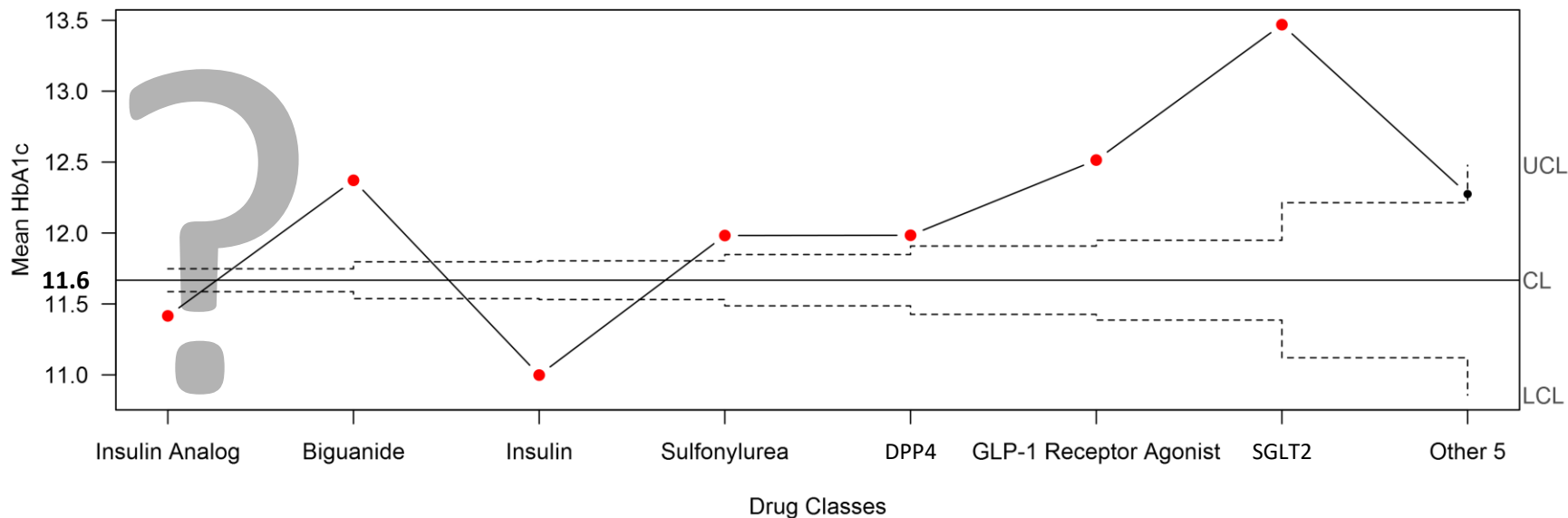
HbA1c Varies with DM Drug Combinations

Stage A: HbA1c by DM Drug Combos (N=6,247) (4,517 patients)



HbA1c Varies with DM Drug Class

Stage A: HbA1c by Drug Classes (N=10,878) (4,517 patients)



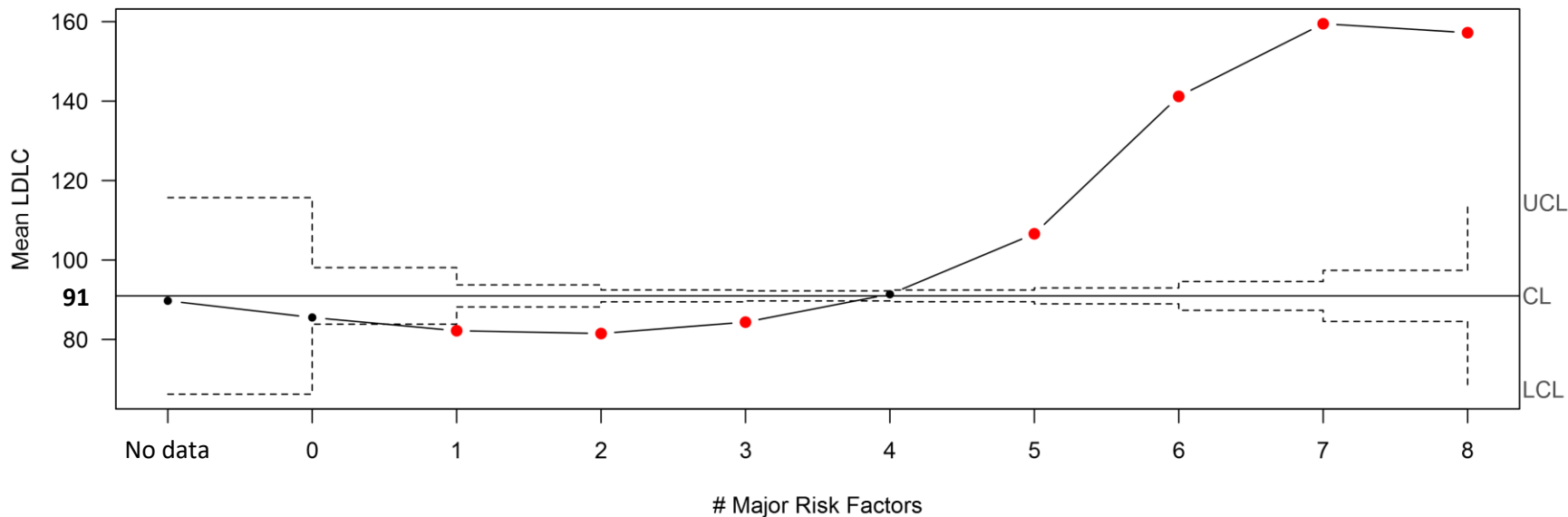
Population Risk Profiles

How do lipid profiles compare among different risk categories?

Mean LDLC Stratified by # of Major Risk Factors

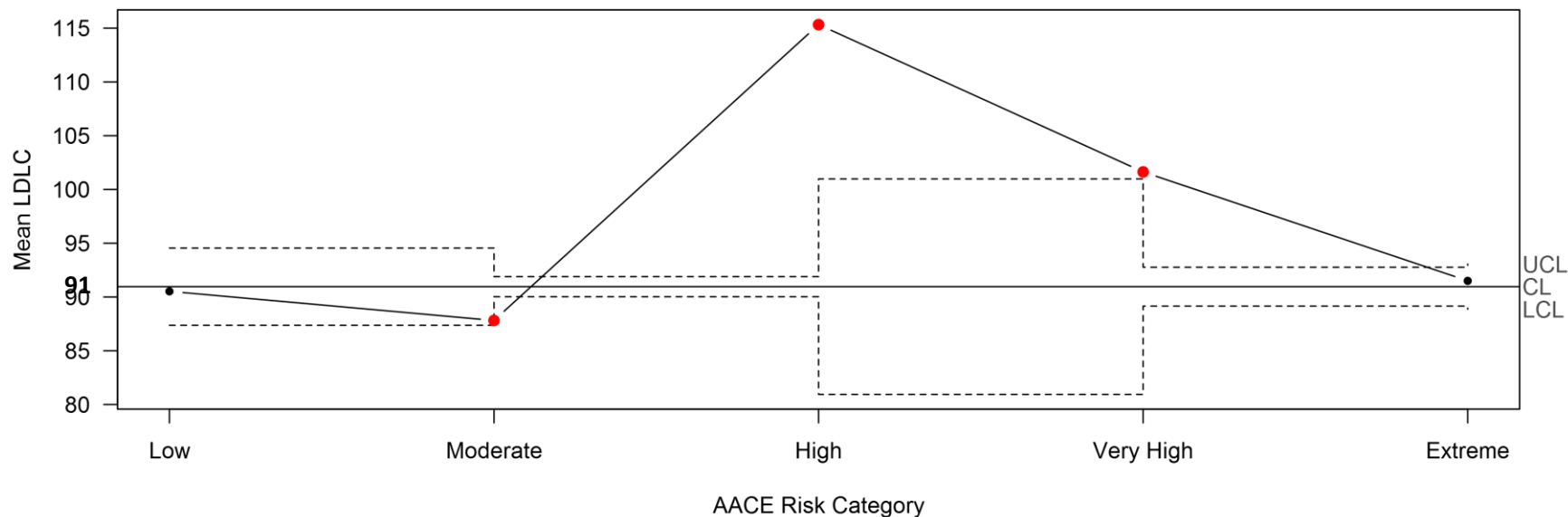
Age, Cholesterol, non-HDL, LDL, HDL, DM, CKD III/IV, Smoking

Stage A: LDLC by # Major Risk Factors (N=22,529) (12,828 patients)



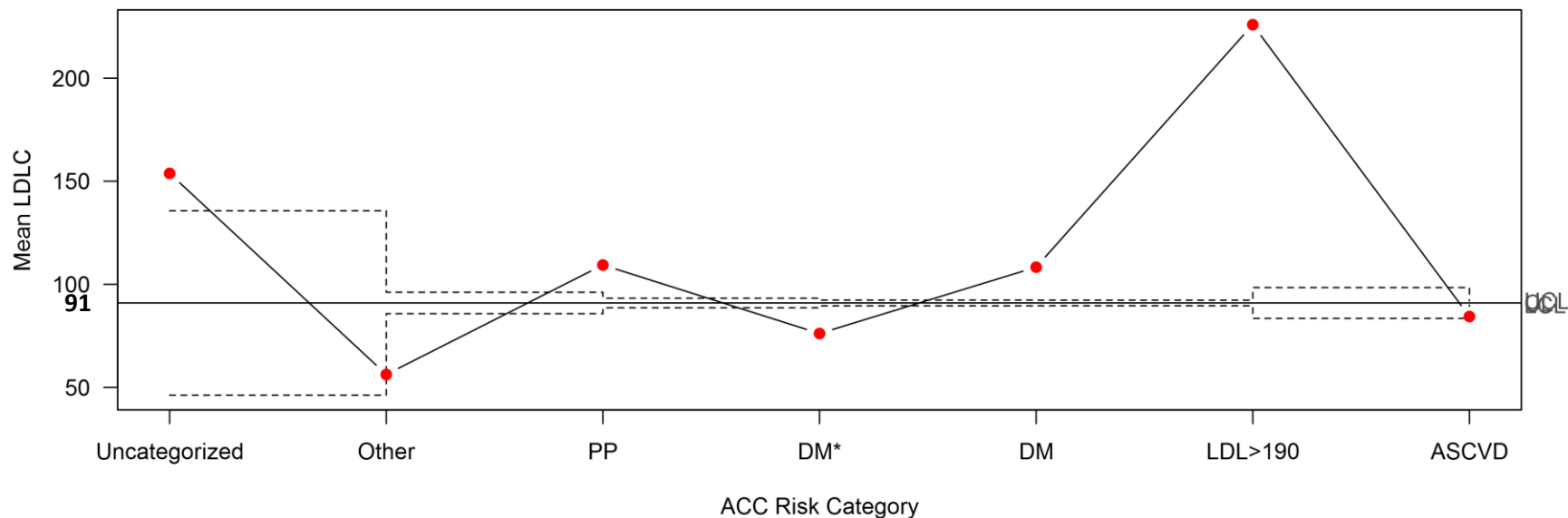
Mean LDLC Stratified by AACE ASCVD Risk Category

Stage A: LDLC by AACE Risk Category (N=22,529) (12,828 patients)



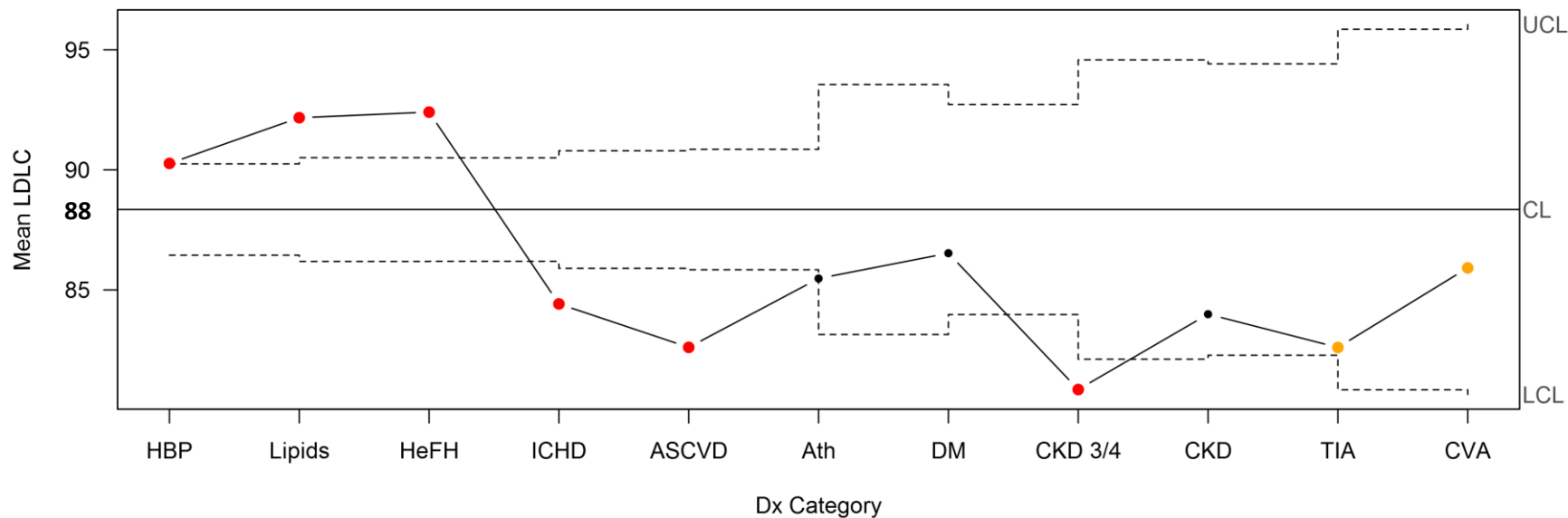
Mean LDLC Stratified by ACC ASCVD Risk Category

Stage A: LDLC by ACC Risk Category (N=22,529) (12,828 patients)



LDLC Stratified by Diagnosis

Stage A: LDLC by Dx Category (N=15,124) (12,493 patients)

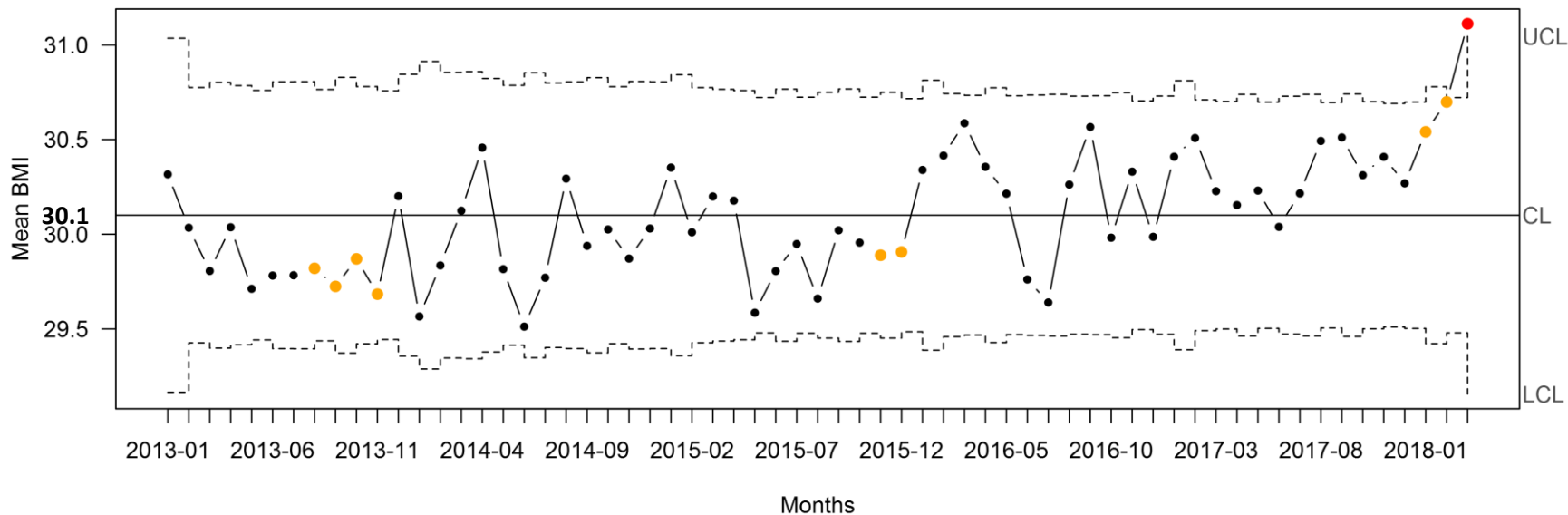


Population Weight

How does body mass effect lipid outcomes?

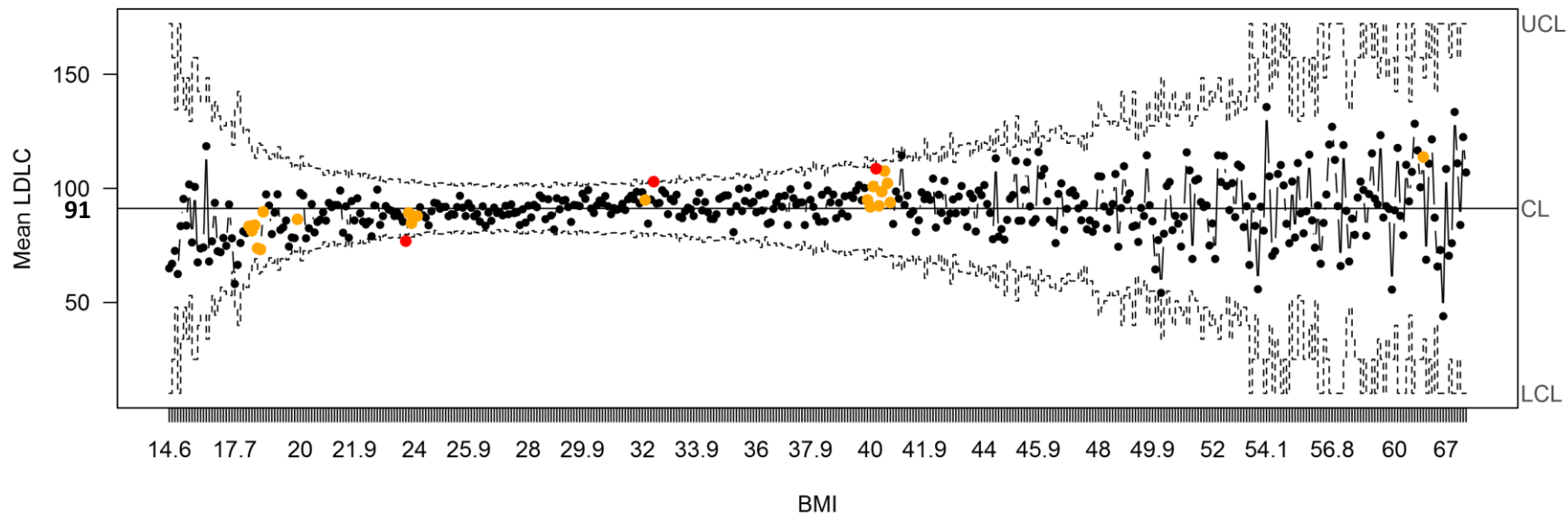
Population BMI Variation Over Time

Stage A: BMI (N=75,498) (20,787 patients)



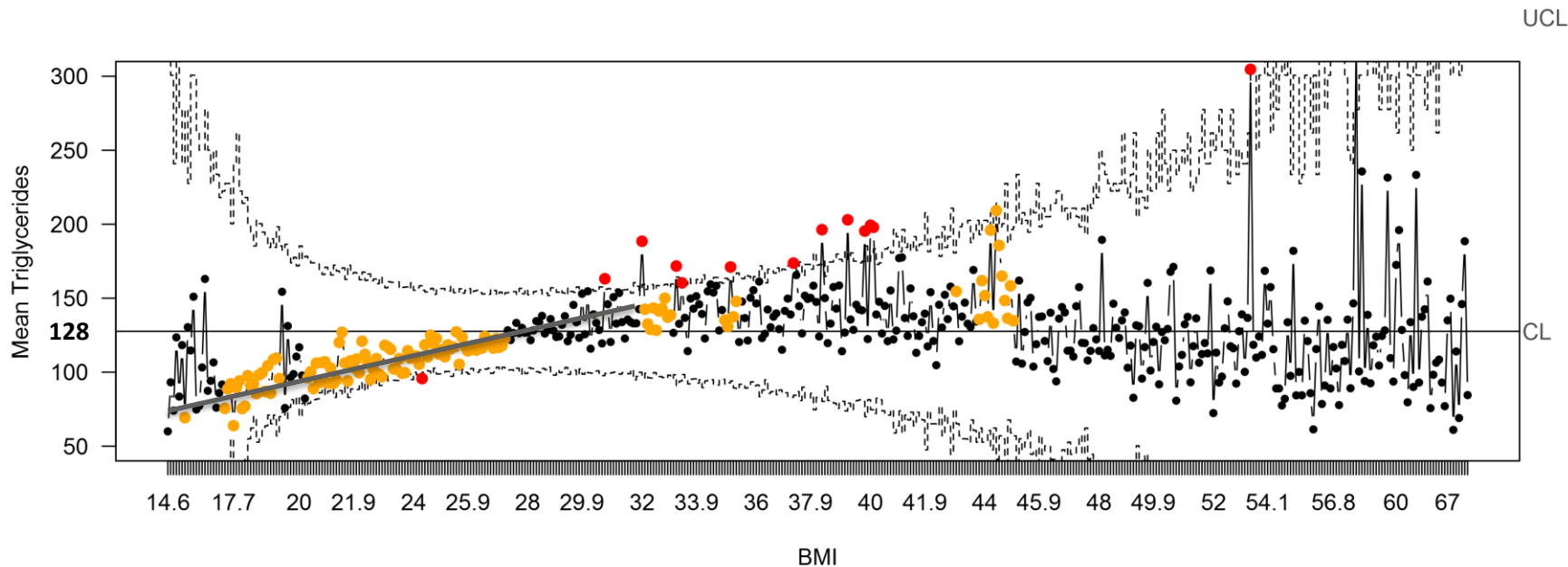
LDLC vs BMI

Stage A: LDLC by BMI (N=20,084) (12,010 patients)



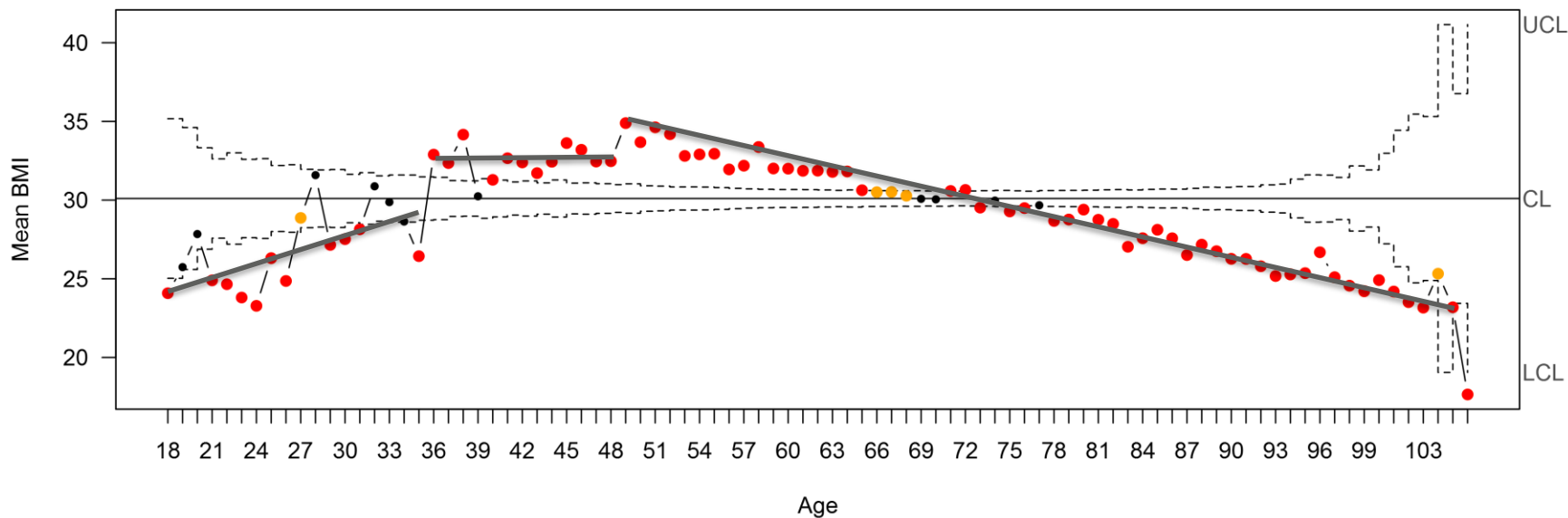
Triglycerides vs BMI

Stage A: Triglycerides by BMI (N=20,363) (12,114 patients)



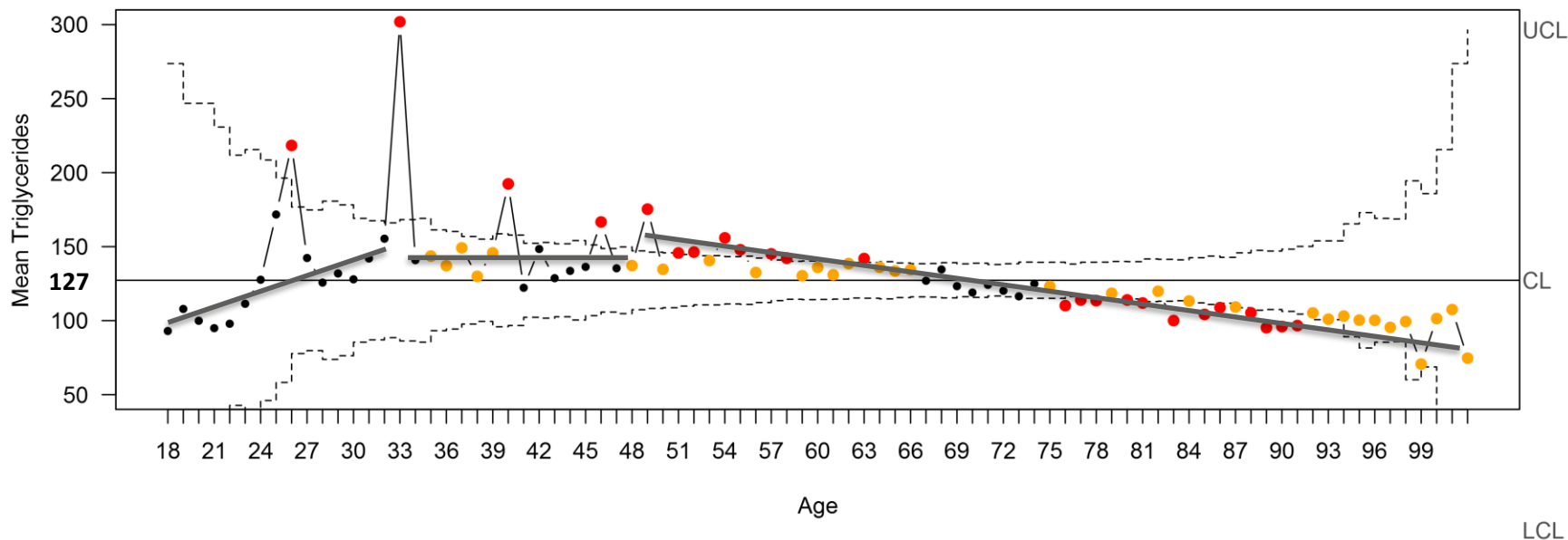
Population BMI Variation With Age

Stage A: BMI by Age (N=75,498) (12,010 patients)



Population Triglyceride Variation With Age

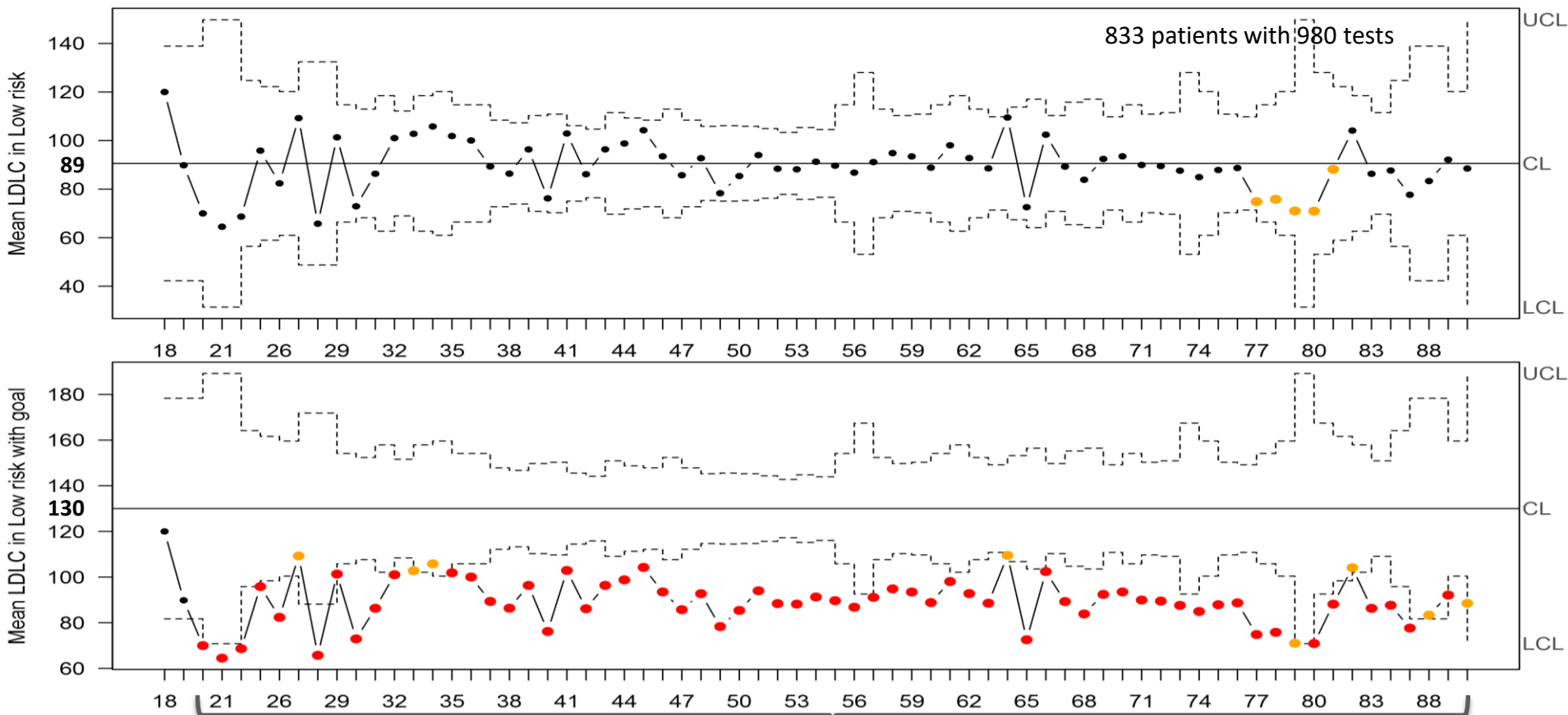
Stage A: Triglycerides by Age (N=22,830) (12,931 patients)



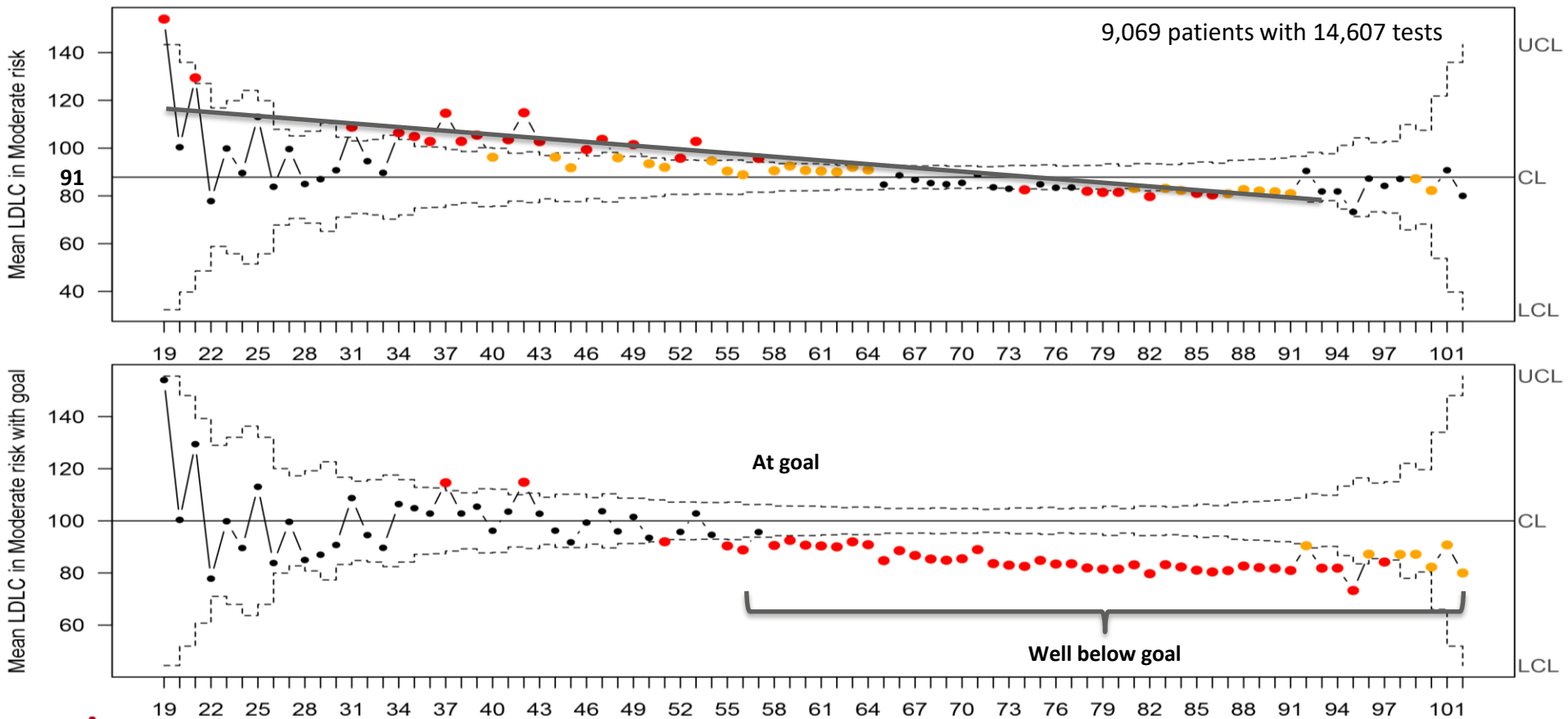
LDLC by AACE Risk Categories

Do AACE risk categories have different clinical variation?

LDLC By Age Compared to AACE Low Risk Goal

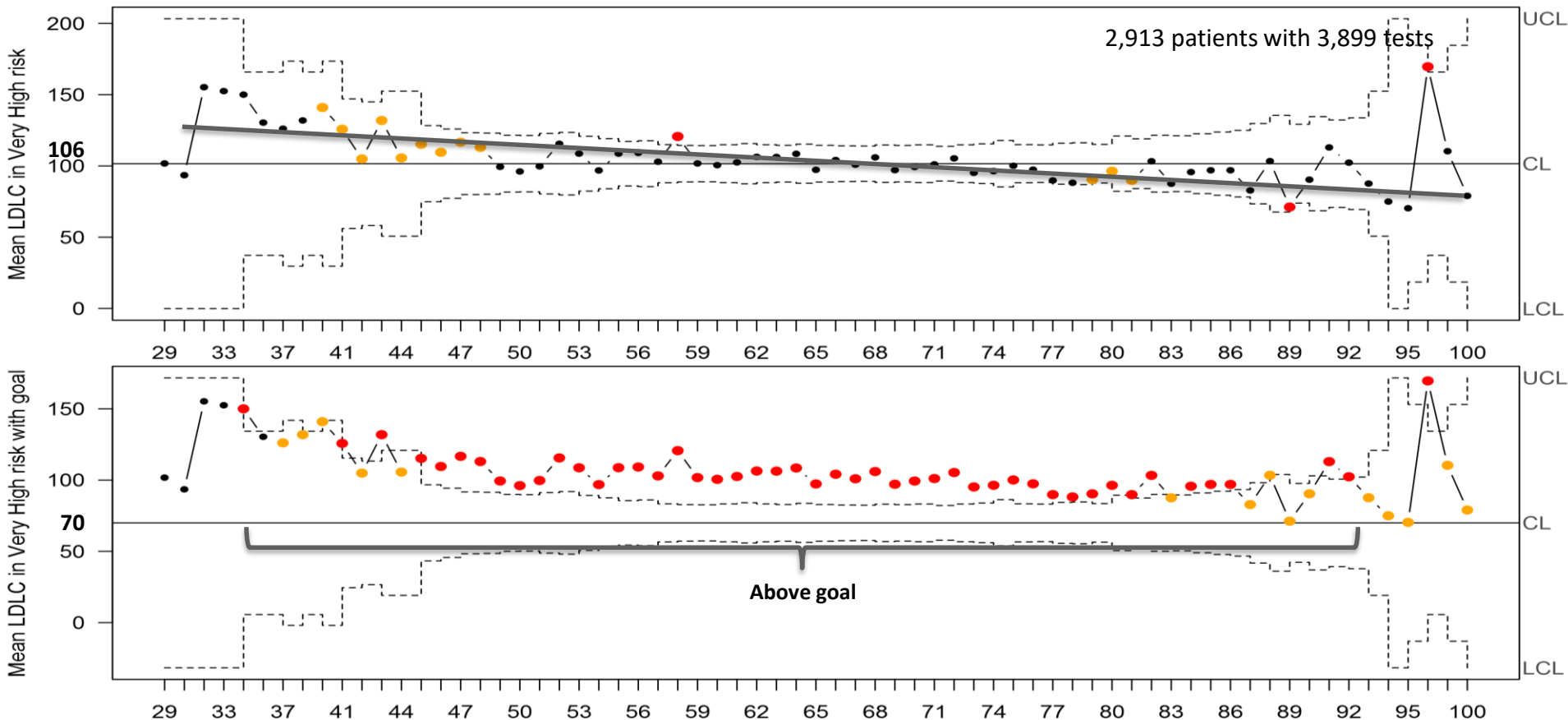


LDLC By Age Compared to AACE Moderate Risk Goal

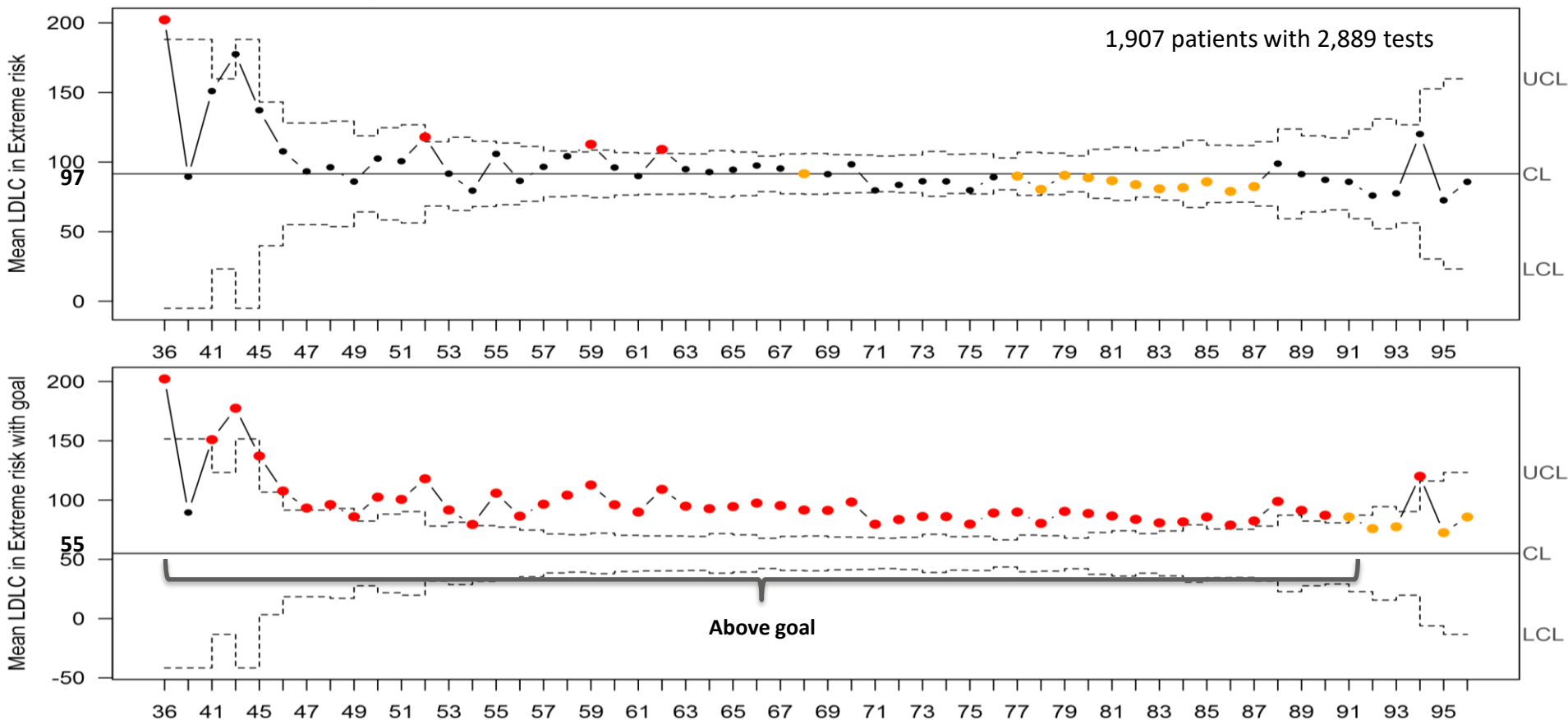




LDLC By Age Compared to AACE Very High Risk Goal



LDLC By Age Compared to AACE Extreme Risk Goal

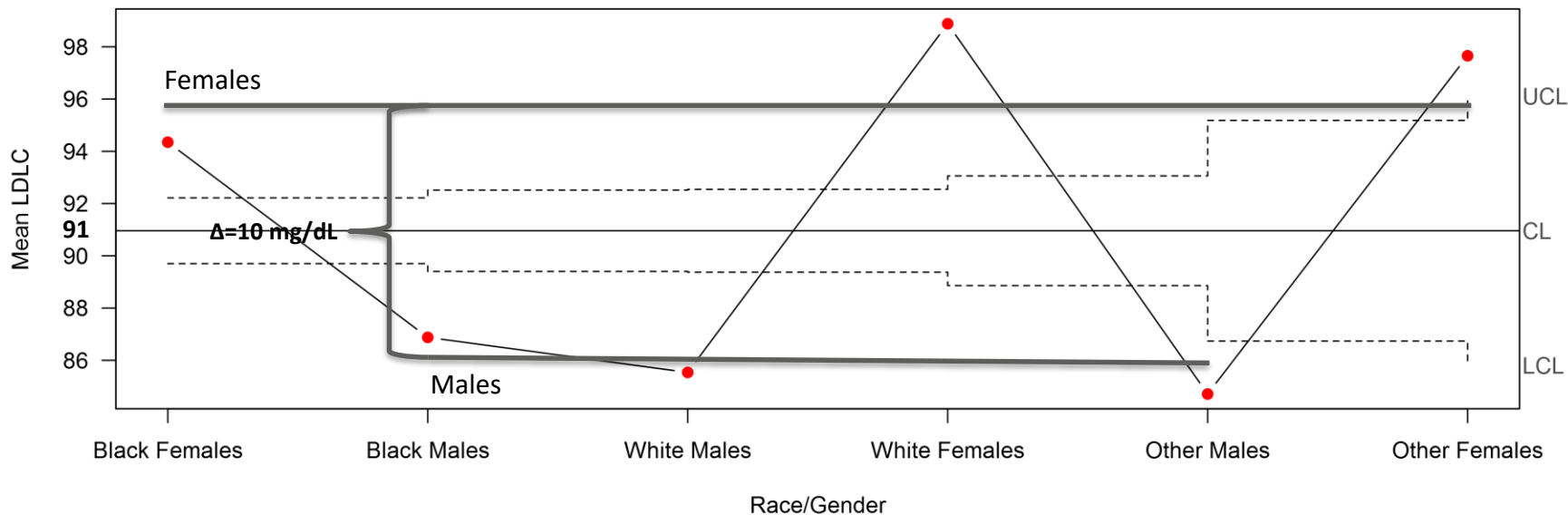


Treatment Disparities

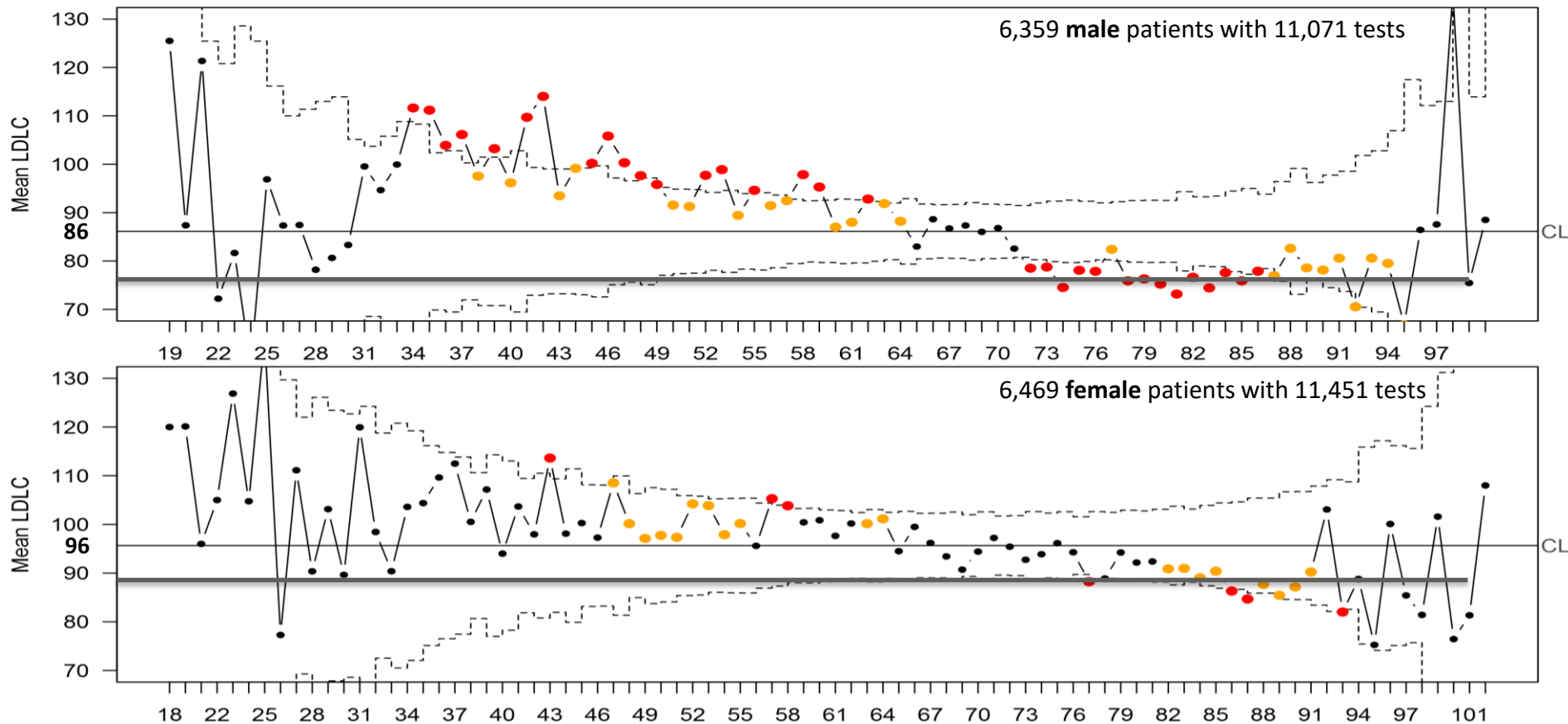
Do population outcomes differ with race or gender?

Mean LDLC Stratified by Race and Gender

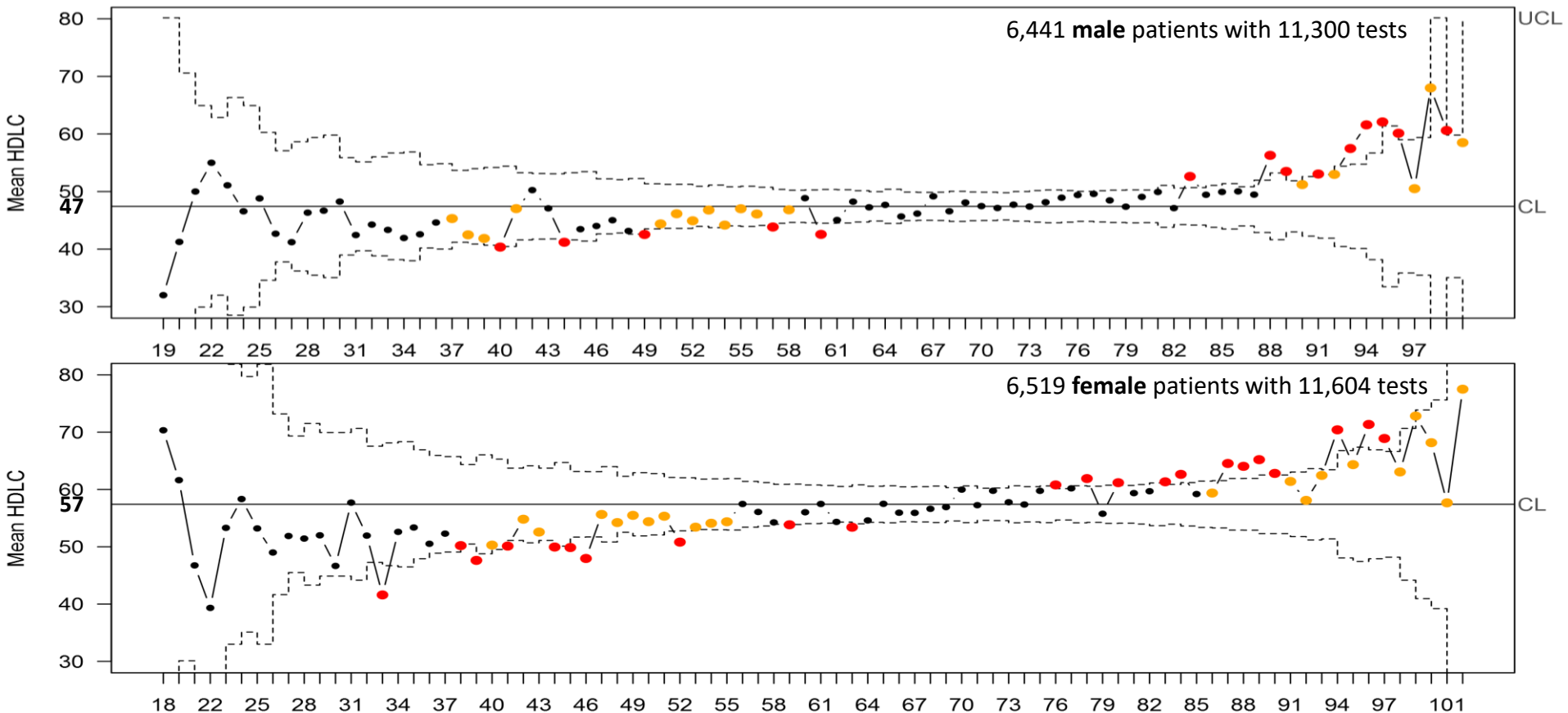
Stage A: LDLC by Race/Gender (N=22,529) (12,828 patients)



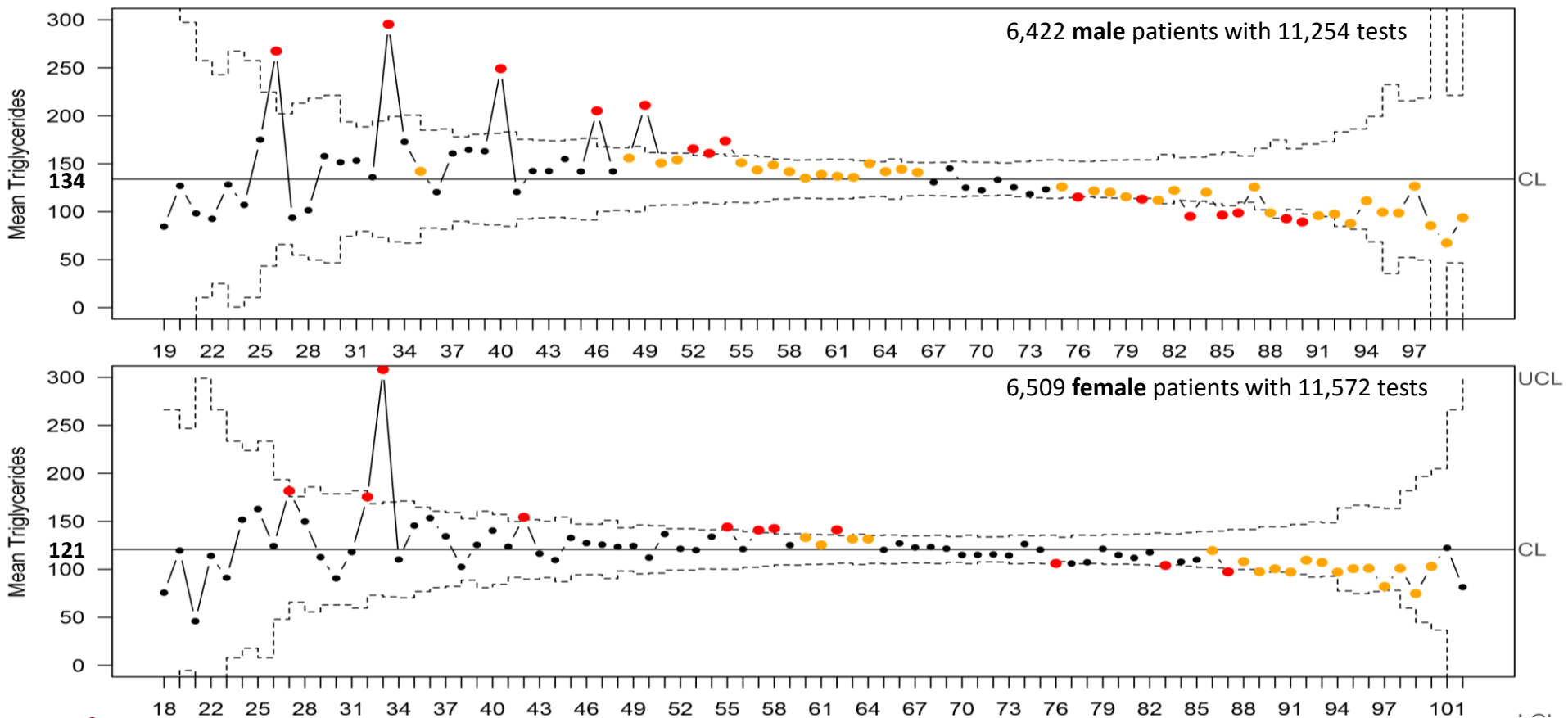
Mean LDLC Stratified by Age and Gender



Mean HDLC Stratified by Age and Gender



Mean Triglycerides Stratified by Age and Gender



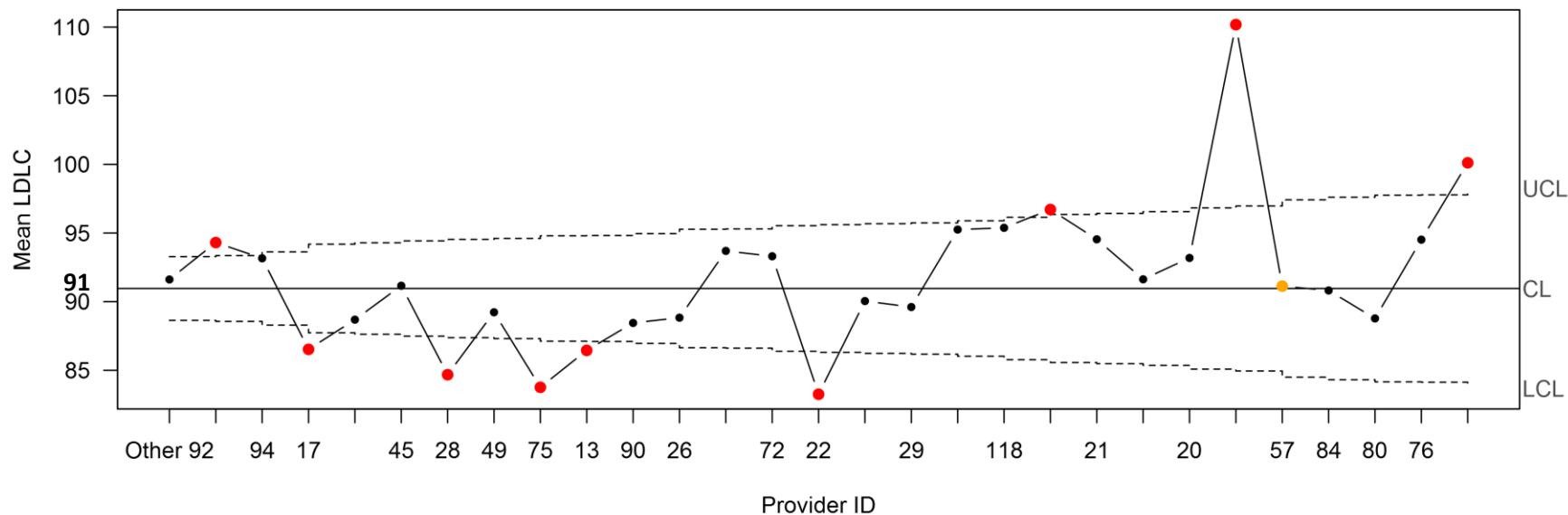
Providers and Risk Profiles

Do providers achieve different outcomes?

Is population risk profile changing over time?

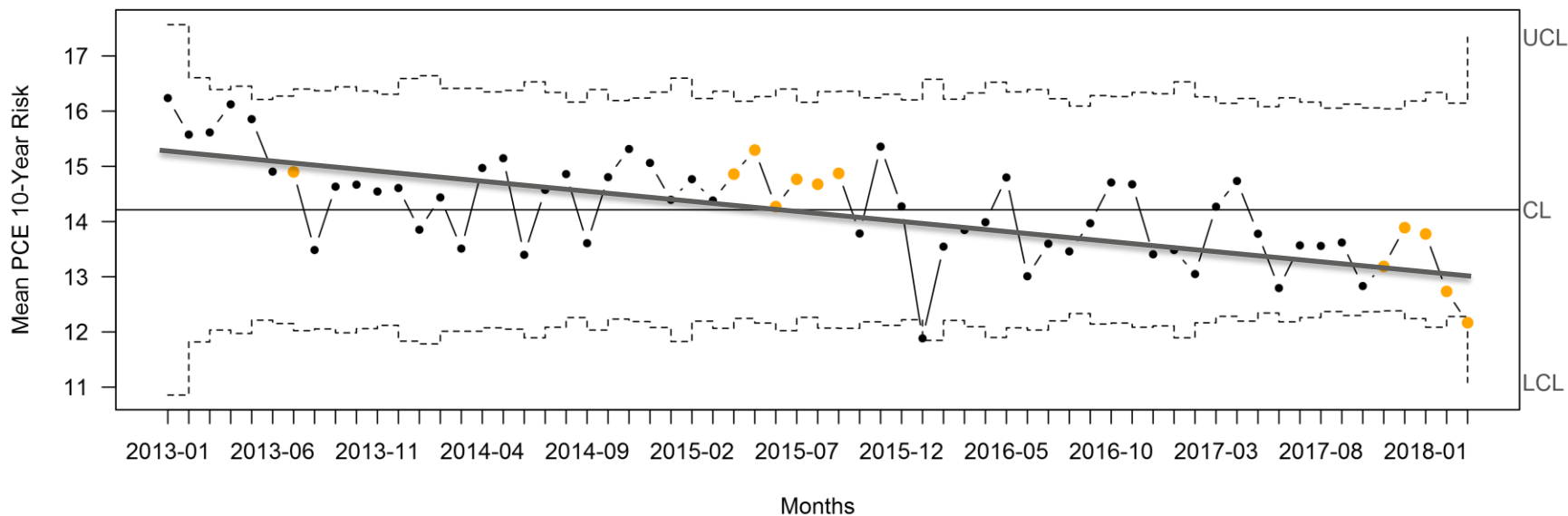
LDLC Stratified by Provider

Stage A: LDLC by Provider ID (N=22,529) (120 providers managing 12,828 patients)



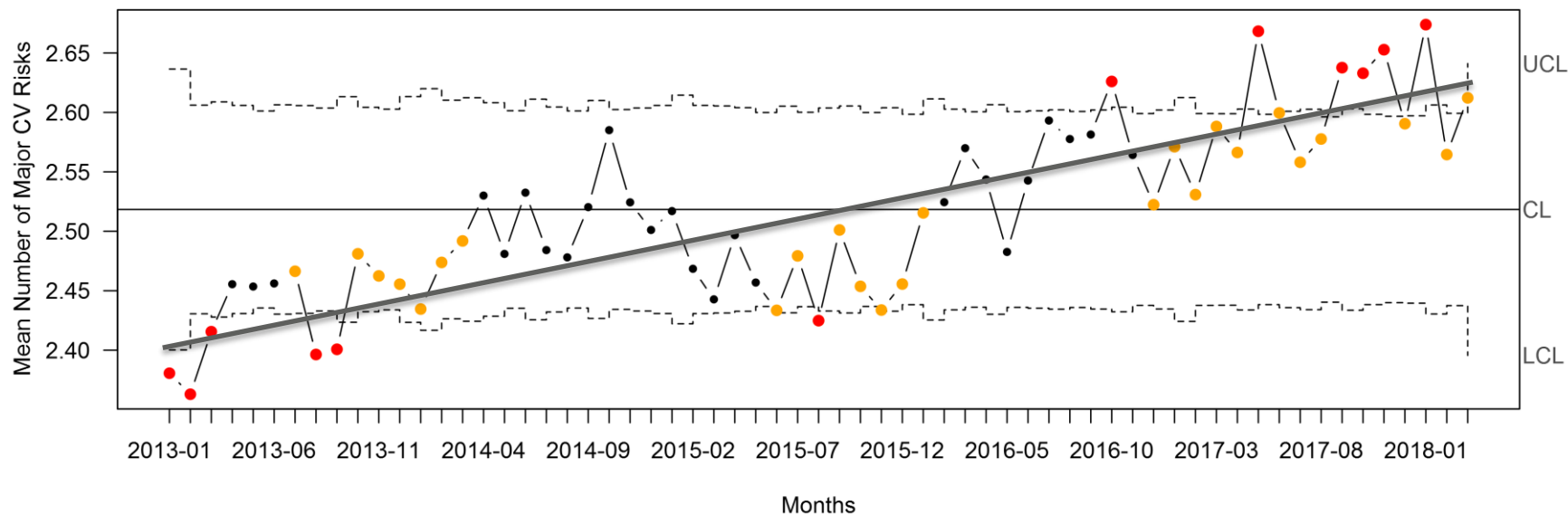
LDLC Stratified by PCE 10-Year Risk Estimates

Stage A: PCE 10-Year Risk (N=13,782) (8,287 patients)



LDLC Stratified by Number of CV Risk Factors

Stage A: Number of Major CV Risks (N=87,762) (21,950 patients)



Potential Quality Issues to Assess and Address

Structural

- EHR lab and data gaps for managing and monitoring population health

Process

- Compare and select among current dyslipidemia guidelines
- Undercoding for ASCVD risk factors of obesity, prediabetes, diabetes
- Better assessment of diabetes population

Outcome

- Dyslipidemia undertreatment with progressive increase in ASCVD risk
- Decrease proportion of patients with poor diabetes control
- Gender disparity in dyslipidemia management
- Poorer dyslipidemia control in younger, at-risk patients

Dyslipidemia Comparison

University of Chicago and NorthShore

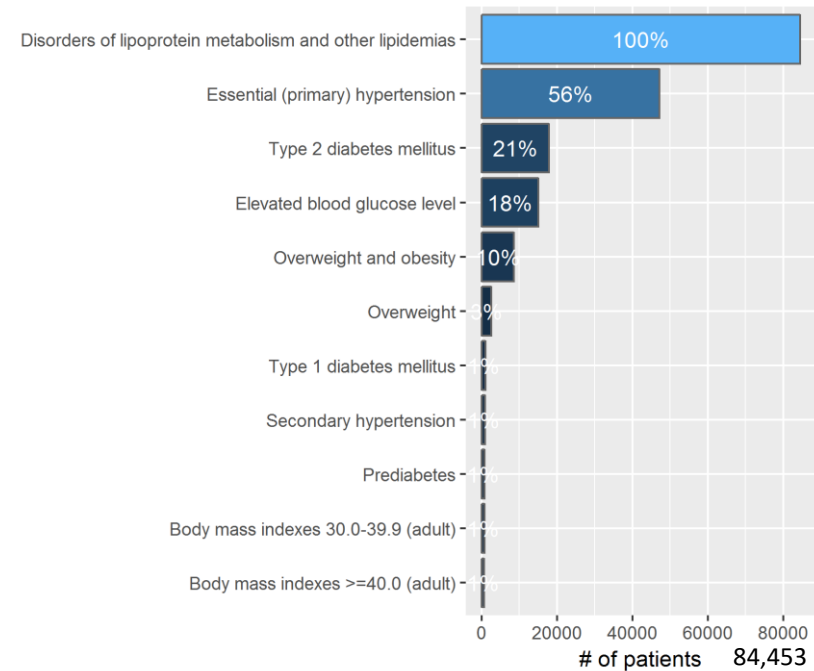
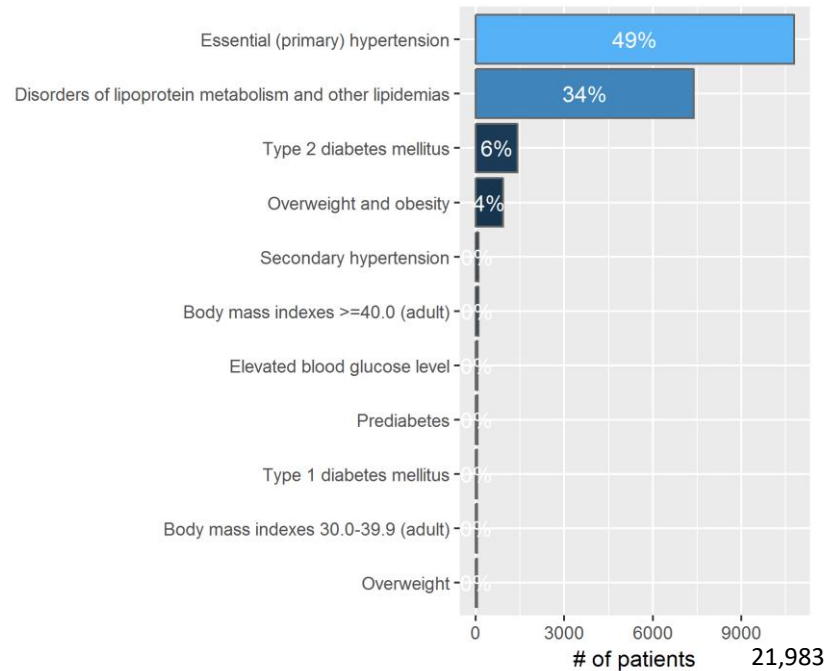


Baseline Data – Demographics

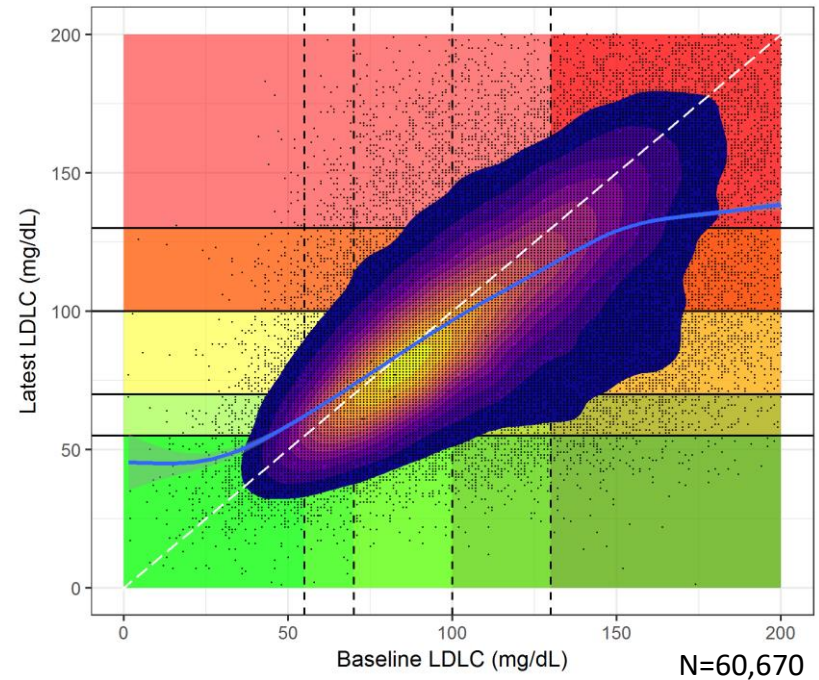
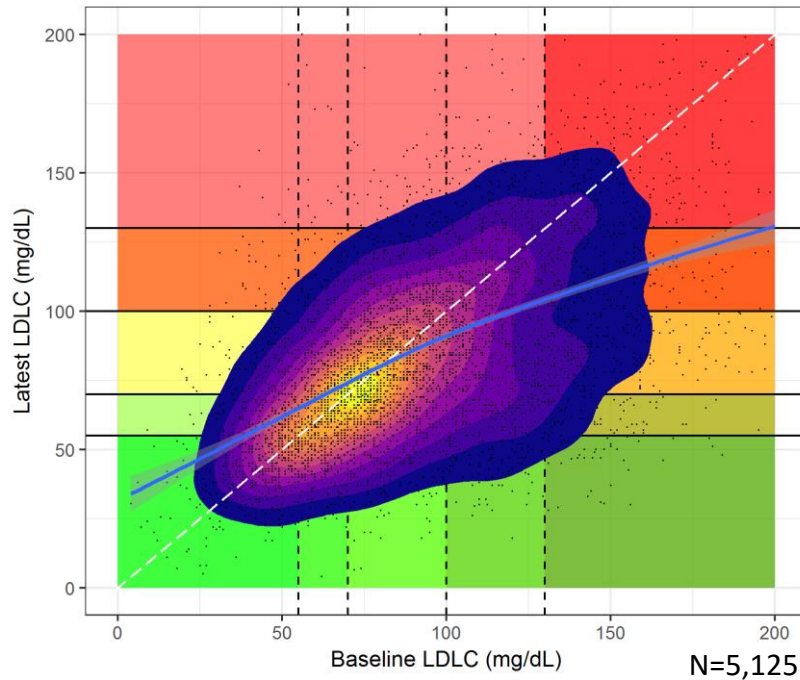
Total N=20,871; Mean Age=64	N	%
Gender		
Male	10,658	51.1%
Female	10,213	48.9%
Race		
African American	9,978	46.9%
White	9,750	46.7%
Asian/Mideast Indian	643	3.1%
Other	419	2.0%
American Indian or Alaskan Native	81	0.4%
CVD/CV Risk Diagnoses		
Hypertension	10,781	49.0%
Dyslipidemia	7,632	34.7%
Coronary Artery Disease	6,681	30.4%
Diabetes/prediabetes	1,658	7.5%
Peripheral Vascular Disease	955	4.3%

Total N=84,463; Mean Age=64	N	%
Gender		
Male	43,772	51.8%
Female	40,681	48.2%
Race		
White	58,778	69.6%
Other	17,562	20.8%
Asian	4,090	4.8%
African American	3,598	4.3%
American Indian or Alaskan Native	192	0.2%
CVD/CV Risk Diagnoses		
Hypertension	44,338	52.5%
Diabetes	18,510	21.9%
Dyslipidemia	14,530	17.2%
Coronary Artery Disease	12,908	15.3%
Peripheral Vascular Disease	2,821	3.3%

Cardiovascular Risk Factor Diagnoses (ICD 10)

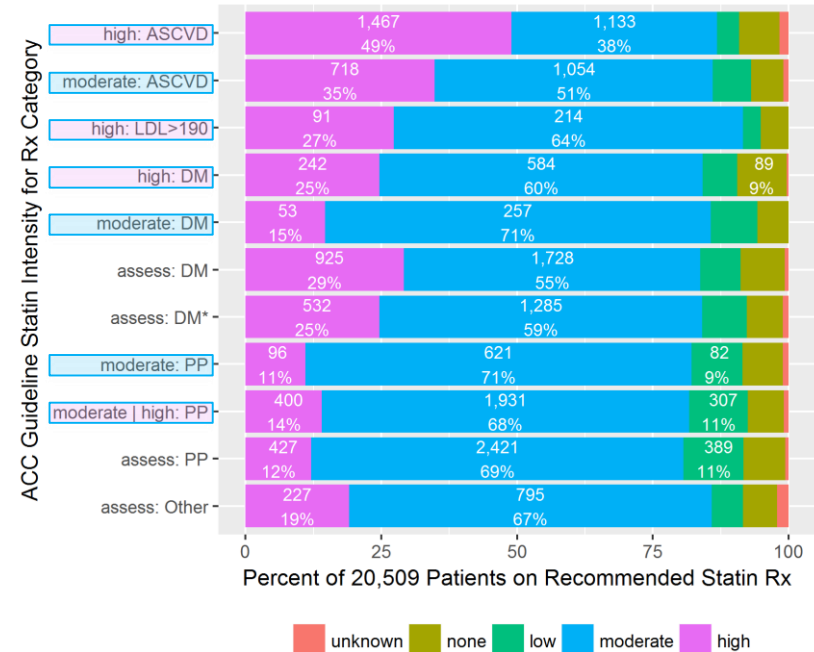
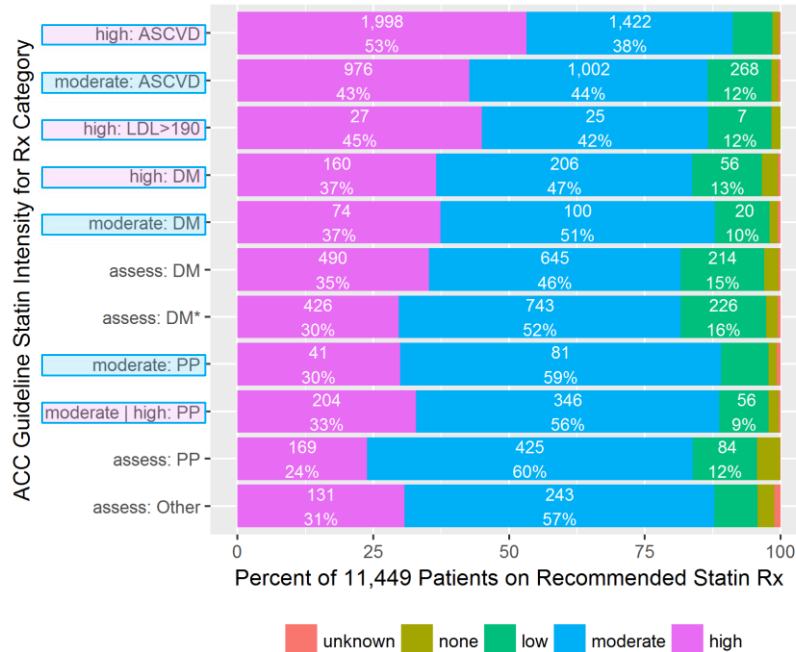


Baseline Data – Evolving Individual LDLC Change



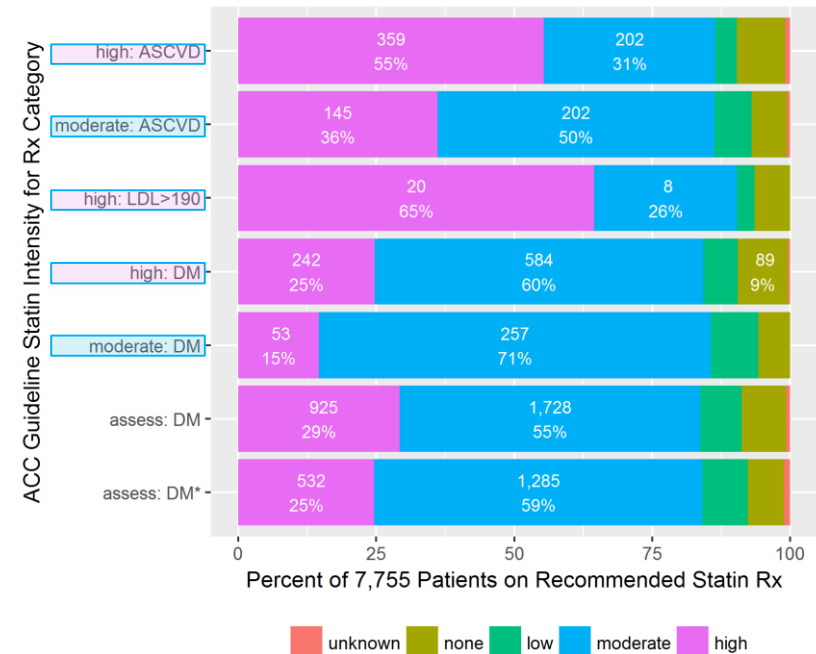
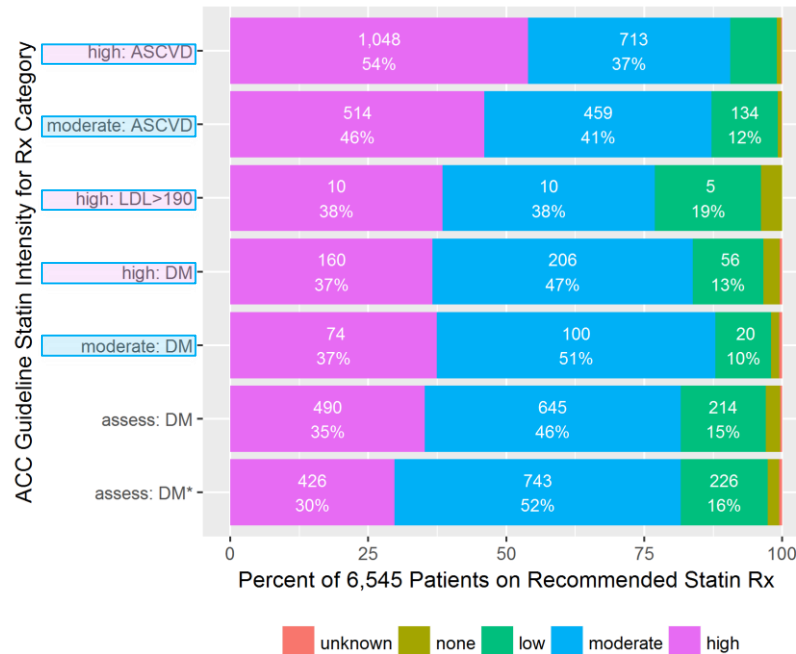
Statin Rx for ACC Risk Categories

Only includes patients on lipid-lowering drugs

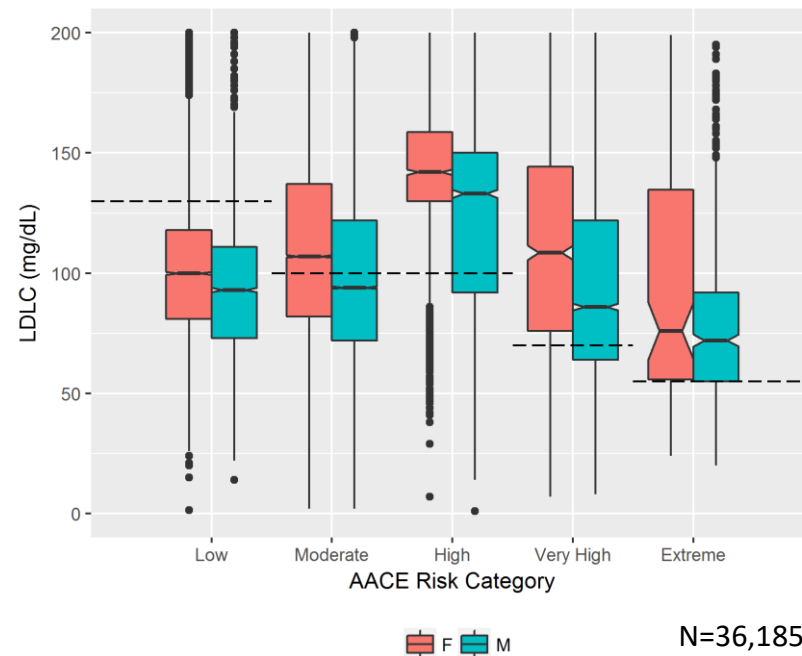
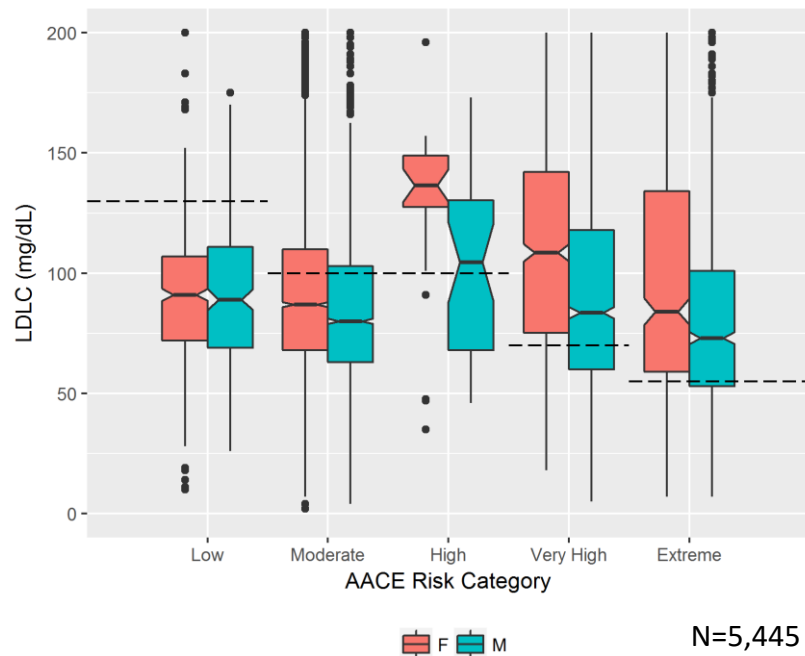


Statin Rx for ACC Risk Categories

Only includes patients with diabetes on lipid-lowering drugs



Baseline Data –LDLC Stratified



Baseline Data – Patients Not at AACE Goals

