
Accuracy of Lipid Profiles Measured with Two Point-of-Care Systems

Abstract

The CardioChek® Plus and the Alere Cholestech LDX® System are rapid, point-of-care (POC) testing methods that measure a lipid profile consisting of total cholesterol, HDL cholesterol, and triglycerides. In the present study, accuracy of both POC lipid profile methods was assessed by comparing with definitive methods performed at the U.S. Cholesterol Reference Method Laboratory Network laboratory. Fingertick specimens were obtained from 180 donors and analyzed using three lots of reagents and two analyzers for each POC method, two replicates per subject. Lipid profile results obtained with the CardioChek Plus exceeded National Cholesterol Education Program total error goals established for lipid tests for 12% to 41% of samples, depending upon the test. For the Alere Cholestech LDX System, total error was exceeded for 3% to 8% of samples. The Alere Cholestech LDX System provided lipid profile results that were in closer agreement with the definitive CDC reference/CRMLN laboratory methods than were the CardioChek Plus results.

Introduction

Risk assessment for atherosclerotic cardiovascular disease and management of patients with dyslipemia depend on measurement of a lipid profile consisting of total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), and triglycerides (TRG). Rapid, point-of-care (POC) testing methods are available for obtaining lipid profile results from whole blood samples.

The CardioChek Plus (PTS Diagnostics, Indianapolis, IN) and Alere Cholestech LDX System (Alere San Diego, Inc.) are small, portable, POC analyzers. Both measure a lipid profile using fingerstick or venous whole blood samples applied to disposable reagent devices and employ reflectance photometry to measure lipid concentrations.

Reference methods developed by the Centers for Disease Control and Prevention (CDC) are the definitive “gold standard” for lipid standardization. CDC reference methods are used to standardize lipid methods by the CDC and member laboratories of the Cholesterol Reference Method Laboratory Network (CRMLN) around the globe. The objective of the present study was to evaluate the accuracy of the CardioChek Plus and Alere Cholestech LDX lipid methods by comparison with CDC reference/CRMLN laboratory methods.

Methods

The study was sponsored by Alere San Diego, Inc. and was conducted at the Rainier Clinical Research Center (Renton, WA) by clinical researchers experienced with using both POC systems. One hundred eighty donors were recruited and screened to ensure a broad distribution of TC, HDL-C, and TRG values. Fingertick samples were obtained from the donors using the capillary collection tubes sold by the manufacturers of the respective POC devices. Two fingerstick samples from each subject were analyzed for TC, HDL-C and TRG using two new analyzers and three lots of test reagents in an alternating scheme for each POC method. POC testing

was conducted according to the manufacturer’s instructions.

Serum samples were obtained by venipuncture at the time the fingerstick samples were obtained and sent to the U.S. CRMLN laboratory (Northwest Lipid Metabolism and Diabetes Research Laboratories, Seattle, WA) for analysis with CDC reference methods for TC and HDL-C along with TRG analysis by a routine clinical method (there is no CDC reference method for TRG). POC and CRMLN lab testing was completed between January and March, 2016.

Accuracy of the POC methods was assessed by comparison with the CRMLN laboratory results. Bias was calculated as the difference between each POC result and the CRMLN laboratory result expressed as a percentage. Results were evaluated for conformance to the National Cholesterol Education Program (NCEP) goals for total error (TE) that take into account both the accuracy (bias) and precision (CV) of a method ($TE = \text{average bias} + 1.96 \times CV$).¹ The NCEP TE goals are less than or equal to $\pm 8.9\%$ for TC, $\pm 13\%$ for HDL-C, and $\pm 15\%$ for TRG. It is expected that 95% of all results will be within the NCEP TE guidelines when comparing with CDC reference methods using the same serum specimen.

Results

CRMLN lab results were available for 94, 103, and 98 study subjects for TC, HDL-C, and TRG, respectively. These were different subpopulations of the 180 donors depending upon recruitment goals for sample distribution for each test. Four outlier CardioChek Plus results were removed according to CLSI EP-09A3 rules: one for HDL-C and three for TRG. In three of the four cases, the second replicate was not an outlier.

Data summarizing the comparison between POC and CDC reference/CRMLN lab methods is shown in the Table. Absolute average bias was greater for each analyte for the CardioChek Plus than for the Alere Cholestech

LDX System. The proportion of results within the NCEP TE goals ranged between 59% and 88% for CardioChek Plus lipids and between 92% and 97% for Alere Cholestech LDX lipids, depending on the analyte. The Figures show the individual results (n=2) for each subject comparing POC and CDC reference/CRMLN lab methods plotted with the NCEP TE. Results exceeding NCEP TE are above the top dotted line or below the bottom dotted line.

Table. Average Bias and Proportion of Individual Results Exceeding NCEP TE

| | CardioChek Plus | | Alere Cholestech LDX System | |
|-------|-----------------|----------------|-----------------------------|----------------|
| | Average Bias | Exceed NCEP TE | Average Bias | Exceed NCEP TE |
| TC | -6.5% | 40.6% | -3.8% | 7.6% |
| HDL-C | -6.9% | 27.8% | -0.6% | 4.9% |
| TRG | 2.8% | 12.2% | -0.8% | 2.7% |

Discussion

In the present study, two rapid, POC methods for measuring lipid profiles were compared. The protocol included testing with three lots of reagents and two analyzers for each POC method. The Alere Cholestech LDX System exhibited consistently lower average bias and substantially more individual results within the NCEP TE goal than the CardioChek Plus for all lipid parameters measured.

References

1. Working Group on Lipoprotein Measurement. National Cholesterol Education Program: recommendations on lipoprotein measurement. NIH Publication No. 95-3044, 1-186. 1995. National Institutes of Health, National Heart, Lung, and Blood Institute.
2. Shephard MD, Mazzachi BC, Shephard AK. Comparative performance of two point-of-care analysers for lipid testing. Clin Lab 2007; 53:561-6.
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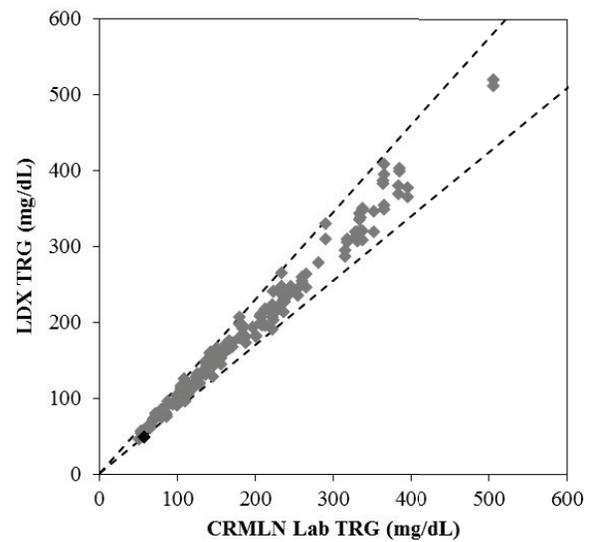
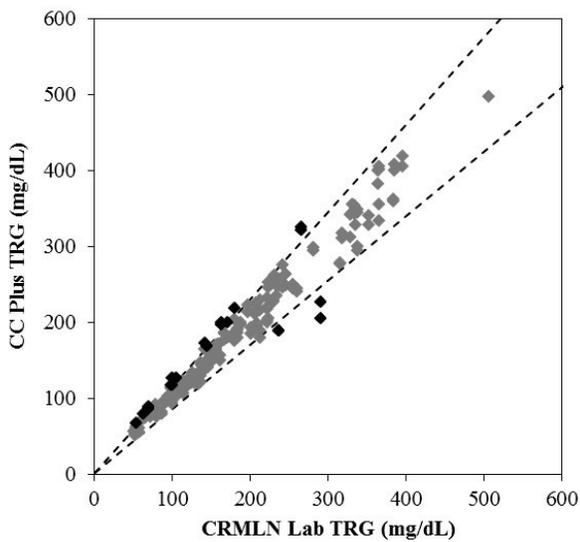
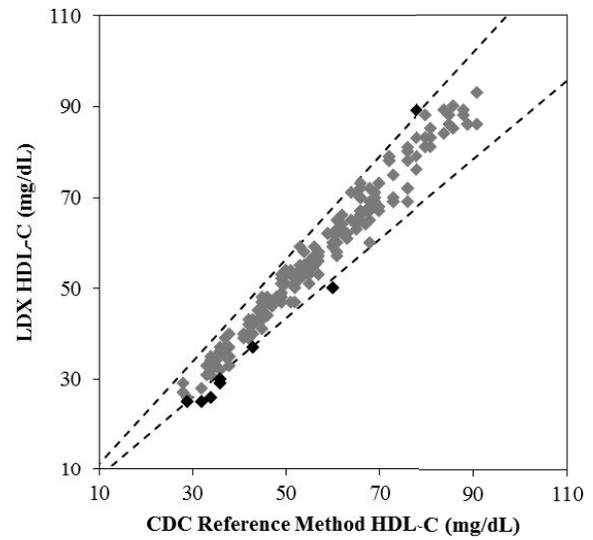
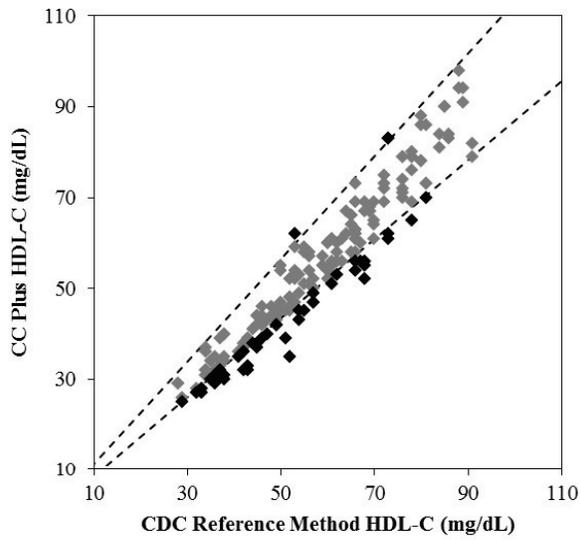
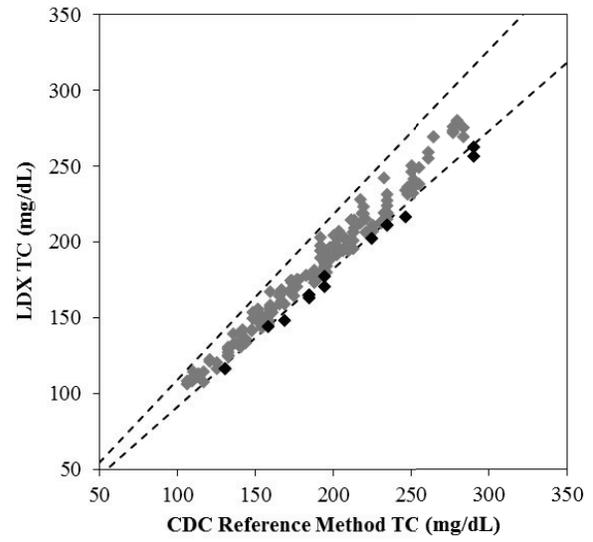
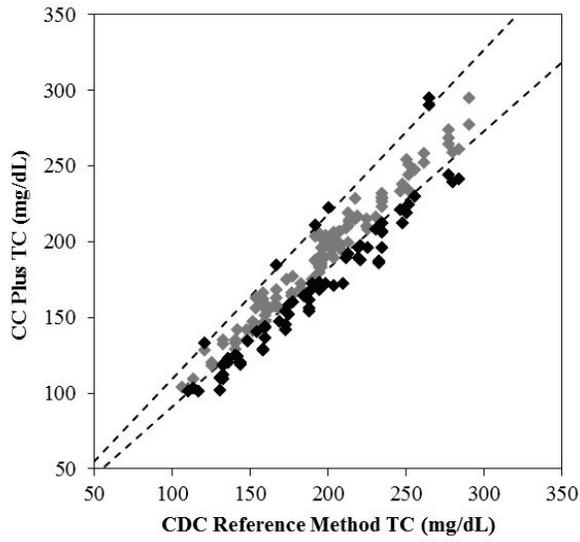
Ideally, five percent of results or fewer should exceed the NCEP total error goals when lipid profile methods are compared with CDC reference methods using serum from a single phlebotomy procedure. In this study, comparisons were made between fingerstick whole blood and serum (two separate phlebotomy procedures and sample matrices). As a result, somewhat broader bias between methods is to be expected. Nonetheless, achieving performance close to NCEP goals is desirable. Individual CardioChek Plus test results exceeded NCEP TE by up to 41%, depending on the lipid test. This proportion of CardioChek Plus results exceeding TE appeared to be a function of both greater overall bias and greater individual variability. By contrast, far fewer Alere Cholestech LDX lipid results exceeded NCEP TE (3–8%, depending on the analyte).

Other authors have reported comparisons of lipids tested with these same two POC systems with similar observations of their relative performance.²⁻⁵ However, as is typical of such studies, the researchers compared the POC methods with routine laboratory methods and not with definitive CDC reference methods as was done for the present study. These results are therefore better able to address the accuracy of the POC methods relative to the “gold standard” in lipid assessment.

In summary, the Alere Cholestech LDX System provided lipid profile results that were in closer agreement with the definitive CDC reference/CRMLN laboratory methods than were the CardioChek Plus results.

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Figures. Lipid Profile Comparisons Between POC and CDC Reference/CRMLN Laboratory Methods
 CardioChek Plus (CC Plus) on the left; Alere Cholestech LDX System (LDX) on the right; dotted lines are NCEP total error (TE); black diamonds (◆) exceed TE, gray diamonds (◇) are within TE.