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Abstract

Background: *While LDL cholesterol measures the cholesterol content within an LDL particle (LDL-P), it may not reflect LDL-P concentrations. If discordance exists, LDL-P may better predict cardiovascular events compared to LDL-C and non-HDL cholesterol (non-HDL-C). In primary prevention patients, discordance has been associated with diabetes, ethnicity, gender, metabolic syndrome, and smoking history.*

Objective: *To describe discordance in patients of a lipid clinic by exploring associations between patient characteristics and discordance among LDL-C, non-HDL-C, or LDL-P. Secondarily to compare proportion of patients with baseline concordance versus discordance who have ASCVD events, diagnoses of new onset diabetes or death.*

Methods: *A retrospective, single-center cohort study at a large academic medical center was conducted. Patients establishing care from January 2009 through December 2012 with complete initial labs were included. Logistic regression models were used to explore associations between discordance and patient characteristics.*

Results: *Of 603 patients screened, the final cohort included 166 patients with 104 (62.7%) discordant. LDL-P was the most common discordant value. Discordance was associated with gender, smoking status, use of lipid lowering medications, and achieving patient specific LDL-C goals. In terms of any event observed after initial measurements, no significant differences were detected between discordant and concordant groups.*

Conclusion: *Within a lipid clinic population, discordance was associated with male gender, smoking status, lipid-lowering therapy, and being at patient specific LDL-C goal. While associations were found in our population, clinicians should consider measuring LDL-P to fully assess presence or extent of discordance.*

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Keywords: Lipid, Discordance, Cholesterol, Cardiovascular Disease, LDL-particle number, LDL-P

Background

Cardiovascular disease in the United States accounts for 600,000 deaths per year, translating to 1 in every 4 deaths.[1] Traditionally low-density lipoprotein cholesterol (LDL-C) has been used to determine risk of adverse cardiovascular events. However, despite current standards and achievement of Adult Treatment Panel (ATP) III defined LDL-C goals, patients with dyslipidemia remain at high risk of cardiovascular disease progression and clinical events.[2, 3] This is particularly true for patients with established coronary heart disease, low high-density lipoprotein cholesterol (HDL-C), diabetes mellitus type 2, and metabolic syndrome.[2, 3] In 2004, ATP III of the National Cholesterol Education Program released a guideline, which served as the primary dyslipidemia guideline for many years.[3, 4] In recent years, many organizations have published clinical guidelines on the management of dyslipidemia.[5-9] Each of these guidelines has a unique stance on cardiovascular risk assessment and targets of treatment. Despite differences in recommendations, each guideline agrees that LDL-C is important in identifying and assessing cardiovascular risk.

Beyond identifying and assessing cardiovascular risk, LDL-C or non-HDL-C has been the primary target of therapy for cardiovascular risk reduction, and in some way, each guideline supports this recommendation. While LDL-C measures the cholesterol content within an LDL particle (LDL-P), it may not be reflective of the concentration of LDL-P. Evidence has suggested that when discordance is present between LDL-C, non-HDL-C, and LDL-P, concentration of LDL-P may better predict cardiovascular risk. [10-13] However, current guidelines do not endorse measurement of LDL-P for all patients, nor is it a primary target of therapy. Without the recommendation for

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routine measurement in place, studies have attempted to determine patient characteristics that may be associated with discordance between LDL-C, non-HDL-C, or LDL-P. Discordance has been studied in healthy, statin-medication naïve, and primary prevention community patients. Within this population, discordance has been associated with gender, diabetes, smoking history, obesity, ethnicity, and metabolic syndrome.[11,12, 14] In patients treated with lipid-lowering medication, discordance between LDL-C and LDL-P is enhanced as statin medications lower LDL-C to a greater extent than lowering LDL-P.[15] Discordance has not been described in the setting of complex patients within a lipid clinic.

The primary purpose of this study is to describe discordance in patients of a lipid clinic by exploring associations between patient characteristics and discordance between LDL-C, non-HDL-C, or LDL-P. The secondary objective is to compare rates of composite and separate endpoints of ASCVD events, diagnoses of new onset diabetes, and/or death in patients with concordance versus discordance.

Methods

We conducted a retrospective, single-center cohort study at The Ohio State University Wexner Medical Center's (OSUWMC) Cardiovascular Risk Reduction and Lipid Clinic. The OSUWMC health-system has over 1300-beds in a tertiary multidisciplinary academic medical center located in Columbus, OH. The Richard M. Ross Heart Hospital has over 150-beds specializing in cardiovascular medicine located on the OSUWMC's campus. Within the Ross Heart Hospital, the Ross Ambulatory Care Center (ACC) is where patients are seen on an outpatient basis for cardiac and vascular conditions. There are several cardiology outreach sites in Columbus. The lipid clinics are referral based interdisciplinary cardiovascular risk reduction clinics established in 2007 and are located within Ross ACC, Carepoint Gahanna, and Carepoint East. In 2009, OSUWMC launched the Integrated Health Information System in the ambulatory care clinics. A physician and an ambulatory care specialty pharmacist staff the intake clinics collaboratively, while both a physician and pharmacist or a pharmacist acting under collaborative practice agreements staffs return clinics. Four physicians and eight pharmacists rotate throughout the seven weekly clinics. Approximately 1200 patients are seen within the lipid clinics each year. The study was exempt from The Ohio State University Institutional Review Board.

Inclusion criteria included patients who: 1) established care in the lipid clinic within OSUWMC between January 1, 2009 and December 31, 2012, 2) obtained an initial traditional lipid profile and LDL-P, and 3) were 18-89 years of age. Exclusion criteria included patients who: 1) did not obtain initial visit LDL-P, 2) experienced a cardiovascular event within 30 days prior to obtaining initial lipid profiles, 3) did not return to OSUWMC for evaluation of cardiovascular health within the prior 18 months of the study end date, October 16, 2014, 4) were pregnant or imprisoned, and 5) had an incalculable LDL-C. Data were obtained using the OSUWMC electronic medical record, EPIC. The following patient characteristics were collected: gender, age, medical insurance, race, height, weight, body mass index, smoking status, primary or secondary cardiovascular prevention, cardiac family history, diabetes, impaired fasting glucose, waist circumference, hypertension, metabolic syndrome, initial LDL-C greater than 190 mg/dL, Framingham's 10-year risk assessment, Atherosclerotic Cardiovascular Disease (ASCVD) 10 year and lifetime risk assessment, goals of therapy, initial lipid-lowering medications, initial traditional lipid profile, and initial LDL-P measured by nuclear magnetic resonance (NMR). ATP III's 2004 update or physician specified targets were used to individualize patient LDL-C and non-HDL-C.[3] LDL-P goals were determined by assessing LDL-C and non-HDL-C goals and obtaining corresponding LDL-P goals based on an equivalent percentile. [16-18] ASCVD events, diagnosis of new onset diabetes mellitus, and death from any cause and death due to cardiovascular disease were also collected. The time a patient was followed in the study was recorded as well due variable follow-up periods. Definitions of data collection points are listed in appendix 1.

The definition of discordance was defined by using the 2004 National Cholesterol Education Program ATP III Update. LDL-C goals of 70 mg/dL, 100 mg/dL, 130 mg/dL, and 160 mg/dL corresponded to approximated population percentiles of 2nd, 20th, 50th, and 80th for LDL-C in the Framingham Offspring Cohort.[16, 17] Non-HDL-C and LDL-P percentiles correlate to the LDL-C thresholds and population percentiles outlined in the Framingham Offspring Cohort (Table 1). [16, 17] Discordance was identified if LDL-P, non-HDL-C, or LDL-C fell into a different population percentile. For example, if LDL-C and non-HDL-C fell between the 20th and 50th percentile, but LDL-P fell between the 50th and 80th percentile the patient had discordant values.

Statistical Analysis

Descriptive statistics were generated for all variables of interest both overall and broken down by whether the patients' values were discordant. Continuous variables were expressed using means, standard deviations, medians and other appropriate measures of spread. Categorical variables were expressed using frequencies and percentages. Logistic regression models were used to estimate the relationship between various predictors and whether or not the patients' baseline values were discordant. Potential predictor variables were selected based on both the observed descriptive statistics and clinical relevance. Then, the relationship between potential predictor variables and concordance/discordance at initial visit was assessed individually using univariable logistic regression. Those variables that were statistically significant at 0.20 level were considered for inclusion in a multivariable model; these include gender, body mass index, current smoker, former smoker, history of myocardial infarction or coronary procedure, Framingham 10-year risk category, primary prevention,

currently on treatment, low HDL-C at baseline, LDL-C at goal at initial visit, and non-HDL-C at goal at initial visit. A backward selection approach was used to select a final multivariable model. All possible two-way interactions between the variables in the final model were considered and none were significant at the 0.01 level. The proportion of patients who experienced an observed ASCVD event or death during the available follow-up period were reported both overall and broken down by concordant/discordance. In addition, logistic regression models were used to estimate odds ratios for ASCVD events or death by discordance status adjusted by length of follow-up time. All analyses were performed using SAS 9.4, SAS Institute, Cary, North Carolina.

Results

There were 266 newly established patients within the lipid clinic from January 1, 2009 and December 31, 2012, and 166 of those met inclusion criteria (Figure 1). Among the thirty-one patients excluded for incalculable LDL-C, thirty patients had triglycerides > 400 mg/dL, and one patient had an LDL-C >400 mg/dL. Of the patients in the final cohort, 104 (62.7%) patients had discordant values compared to 62 (37.4%) patients with concordant values.

Patients with discordant laboratory values were either discordant in one measure (i.e. two of the three values fell within the same percentile while one fell into a different percentile) or all three measures of LDL-C, non-HDL-C, and LDL-P could fall within different percentiles. Among the discordant subgroup, 68 patients were discordant in one measure, and among these patients, LDL-P fell into the different population patient percentile for 43 (63.2%) patients whereas LDL-C was different for 17 patients (25%). Of the 43 patients where LDL-P was the unique discordant value, LDL-P fell into the higher population patient percentile for 36 (86.1%) patients. Among the 36 patients with discordant laboratory values across all three measurements, LDL-P fell into the highest population patient percentile for 31 (86.1%) patients; LDL-C never fell into the highest percentile when all three values differed.

Baseline demographics were summarized both overall as well as for the concordant and discordant subgroups, separately (Table 2). Overall, males comprised 54.8% of the cohort; 62.5% of the discordant subgroup was male compared to 41.9% of the concordant subgroup. The average age of the cohort was 51.6 years (range 18 – 82) with the majority of patients being Caucasian (83.1%). A large proportion of patients presented with metabolic syndrome (69.9%), hypertension (68.1%), and on lipid lowering therapy (66.3%) compared to the less frequently observed diabetes (23.5%), impaired fasting glucose (40.4%), and currently smoking (20.5%). Of the 110 patients on medications, 61 (55.5%) patients were taking two or more medications.

Within the concordant subgroup, a larger proportion of patients were primary prevention (74.2%) compared to the discordant subgroup (58.7%); whereas within the discordant subgroup, more individuals were utilizing lipid-lowering therapies (77.9%) compared to the concordant subgroup (46.8%). In addition, a larger proportion of patients with discordant laboratory values had achieved LDL-C goals (42.3%) and non-HDL-C goals (32.7%) at initial visit compared to patients who achieved LDL-C goals (11.3%) and non-HDL-C (11.3%) goals in the concordant subgroup.

Characteristics included in the final multivariable logistic regression model were gender, body mass index, current smoker, former smoker, history of myocardial infarction or coronary procedure, Framingham 10-year risk category, primary prevention, currently on treatment, low HDL-C at baseline, LDL-C at goal at initial visit, and non-HDL-C at goal at initial visit. Among these, the following were included in the final multivariable logistic regression model: gender, current and former smoker, on treatment at initial visit, and LDL-C at goal at initial visit.

Within the cohort, the odds of having a discordant laboratory value were significantly higher for males, current smokers, former smokers, patients currently on treatment at initial visit, and patients at their LDL-C goal at initial visit (Table 3). For instance, the odds of having a discordant laboratory value were 3.93 times higher for those individuals utilizing lipid-lowering therapies compared to those who were not. Interestingly, for patients who achieved LDL-C goals at initial visit the odds of having a discordant laboratory value were 7.31 times higher than those who were not at LDL-C goal at initial visit.

For the secondary objective, observed diagnoses of new onset diabetes, ASCVD events, death due to cardiovascular disease, and non-cardiovascular death are represented in Table 4. The length of follow-up was variable for each patient; the minimum follow-up time was 1.3 years and the maximum follow-up time was 4.9 years. Among the concordant and discordant subgroups, 7 (11.3%) and 21 (20.2%) patients, respectively, experienced some type of event – ASCVD event, diagnosis of new onset diabetes or death – during their observed follow-up time. Upon adjusting for length of follow-up time, no significant difference was detected between discordant and concordant subgroups (OR 1.99, 95% CI 0.79 – 5.00). Similarly, ASCVD events or diagnoses of new onset diabetes were observed in the concordant subgroup for 6 individuals (9.7%) compared to 19 individuals (18.3%) in the discordant subgroup. Again, after adjusting for length of follow-up, no significant difference was detected between discordant and concordant subgroups (OR 2.09, 95% CI 0.78 – 5.55). One patient died from non-cardiovascular complications in the concordant subgroup whereas four patients died from cardiovascular complications in the discordant subgroup during the observed follow-up period.

Discussion

Discordance was associated with male gender, current and former smokers, currently on lipid lowering therapy at initial clinic visit, and being at patient specific LDL-C goal at initial clinic visit. Within our cohort, these associations indicate that discordance is more likely when certain patient characteristics are present. For example, a male presenting to clinic is more likely to have a discordant value compared to a female, and a patient on a lipid lowering medication at initial visit is more likely to have a discordant value than a patient without pharmacologic lipid lowering therapy.

With respect to current guidelines, the ACC/AHA Lipid Management guidelines recommend statin therapy, often at moderate or high intensity, for patients of statin benefit groups with a goal of 30-50% LDL-C reduction.[6] The National Lipid Association (NLA) Lipid Management guidelines recommend targeting non-HDL-C as the primary goal for cardiovascular risk reduction through lipid management.[9] In regards to advanced lipoprotein testing, several organizations have endorsed the measurement of LDL-P as secondary goals of therapy or as additional assessments of residual cardiovascular risk.[9, 19-21] NLA acknowledges that the measurement of LDL-P can be clinically useful especially once non–HDL-C and LDL-C goals have been attained.[9] Furthermore, the Inflammatory Markers and Advanced Lipoprotein expert panel states that LDL-P measurement is reasonable for many patients including those patients with: 1) an intermediate risk of cardiovascular disease and treated to LDL-C and non-HDL-C goal 2) cardiovascular disease on lipid-lowering therapy 3) cardiovascular risk equivalents defined by ATP III on lipid-lowering therapy, and 4) recurrent cardiovascular events. [4, 19] Finally, a recent report indicates that measurement and assessment of LDL-P among non-statin benefit group patients is useful in determining overall cardiovascular risk.[22] Measurement of LDL-P is optimal in order to fully assess the presence and extent of discordance as well as cardiovascular risk.

It is well established that when discordance exists, LDL-P better predicts cardiovascular risk. [10-13] Measuring and targeting both LDL-C and LDL-P compared to LDL-C alone has been proven to be a cost-effective approach for the healthcare-system.[23] Despite this, LDL-P is not routinely assessed due to varying third party-payer reimbursement models, availability of laboratory tests, and lack of consistency in recognition as a standard of care across lipid management guidelines; measuring and assessing LDL-C and non-HDL-C remain the standard of care.[5-9, 23] If one could reliably predict discordance, this could provide health-care professionals a convenient and efficient method in identifying cardiovascular risk and managing dyslipidemia.

The results of the current study support previously defined associations between patient characteristics and discordance among laboratory values, while at the same time, presents new associations. Discordance has previously been associated with age, gender, diabetes mellitus, ethnicity, metabolic syndrome, smoking status, obesity, and private insurance. [11, 12, 14] The results of the current study support the association between discordance and gender that was found by Otvos, et al., as well as the association between discordance and smoking status found by Kilgore, et al. [11, 14] However, the current study also found that discordance was associated with lipid lowering therapy and achievement of LDL-C goals at initial visit. When considering discordance among patients being treated with lipid lowering therapy, Rosenson, et al. indicated that discordance between LDL-C and LDL-P is enhanced as statin medications lower LDL-C to a great extent than lowering LDL-P.[15] It is evident that certain patient characteristics may be associated with discordance.

The current study is the first to look at a description of discordance in a lipid clinic, being based on patient characteristics in complex patients who are being evaluated for cardiovascular disease or are being treated with lipid lowering therapies. Additionally, it is the first to look at patient characteristics associated with discordance between three variables together of LDL-C, non-HDL-C, and LDL-P.

While event rates were low in the current study, previous literature has reported that patients with discordance have a higher degree of cardiovascular risk.[10-13] In this study, LDL-P was found to be in the highest population percentile for the majority of patients when discordance was present. Additionally, although not significantly different, the discordant subgroup did have more observed non-death related ASVCD events, diagnoses of diabetes, and deaths due to cardiovascular complications compared to the concordant subgroup.

Limitations to the current study include the single-center, retrospective study design as well as the small population size. The single-center design is a limitation of the study as these patients may have different characteristics than other populations. Although the results of this study may not be directly applicable to other cohorts of patients, our results are somewhat consistent with what others have observed. The retrospective nature of the study is a limitation because we were only able to include patients who had the full lipid assessment. While the lipid clinic's protocols suggest that at initial clinic visit every patient have a LDL-P drawn, every provider did not routinely draw this for every patient, creating a selection bias. Additionally, the small population size makes the application of this to lipid patients across regions of the country difficult as patient populations may vary. Furthermore, concordance and discordance was assessed at a single point in time, the initial visit to lipid clinic. Application of clinical outcomes in this study is limited due to low event rate, and variable follow-up times; those patients with longer follow-up times had more opportunities to experience an observed event or death compared to those with shorter follow-up. It is also a limitation that some patients included in the secondary

outcome based on initial concordance or discordance may become the opposite while on treatment.

Prospective research is needed to determine if patient characteristics can reasonably predict discordance between LDL-C, non-HDL-C, and LDL-P. Additionally, prospective studies are also necessary to examine whether a patient may fluctuate between concordance and discordance over a period of time as well as determining if knowledge of discordance at initial visit and subsequent therapy changes are associated with improved clinical outcomes. Further research is also needed to identify specific lipid-lowering therapies that may or may not be associated with discordance as well as how combination therapy affects discordance.

Within a lipid clinic population, discordance was associated with male gender, current or former smokers, lipid-lowering therapy, and being at patient specific LDL-C goal. Until these or other associations can be explored as predictive, clinicians should consider measuring LDL-P in patients to assess the presence or extent of discordance.

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Table 1 Definition of Discordance[17]

Percentile	LDL-C (mg/dL)	Non-HDL-C (mg/dL)	LDL-P (mmol/L)
< 2	< 70	< 83	< 720
2 - < 20	70 - 99	83 - 118	720 - 1099
20 - < 50	100 - 129	119 - 152	1100 - 1439
50 - < 80	130 - 159	153 - 186	1440 - 1819
≥ 80	≥ 160	≥ 187	≥ 1820

Figure 1 Study Diagram

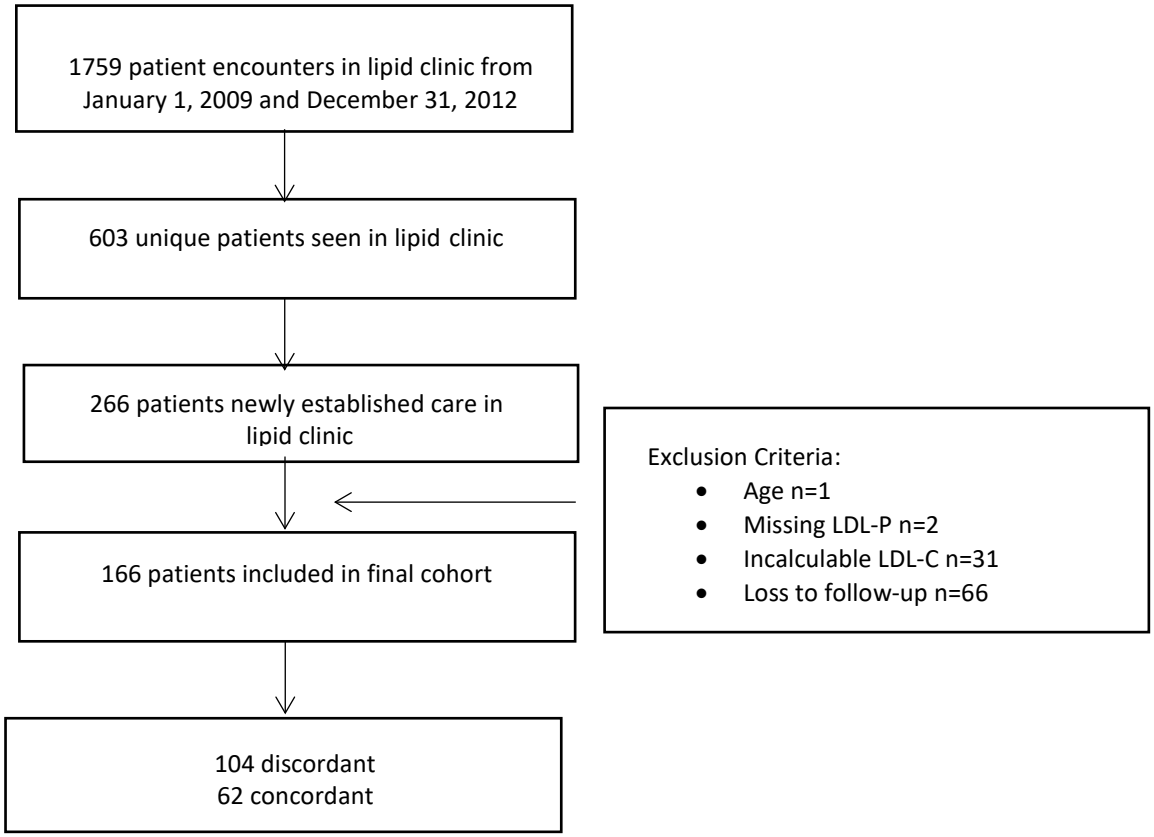

Table 2: Baseline Patient Characteristics for Total Cohort, Concordant Subgroup, and Discordant Subgroup

Variable	Concordant (n=62)	Discordant (n=104)	Total N=(166)
Male, n (%)	26 (41.9%)	65 (62.5%)	91 (54.8%)
Age, mean (SD) [range]	51.4 (12.2) [24 – 82]	51.7 (11.4) [18 – 75]	51.6 (11.7) [18 – 82]
BMI, mean (SD) [range]	30.2 (6.1) [20.7 – 48.8]	32.3 (6.9) [21.8 – 63.9]	31.5 (6.7) [20.7 – 63.9]
Waist Circumference[a], mean (SD) [range]	37.9 (5.6) [26 – 55]	40.6 (5.5) [30 – 61]	39.6 (5.7) [26 – 61]
Race			
Caucasian, n (%)	51 (82.3%)	87 (83.7%)	138 (83.1%)
African American, n (%)	8 (12.9%)	13 (12.5%)	21 (12.7%)
Other, n (%)	3 (4.8%)	4 (3.9%)	7 (4.2%)
Diabetes mellitus, n (%)	12 (19.4%)	27 (26.0%)	39 (23.5%)
Impaired fasting glucose, n (%)	22 (35.5%)	45 (43.3%)	67 (40.4%)
Current smoker, n (%)	9 (14.5%)	25 (24.0%)	34 (20.5%)
Former smoker, n (%)	11 (17.7%)	35 (33.7%)	46 (27.7%)
Metabolic syndrome, n (%)	40 (64.5%)	76 (73.1%)	116 (69.9%)
History of myocardial infarction, n (%)	9 (14.5%)	20 (19.2%)	29 (17.5%)
History of stroke/transient ischemic attack, n (%)	3 (4.8%)	5 (4.8%)	8 (4.8%)
History of coronary procedure, n (%)	16 (25.8%)	39 (37.5%)	55 (33.1%)
History of vascular disease or procedure, n (%)	0 (0.0%)	2 (1.9%)	2 (1.2%)
Cardiovascular family history, n (%)	32 (51.6%)	54 (51.9%)	86 (51.8%)
Diagnosis of hypertension or medications, n (%)	39 (62.9%)	74 (71.2%)	113 (68.1%)
Statin intolerant, n (%)	20 (32.3%)	22 (21.2%)	42 (25.3%)
ASCVD 10 year risk[b]			
0 - < 5, n (%)	12 (19.4%)	15 (14.4%)	27 (16.3%)
5 - < 7.5, n (%)	5 (8.1%)	10 (9.6%)	15 (9.0%)
> 7.5, n (%)	33 (53.2%)	62 (59.6%)	95 (57.2%)
ASCVD lifetime risk[b]			
0 - < 5, n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
5 - < 7.5, n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
> 7.5, n (%)	48 (77.4%)	73 (70.2%)	121 (72.9%)
Framingham 10 year risk			
0 - < 10, n (%)	29 (46.8%)	34 (32.7%)	63 (38.0%)
10 - 20, n (%)	11 (17.7%)	14 (13.5%)	25 (15.1%)
>20, n (%)	22 (35.5%)	56 (53.9%)	78 (47.0%)
Private insurance payer	44 (71.0%)[c]	76 (73.1%)	120 (72.3%)
Primary prevention, n (%)	46 (74.2%)	61 (58.7%)	107 (64.5%)
Treatment at initial visit, n (%)	29 (46.8%)	81 (77.9%)	110 (66.3%)
1 treatment, n (%)	16 (55.2%)	33 (40.7%)	49 (44.6%)
2+ treatments, n (%)	13 (44.8%)	48 (59.3%)	61 (55.5%)
High-intensity statin, n (%)	5 (17.2%)	25 (30.9%)	30 (27.3%)
Moderate-intensity statin, n (%)	8 (27.6%)	31 (38.3%)	39 (35.5%)
Low-intensity statin, n (%)	1 (3.5%)	7 (8.6%)	8 (7.3%)
Ezetimibe, n (%)	2 (6.9%)	14 (17.3%)	16 (14.6%)
Bile Acid Sequestrants, n (%)	1 (3.5%)	2 (2.5%)	3 (2.7%)
Fibrates, n (%)	6 (20.7%)	29 (35.8%)	35 (31.8%)
Fish-Oil, n (%)	16 (55.2%)	26 (32.1%)	42 (38.2%)
Niacin, n (%)	9 (31.0%)	14 (17.3%)	23 (20.9%)
Low HDL at initial visit[d], n (%)	17 (27.4%)	45 (43.3%)	62 (37.4%)
LDL-C >190 at initial visit, n (%)	21 (33.9%)	3 (2.9%)	24 (14.5%)
High triglycerides at initial visit[e], n (%)	29 (46.8%)	65 (62.5%)	94 (56.6%)
Goal at initial visit: LDL-P[f], n (%)	3 (4.8%)	11 (10.6%)	14 (8.4%)
Goal at initial visit: LDL-C[f], n (%)	7 (11.3%)	44 (42.3%)	51 (30.7%)
Goal at initial visit: non-HDL-C[f], n (%)	7 (11.3%)	34 (32.7%)	41 (24.7%)

[a] 9 patients did not have a waist circumference recorded

[b] 29 patients did not have a calculated ASCVD 10 year risk score due to an age <40 or >79 years of age and 45 patients did not have a calculated ASCVD Lifetime risk score due to ages <20 or >59 years of age

[c] Insurance type for five patients within concordant group was unknown

[d] Low HDL defined as HDL <40 for males and HDL <50 for females

[e] High triglycerides defined as triglycerides >150

[f] LDL-C and non-HDL-C goals were determined by ATP III Guidelines, and LDL-P goals were equivalent to LDL-C and non-HDL-C population percentiles.

Table 3: Odds Ratios of Patient Variables and Discordance

Variable	Odds Ratio	95% CI	p-value
Gender: Male vs. Female	2.38	(1.12, 5.07)	0.025
Current Smoker: Yes vs. No	3.62	(1.35, 9.68)	0.011
Former Smoker: Yes vs. No	3.04	(1.21, 7.63)	0.018
Currently on Treatment: Yes vs. No	3.93	(1.83, 8.45)	0.0005
At Goal at Baseline: LDL-C: Yes vs. No	7.31	(2.72, 19.64)	<0.0001

Table 4: Secondary Outcomes between Concordant and Discordant Subgroups

Variable	Concordant (n=62)	Discordant (n=104)	Total (N=166)
Any non-death event[a], n (%)	6 (9.7%)	19 (18.3%)	25 (15.1%)
Diagnosis of new onset diabetes mellitus, n (%)	4 (6.5%)	7 (6.7%)	11 (6.6%)
ASCVD Events			
Myocardial infarction, n (%)	1 (1.6%)	4 (3.9%)	5 (3.0%)
Stroke/transient ischemic attack, n (%)	0 (0.0%)	1 (1.0%)	1 (0.6%)
Coronary procedure, n (%)	3 (4.8%)	11 (10.6%)	14 (8.4%)
Vascular disease or procedure, n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Any ASCVD Events	3 (4.8%)	13 (12.5%)	16 (9.6%)
Death			
Non- cardiovascular death, n (%)	1 (1.6%)	0 (0.0%)	1 (0.6%)
Cardiovascular death, n (%)	0 (0.0%)	4 (3.9%)	4 (2.4%)
Total Death	1 (1.6%)	4 (3.9%)	5 (3.0%)

[a] Composite endpoint representing number of patients that had an ASCVD event or diagnoses of new onset diabetes

Appendix 1 – Data Collection Definitions

Data Collection Point	Definition
Gender	Male or Female
Age	Defined at initial visit
Ethnicity	Non-Hispanic or Latino
Race	Caucasian, African Americans, Asian
Insurance Status	Patient's medical insurance at the time of initial visit
Smoking History	Current smoking history will include cigarettes, cigars, and chewing tobacco. Former tobacco users will also be recorded
Primary Prevention	Patient has not experienced a cardiovascular event
Secondary Prevention	Patient has already experienced a cardiovascular event
Cardiovascular event	Cardiovascular events include myocardial infarctions,
Cardiac Family History	Family history is defined as premature coronary heart disease in a first degree relative if male <55 years and females <65 according to Adult Treatment Panel (ATP) III Guidelines
Diabetes	A1c > 6.5 according to American Diabetes Association or the use of diabetic medications
Impaired Fasting Glucose	Fasting glucose > 100
Hypertension	Diagnosis listed in problem list, antihypertensive medications on medication profile or BP ≥ 135/85 at initial visit
	According to ATP III Guidelines, patient must meet 3 of 5:
	Waist Circumference > 40 inches for males and >35 inches for females
	Triglycerides > 150 mg/dL
	BP ≥ 135/85
	Low HDL <40 mg/dL in men and <50 mg/dL for females
	Impaired Fasting Glucose >100 mg/dL
Framingham's 10-year risk assessment	Calculation using the online NHLBI tool that estimates cardiovascular event risk during a 10 year period and can aid in determination of LDL targets of therapy according to ATP III Guidelines
ASCVD 10-year and lifetime risk assessment	ASCVD stands for Atherosclerotic Cardiovascular Disease ASCVD 10 year and lifetime risk are calculations that estimates cardiovascular event risk and can aid in the determination of targets of therapy according to the American Heart Association/American College of Cardiology (AHA/ACC) Guideline on the Assessment of Cardiovascular Risk
Goals of Therapy	Goals of therapy are patient specific recommendations for low density lipoproteins cholesterol (LDL-C), non-high density lipoproteins cholesterol (HDL-C), and low density lipoprotein particles (LDL-P)
Initial cholesterol-lowering medications	Identification of cholesterol medications currently used when presenting initially to clinic as well as classification of statin therapy based on 2013 AHA/ACC Assessment of Cardiovascular Risk
Traditional Lipid Profile	Traditional lipid profile includes measurement of total cholesterol, LDL-C, HDL-C, and triglycerides. Non-HDL-C can be calculated by subtracting HDL from total cholesterol.
ASCVD Events	ASCVD events are defined as coronary heart disease (CHD), stroke, and peripheral artery disease. Specifically looking for myocardial infarctions, stroke, trans-ischemic attack (TIA), coronary procedures, and diagnosis of vascular disease or vascular procedure