# Clinical Comparison of Point-of-Care and Conventional Laboratory for Lipid Panel Testing

**BACKGROUND: Why Measure Lipids at the Point-of-Care Level**?

A point-of-care (POC) lipid panel is commonly conducted during myriad wellness screenings for the detection of hypercholesterolemia as well as for diabetes and cardiovascular disease (CVD) risk assessment in the adult and increasingly in the pediatric population. In less than 5 minutes, patients are given their total cholesterol, HDL and triglycerides values along with their calculated LDL and total cholesterol/HDL ratio, allowing for a personalized categorization per the Framingham[1] risk classification system, and allowing for appropriate counseling decisions. With a POC test, in one rapid, easy and accurate screening, a patient can obtain their lipid panel results and may be provided tools for risk reduction, lifestyle changes and weight management and be counseled to see a physician for further follow-up.

POC lipid screening of asymptomatic adults at wellness events, such as corporate workplaces, pharmacies, and schools, offers several advantages over conventional laboratory testing at the private level. Advantages include broader patient accessibility where they work, live, or recreate with immediate results. Additionally, fingerstick blood sampling is often perceived to be less painful and less intimidating than a needle-to-tube or syringe venipuncture for many, particularly pediatric patients. POC testing allows patients to be screened more often, whether in a physician's office or elsewhere. Frequent testing, e.g. quarterly, is beneficial as diet, exercise, and other lifestyle changes can have significant effects on results. POC lipid testing is also associated with improved statin therapy compliance. It is reported in the literature that typically 50% of patients stop using their lipid-lowering drug within the first 3 months and only 25% of the patients are compliant with the medication after 1 year. [2,3] However, a study conducted by Bluml et al. showed that "routine lipid testing and immediate face-to-face counselling achieved 90% compliance over a 24 month period." [4]

[1] Framingham Heart Study. Available at: www.framinghamheartstudy.org.
[2] Benner, et al. JAMA. 2002 Jul 24-31. 288(4):455-61.
[3] Jackevicious, et al. JAMA. 2002 Jul 24-31. 288(4):462-7.
[4] Bluml, B., et al. Journal of American Pharmacy Association. 2000. 40(2):157-165.

**CURRENT PUBLISHED DATA ON POC ACCURACY**

There are a limited number of controlled clinical trials for POC lipid measurement; however of those that have been performed, nearly all affirm that POC tests are as accurate as conventional laboratory tests as it relates to stratifying patient's risk of cardiovascular disease, such as in the 2009 Australian non-inferiority trial.[5] In this trial, randomized high-risk patients (diabetics, known hyperlipidemia, high risk of CVD) were monitored with POC or standard laboratory analyses. The study was designed to show that POC testing was no worse than lab testing by a pre-specified minor amount. The results provided evidence that POC testing is non-inferior compared to conventional laboratory testing. Most non-randomized studies of POC lipid measuring devices are limited to correlation analyses between the POC device and a laboratory system. In general, all studies conclude that POC testing is an accurate and useful alternative to laboratory testing for CVD screening based on cholesterol levels. In the identification of individuals at risk for CVD, many studies employ the kappa statistic – an evaluation of the level of agreement between two observations. These studies define agreement as "excellent" for $\kappa > 0.75$, "fair to good" for $\kappa$ between 0.40 and 0.75 and "poor" if $\kappa < 0.40$.[6] Agreement was routinely observed at the excellent level in these studies for all systems evaluated.[7]

According to a 2011 report,[8] "POC cholesterol testing appears to be suited for screening purposes in asymptomatic adults." As such, we set out to compare the clinical effectiveness of real-life lipid testing with myriad sites, screeners and reference analyzers at the POC versus in a highly-controlled, conventional laboratory setting.

**RECENT DATA EVALUATING POC LIPID TESTING: Methodology**

Evaluations of the current performance of the CardioChek® POC lipid panel test are sometimes performed prior to or as a part of implementing the system. Data collected across seven (7) such clinical sites from July 1, 2012 to November 30, 2012 were aggregated for this report. Sites included large academic centers, hospital systems (IDNs) and high-profile US hospitals, screeners and government facilities. There were 252 samples across the seven (7) geographically-distributed sites.

These data were collected as part of independent customer assessments of the CardioChek® PA analyzer for use with adult patients. Each of these evaluations was performed independent of the others, under conditions reflective of the intended use of the POC systems. In this way the results obtained mirror "real-world" clinical

[5] Bubner, T., Laurence, O., Gialamas, A., et al. Effectiveness of point-of-care testing for therapeutic control of chronic conditions: results from the PoCT in General Practice Trial. 2009. 190(11):624-6.
[6] Jain, A., Persaud, J., Rao, N., et al. Annals of Clinical BioChemistry. 2011. 48:159-165.
[7] Parikh, P., Mochari, H., & Mosca, L. American Journal of Health Promotions. 2009. 23(4)279-82.
[8] Canadian Agency for Drugs and Technology. 2011. Available at: http://www.cadth.ca/media/pdf/htis/may2011/RC0272000_POC_Choleseterol_Testing_for_CHD_Final.pdf.

performance. These studies were all supported by Polymer Technology Systems, Inc.

- Three sites included two different laboratory analyzers in the comparison.
- Four sites (one with two laboratories) evaluated both the PTS CardioChek® PA (CCPA) analyzer using the PTS Panels® Lipid Panel test strips and the Alere Cholestech LDX® (LDX) analyzer using the Cholestech Lipid Panel test strips.
- All sites reported data for total cholesterol, HDL cholesterol, and triglycerides from each system. Sites included wellness screening companies, hospitals, and corporate wellness programs.

Each site independently chose their reference laboratory. Those clinical sites opting to have the samples analyzed at multiple laboratories reported data from each. Analyses include linear regression and clinical risk classification. For risk classification, each individual result was categorized based on Framingham risk categories for each analyte—total cholesterol, HDL, and triglycerides (Table 2). From these analyses, a clinical agreement table was compiled applying strict limits to quantify agreement.

## RESULTS

### Linear Regression Analysis

Linear regression analyses were performed using the Reference Analyzer in Table 1 as the independent (x) variable. Results are shown in Table 1.

**Table 1. Linear Regression Analysis**

| Site | Site A Hospital | | | Site B IDN | | Site C Academic Center | | | | Site D Screener | | Site E Retail Clinic | | Site F Government | | | | Site G Hospital | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n | 40 | | | 35 | | 17 | | | | 64 | | 40 | | 30 | | | | 26 | |
| Make | Siemens | PTS | PTS | Roche | PTS | Beckman | PTS | PTS | Alere | PTS | Alere | PTS | Alere | PTS | PTS | Alere | Alere | PTS | PTS |
| Model | EXL | CCPA ven | CCPA fs | Cobas | CCPA ven | AU2700 | CCPA ven | CCPA fs | LDX fs | CCPA ven | LDX ven | CCPA ven | LDX ven | CCPA ven | CCPA fs | LDX ven | LDX fs | CCPA ven | CCPA fs |
| Reference Analyzer | Roche Integra | | | Beckman AU5400 | | Beckman AU5400 | | | | Beckman AU5400 | | Beckman AU5400 | | Not Specified | | | | Beckman DxC | |
| **Total Cholesterol** | | | | | | | | | | | | | | | | | | | |
| slope | 1.0 | 1.1 | 1.0 | 0.9 | 0.7 | 1.0 | 0.7 | 0.69* | 0.9 | 1.0 | 1.0 | 0.9 | 1.0 | 0.7 | 0.8 | 1.0 | 0.9 | 1.1 | 1.0 |
| intercept | -11.8 | -15.5 | 7.2 | 24.0 | 47.2 | -0.4 | 40.2 | 45.6* | -3.7 | 1.7 | -6.6 | 12.1 | -6.9 | 45.8 | 23.5 | -11.8 | 6.0 | -20.2 | 0.5 |
| R | 0.99 | 0.89 | 0.85 | 0.89 | 0.86 | 0.99 | 0.86 | 0.91* | 0.98 | 0.92 | 0.97 | 0.94 | 0.98 | 0.80 | 0.91 | 0.98 | 0.95 | 0.93 | 0.93 |
| **HDL Cholesterol** | | | | | | | | | | | | | | | | | | | |
| slope | 1.0 | 1.0 | 1.0 | 0.9 | 1.0 | 0.8 | 1.0 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 0.9 | 0.9 | 0.8 | 1.1 | 1.1 |
| intercept | -7.7 | 2.9 | 1.0 | 0.9 | -9.4 | 8.9 | -1.6 | 5.4 | 0.8 | 2.6 | -7.2 | 2.8 | -1.0 | -6.0 | 0.4 | -4.5 | -0.9 | 1.6 | 1.9 |
| R | 1.00 | 0.95 | 0.92 | 0.94 | 0.88 | 0.98 | 0.94 | 0.72 | 0.98 | 0.89 | 0.98 | 0.94 | 0.98 | 0.90 | 0.85 | 0.97 | 0.95 | 0.93 | 0.96 |
| **Triglycerides** | | | | | | | | | | | | | | | | | | | |
| slope | 1.1 | 1.0 | 0.7 | 1.0 | 0.9 | 1.0 | 0.7 | 0.7 | 0.9 | 1.0 | 1.0 | 0.8 | 1.1 | 0.8 | 0.8 | 1.0 | 0.9 | 0.9 | 1.2 |
| intercept | -5.1 | 2.4 | 53.9 | 1.4 | 13.8 | 2.8 | 38.3 | 11.6 | 6.1 | 0.5 | -8.4 | 18.7 | -5.4 | 6.0 | 21.8 | -2.6 | 10.1 | 6.5 | -5.7 |
| R | 1.00 | 0.99 | 0.82 | 0.98 | 0.97 | 1.00 | 0.97 | 0.95 | 0.99 | 0.97 | 0.99 | 0.97 | 1.00 | 0.97 | 0.97 | 1.00 | 0.98 | 0.99 | 0.98 |

*A single outlier result was removed from the linear regression analysis for Site C - CCPA fs. This value is included in all other analyses.

**KEY:** CCPA = CardioChek PA
LDX = Cholestech LDX
ven = venous sample
fs = fingerstick sample

**Clinical Decision Agreement Analysis**

Table 2 outlines Framingham Standards for Risk Classification of total cholesterol, HDL cholesterol, and triglycerides. A blood sample yielding total cholesterol results of 189 mg/dL on one test system and 199 mg/dL on another is rated as an "Agreement" since both values provide the same clinical decision of "Desirable." In contrast, a blood sample yielding total cholesterol results of 199 mg/dL on one test system and 200 mg/dL on another is rated as a "Non-Agreement" since the 199 value provides a clinical decision point of "Desirable" and the 200 value indicates a clinical decision point of "Borderline High," despite the clinical insignificance of the discrepancy.

**Table 2. Clinical Risk Classification for Lipid Panel Results**

| Total Cholesterol (mg/dL) | | | HDL (md/dL) | | Triglycerides (mg/dL) | | |
|---|---|---|---|---|---|---|---|
| <200 | 200-240 | >240 | <40 | ≥40 | <150 | 150-200 | >200 |
| Desirable | Borderline High | High | Risk Factor | Desirable | Desirable | Borderline High | High |

Risk classification comparisons were performed using baseline reference analyzers, as indicated in Table 1, as the "true," or most accurate, reference result. Table 3 shows the percentage of results in agreement based on the strict criteria discussed above. All differences, across all clinical sites, were one category differences.

**Table 3. Clinical Decision Agreement Results (% Agreement)**

| Site | Site A | | | Site B | | Site C | | | | Site D | | Site E | | Site F | | | | Site G | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Make | Siemens | PTS | PTS | Roche | PTS | Beckman | PTS | PTS | Alere | PTS | Alere | PTS | Alere | PTS | PTS | Alere | Alere | PTS | PTS |
| Model | Lab | CCPA ven | CCPA fs | Cobas | CCPA ven | AU2700 | CCPA ven | CCPA fs | LDX fs | CCPA ven | LDX ven | CCPA ven | LDX ven | CCPA ven | CCPA fs | LDX ven | LDX fs | CCPA ven | CCPA fs |
| Cholesterol | 83% | 88% | 83% | 77% | 94% | 94% | 78% | 82% | 82% | 80% | 80% | 83% | 87% | 78% | 78% | 90% | 80% | 73% | 85% |
| HDL | 93% | 98% | 95% | 94% | 80% | 100% | 100% | 95% | 95% | 98% | 86% | 88% | 95% | 97% | 90% | 74% | 66% | 83% | 88% |
| Triglycerides | 93% | 91% | 91% | 94% | 90% | 100% | 95% | 95% | 95% | 92% | 97% | 95% | 98% | 78% | 80% | 93% | 93% | 100% | 92% |

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## DISCUSSION OF RESULTS

The major limitation from these studies is the number of samples collected. Clinical and Laboratory Standards Institute (CLSI) guidelines (EP09) recommend that at least 40 samples, across the reportable range, be evaluated for method comparison studies. Only half of the sites with data presented above met this requirement. The sample sizes selected were determined by the sites themselves and represent what might be expected to be observed in similar evaluations for these types of clinical institutions.

**Table 4a. Agreement Summary: Lab and POC**

| % agreement with reference laboratory across all sites | Lab | POC |
|---|---|---|
| Total Cholesterol | 83% | 83% |
| HDL Cholesterol | 95% | 89% |
| Triglycerides | 95% | 92% |

**Table 4b. Agreement Summary: Lab and POC (venous and fingerstick)**

| % agreement with reference laboratory across all sites | Lab | POC venous | POC fingerstick |
|---|---|---|---|
| Total Cholesterol | 83% | 83% | 81% |
| HDL Cholesterol | 95% | 90% | 88% |
| Triglycerides | 95% | 93% | 90% |

**Table 4c. Agreement Summary: Lab and POC (CCPA and LDX)**

| % agreement with reference laboratory across all sites | Lab | CCPA | LDX |
|---|---|---|---|
| Total Cholesterol | 83% | 82% | 83% |
| HDL Cholesterol | 95% | 92% | 83% |
| Triglycerides | 95% | 90% | 96% |

**Table 4d. Agreement Summary: Lab/CCPA and LDX (CCPA and LDX)**

| % agreement with reference laboratory across all sites | Lab | CCPA | | LDX | |
|---|---|---|---|---|---|
| | | venous | fingerstick | venous | fingerstick |
| Total Cholesterol | 83% | 83% | 81% | 84% | 81% |
| HDL Cholesterol | 95% | 92% | 92% | 86% | 77% |
| Triglycerides | 95% | 91% | 88% | 96% | 94% |

## CONCLUSION

CardioChek® point-of-care tests have been determined to be a more convenient, viable alternative to traditional laboratory testing for lipid panels. POC testing requires less than 5 minutes to perform, can be performed at a variety of convenient and mobile locations and patients are given detailed results immediately. The data collected from multiple clinical sites assessing the CardioChek PA analyzer demonstrates that the differences observed between conventional laboratory analyzers are similar in magnitude to those observed between POC analyzers and the laboratory. Additionally, CardioChek POC tests have been observed, analyzed and positively reviewed in several publications further solidifying the convenience, accuracy and progressive nature of point-of-care analyzers.