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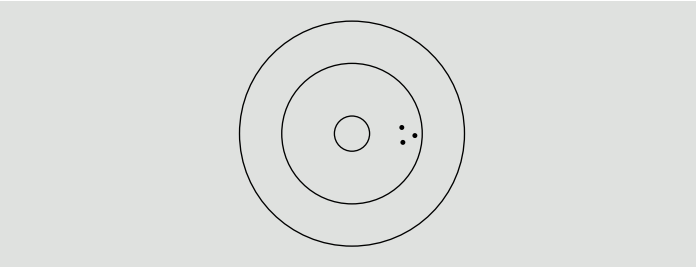
Performance Evaluations on the Cholestech LDX™ System

The purpose of this System Brief is to discuss some of the important points in running a performance evaluation between the Cholestech LDX System and your current method and interpreting the results. The goal of a performance evaluation should be to give you confidence in the accuracy and precision of your Cholestech LDX System. The quality of the results also depends on a number of pre-analytical factors, which will be discussed in this bulletin. If you would like help with an evaluation, contact the Abbott Product Support Care Center. Abbott Product Support has a protocol that can assist you in evaluating the performance of your Cholestech LDX System.

WHAT IS ACCURACY?

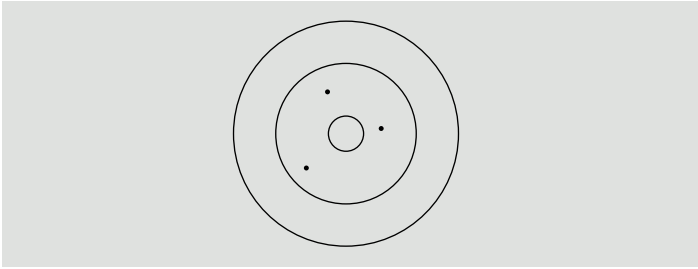
Accuracy is how close a result is to the "true" value.



Using a target as an example, accuracy is how close your shot is to the center of the bull's eye. The three shots on the target are close to the center but a little biased to the right. "Bias" is a word used to describe or indicate how far you are from the "true" value or the bull's eye. For comparison purposes, the "true" value may be a well standardized reference method or the result you get from the method you currently use.

WHAT IS PRECISION?

Precision is reproducibility or how closely several results analyzed on the same sample agree. Using the example of the bull's eye, the first target has three shots that are close together, or very precise.



The second target has three shots that are scattered around the center. These are not precise. If you average all of the shots, the accuracy would be right on the bull's eye. But if you are only going to make one measurement, you want that one measurement to be accurate. Without good precision you will not always have accurate results.

See the System Brief on *Precision, Accuracy, and Total Analytical Error* for a further discussion of accuracy and precision.

FACTORS TO CONSIDER BEFORE RUNNING AN EVALUATION

SAMPLE TYPE

Whenever possible it is best to compare the same sample type on the Cholestech LDX System and your current method. This will eliminate the variability caused by collection methods and sample types. The acceptable sample type for the Cholestech LDX System is lithium heparin fingerstick whole blood and lithium or sodium heparin venous whole blood (green top tube). Refer to the package insert that accompanies each box of Cholestech LDX cassettes to determine the appropriate sample type for that cassette.

Note: Any sample type may be used for evaluating the Cholestech LDX System. However, for routine use, the Cholestech LDX System is categorized as CLIA waived for fingerstick or venous whole blood unprocessed samples only.

BLOOD COLLECTION TECHNIQUE

Consult your Cholestech LDX System User Manual for the proper fingerstick technique. Excessive squeezing of the finger will affect all test results. Leaving the tourniquet on too long during the venipuncture has been shown to elevate cholesterol an average of 10%–15%.

TIMING

The samples to be run on the Cholestech LDX System and the comparison method should be drawn at the same time and in the same location.

SAMPLE HANDLING

Venous samples should be well mixed, inverted gently 7–8 times and tested on the Cholestech LDX System within 30 minutes of collection. Fingerstick samples should be run rapidly after collection. Refer to the package insert that accompanies each box of Cholestech LDX cassettes to determine how long samples can remain in the capillary tube. Samples should be run on the reference or comparison method on the same day they are collected. Delay in running the samples will add more variability to the results.

GLUCOSE

When evaluating glucose results on fingerstick samples, keep in mind that capillary blood glucose levels on non-fasting individuals may be 20 to 70 mg/dL greater than venous levels drawn at the same time.[1]

After the sample is placed into the cassette well, *immediately* place the cassette into the drawer and push the RUN button.

TRAINING

Read the Cholestech LDX System User Manual and watch the Cholestech LDX System Training Video before running your evaluation. Technical Support can answer any questions you have before you begin your evaluation.

QUALITY CONTROL

Run the Optics Check cassette and quality control material before running patient samples. Ensure that all results are within established ranges before running patient samples.

HOW MANY SAMPLES SHOULD BE TESTED IN AN EVALUATION?

Your confidence in the results will increase with the number of samples you run. Abbott recommends that you run at least 20 samples. With n= 20 samples you will have a reasonable degree of confidence that the results of the evaluation are an accurate indication of the true performance of the Cholestech LDX System. You can run fewer samples, but your confidence in the results will not be as high. The samples should also cover the measuring range for each analyte.

HOW DO WE LOOK AT THE RESULTS?

The quality of a result from any test method depends on the accuracy and precision of the method. The difference between two methods may be expressed in terms of total error (TE), which takes into account both accuracy and precision. The National Cholesterol Education Program (NCEP) has established total error goals for lipid tests that can be used to determine whether any differences between routine lipid methods and the Centers for Disease Control and Prevention (CDC) reference methods are acceptable.[2] These NCEP TE goals are shown in Table 1.

TABLE 1

ANALYTE	NCEP TE	CLIA PT
Total Cholesterol	≤ 8.9%	± 10%
HDL Cholesterol	≤ 13%	± 30%
Triglycerides	≤ 15%	± 25%
LDL Cholesterol	≤ 12%	N/A

This means that you can expect 95% (95 out of 100) of the test results in normal individuals to be within these total error goals when you compare the results from a routine lipid method to the CDC reference method for that analyte. The NCEP goals apply to all testing methods regardless of instrument size or location.

There are challenges in interpreting lipid method comparison data when neither method is a CDC reference method. For example, consider two methods, A (your current method) and B (the Cholestech LDX System). Assume that total precision is identical between the two. Method A is compared with a CDC reference method and found to have a negative bias, but overall an acceptable total error. Method B is compared with a CDC reference method and found to have a positive bias, but overall an acceptable total error. However, it is possible that when A and B are compared with each other, and method A is considered the "reference," the total error for method B will exceed total error limits because method A has a negative bias and method B has a positive bias compared to the CDC reference method.

When interpreting results between methods, it is also important to remember that the NCEP goals apply to comparisons of the same sample by different methods. There will be additional variability when different sample types are compared, even when the samples are drawn at the same time.

Laboratory directors may be interested in other performance criteria. The Clinical Laboratory Improvement Amendments (CLIA) proficiency testing (PT) limits are often considered if available for certain tests. CLIA PT limits for lipids are shown in Table 1.

Although there is not a nationally recognized TE goal for glucose, the Cholestech LDX System provides results that are consistent with good patient care, meeting a total error of ≤ 12%.

LOOKING AT A TYPICAL SET OF RESULTS

(See Table 2 for an example.)

Place the results in a spreadsheet and calculate the % Bias between the two results as follows:

- Is there the same number of results for both methods? If not, delete the missing results from both data sets.
- Are all results within the testing range of both methods? If not, eliminate those results from both data sets.
- Are the results acceptable? Look at the % Bias column. For total cholesterol (TC), 19 of the 20 results are within the total error goals, ≤ 8.9%. 95% of the results should be ≤ 8.9%, or 1 in 20 may be > 8.9%. The total cholesterol results fulfill these criteria and the mean bias of –0.9% is also acceptable.

  For HDL cholesterol (HDL), 19 of the 20 results are within the total error goals, < 13%. The 1 result out of 20 that is > 13% is acceptable. The mean bias of 5.2% is also acceptable.

Conclusion: This evaluation is acceptable for both total cholesterol and HDL cholesterol.

STANDARDIZATION OF LIPID TESTS

Calibration or standardization differences between methods can also play a role in the agreement in results between the Cholestech LDX System and your current method.

In order to achieve the lipid performance goals established by the NCEP, the CDC has developed definitive methods for measuring total, HDL and LDL cholesterol and triglycerides. These methods are the established accuracy base for lipid measurement.

The goal of lipid standardization is for the results of tests conducted in clinical laboratories to be traceable to the CDC methods. The CDC administers two programs to support lipid standardization. The Cholesterol Reference Method Laboratory Network (CRMLN) assists manufacturers in certifying that their lipid reagents meet NCEP performance goals and are traceable to CDC methods. CRMLN certification is biennial and is available for total, HDL and directly measured LDL cholesterol. The Lipid Standardization Program (LSP) provides quarterly certification for total and HDL cholesterol and triglycerides for research and clinical laboratories.

Cholestech LDX lipids are CRMLN certified as traceable to CDC methods for total and HDL cholesterol, and LSP certified for total and HDL cholesterol and triglycerides.

OTHER STATISTICAL METHODS

A common statistical test used to evaluate agreement between methods as calculation of the slope, intercept is linear regression. This test utilizes additional statistical parameters such as correlation coefficient. This test is useful but only under certain conditions:

- The number of samples must be large, ideally 40 or more.
- The range of results for each analyte should be wide (i.e., 150–400 mg/dL for total cholesterol or 15–90 mg/dL for HDL). This requirement is often difficult to meet.
- Linear regression may be invalid if there are outlying points at the upper or lower end of the sample range that do not agree.

If you are interested in performing linear regression on your data, contact Abbott Technical Support and we will be glad to help you with the calculation and interpretation of the results.

TABLE 2

SAMPLE ID	TC REF SER	TC LDX FS	TC BIAS	HDL REF SER	HDL LDX FS	HDL BIAS
1	196	200	2.0%	75	75	0.0%
2	240	250	4.2%	72	77	6.9%
3	300	285	-5.0%	65	66	1.5%
4	165	171	3.6%	35	39	11.4%
5	120	119	-0.8%	49	54	10.2%
6	227	218	-4.0%	61	64	4.9%
7	208	204	-1.9%	27	27	0.0%
8	174	184	5.7%	45	50	11.1%
9	196	180	-8.2%	26	28	7.7%
10	217	200	-7.8%	32	33	3.1%
11	240	231	-3.8%	80	85	6.3%
12	206	199	-3.4%	44	45	2.3%
13	183	167	-8.7%	38	36	-5.3%
14	285	290	1.8%	21	22	4.8%
15	246	225	-8.5%	56	62	10.7%
16	195	218	11.8%	30	35	16.7%
17	152	162	6.6%	41	43	4.9%
18	218	210	-3.7%	55	54	-1.8%
19	274	289	5.5%	49	49	0.0%
20	261	254	-2.7%	33	36	9.1%
Mean	**215**	**213**	**-0.9%**	**47**	**49**	**5.2%**

TC, total cholesterol; HDL, HDL cholesterol; Ref, reference or comparison method; LDX, Cholestech LDX System; FS, fingerstick; Ser, serum

1. Sacks DB. Carbohydrates. In: Burtis CA, Ashwood ER, Bruns DE, editors. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 4th ed. St. Louis, MO: Elsevier, Inc.; 2006 p. 868-869.
2. National Cholesterol Education Program, U.S. Department of Health and Human Services: Recommendations on Lipoprotein Measurement from the Working Group on Lipoprotein Measurement. NIH Publication No. 95-3044, 1995.

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