CardioChek® Plus

Comparison Study Summary

December 4, 2017

1 PROTOCOL

This evaluation was conducted on November 30, 2017. It consisted of a comparative analysis of the PTS Diagnostics CardioChek® Plus analyzer using the PTS Panels® Lipid Panel + eGLU test strips smart bundle. The study compared fingerstick samples on the CardioChek Plus analyzer and Alere LDX analyzer to serum samples tested on Quest Diagnostics Beckman Coulter AU5400 (AU5400) and PTS Diagnostics Roche Cobas® Integra 400 plus (Integra). Twenty-three (23) participants were tested.

Due to expanding capillary-venous glycemic gradients as blood glucose increases after eating, only fasting patients were utilized for the glucose calculations of the fingerstick results.

At the test site, a Quest Diagnostics employee performed a venipuncture blood draw and collected one (1) lithium heparin whole blood green top tube and one (1) serum clot red top tube. The serum tube for each participant was allowed to clot for 30 minutes and then centrifuged. The serum was then split into two aliquots. The first aliquot for each sample was packaged for delivery to Quest Diagnostics for lipid panel and glucose analysis on the AU5400. The second aliquot was packaged on ice packs and delivered to PTS Diagnostics for next day analysis on the Integra. The lithium heparin whole blood tube was retained in the testing area for use in the precision analysis and for glucose spikes.

Immediately following the blood draw, a fingerstick was performed by a PTS Diagnostics employee. The first drop of blood was dosed to the electrochemical glucose test strip on the CardioChek Plus analyzer. The residual blood was wiped from the finger with gauze, a 40µL PTS Collect™ capillary tube was collected, and the sample was dosed to the lipid panel test strip on the CardioChek Plus analyzer. The residual blood was wiped from the finger and a 40µL capillary tube and plunger was collected and dosed to the LDX cassette. Two LDX analyzers were used in the study and were alternated between participants.

To cover the dynamic range of the glucose test strip, four (4) glucose sample spikes were made using glucose spiking solution from PTS Diagnostics. Glucose spiking solution was added to the whole blood and the samples were allowed to equilibrate at room temperature. After 30 minutes, the electrochemical glucose (eGLU) strip on the CardioChek Plus analyzer was dosed using a transfer pipette. The remaining sample was immediately centrifuged and processed in the same manner as the participant samples.

1 PROTOCOL, CONTINUED

The precision study was completed using the whole blood collected in the lithium heparin tubes. Three samples which represented a low, mid, and high value for total cholesterol, HDL cholesterol, triglycerides, and glucose were run ten (10) times each on an individual CardioChek Plus analyzer using a precision pipette for lipid panel analysis and transfer pipettes for eGLU analysis.

The following table lists the ranges of Integra results for the samples tested.

All results are in mg/dL

	Testing Range
Total Cholesterol	90 – 270
HDL Cholesterol	33 – 100
Triglycerides	49 – 338
Glucose (spikes included)	76 – 509

2 RESULTS

Evaluation by Average Difference

The following graphs and tables show the detailed analyses of the relationship of the results from the CardioChek Plus test system, LDX analyzer, Integra analyzer, and the AU5400 analyzer.

The difference between the CardioChek Plus result and the laboratory result is calculated pair-wise. The average of the differences is calculated. The **average difference** is expected to be:

Total cholesterol:	± 10%
HDL cholesterol:	± 12%
Triglycerides:	± 15%
Glucose <100 mg/dL:	±15 mg/dL
Glucose ≥100 mg/dL:	±15%

The average difference calculated from the actual individual paired % Bias to the **Integra** analyzer ((Comparator Result – Integra Lab Result) ÷ Integra Lab Result) *100 is as follows:

Average of Paired % Biases			
vs. Integra	**AU5400**	**CardioChek Plus Analyzer**	**LDX**
Total Cholesterol	2.7%	0.1%	-2.1%
HDL Cholesterol	-8.1%	-2.2%	-2.9%
Triglycerides	3.5%	3.8%	-5.0%
Glucose *spikes included	-2.0%	2.2%	-0.4%

The average difference calculated from the actual individual paired % Bias to the **AU5400** analyzer ((Comparator Result – AU5400 Lab Result) ÷ AU5400 Lab Result) *100 is as follows:

Average of Paired % Biases		
vs. AU5400	**CardioChek Plus Analyzer**	**LDX**
Total Cholesterol	-2.5%	-4.6%
HDL Cholesterol	6.4%	5.6%
Triglycerides	0.5%	-8.4%
Glucose *spikes included	4.2%	1.7%

NOTE: This value is the average difference of all results; differences between individual results are expected to vary both below and above the average.

Analyte Summaries

The summary of the linear regression and predicted bias data is shown on the following pages for each analyte. The regression statistics are displayed for each individual instrument used. This data is then used to calculate the predicted biases for each analyte at specific clinical decision values. Actual predicted % differences from the reference analyzers are calculated as:
((Comparator Result – Reference Lab Result) ÷ Reference Lab Result) *100 = % Bias

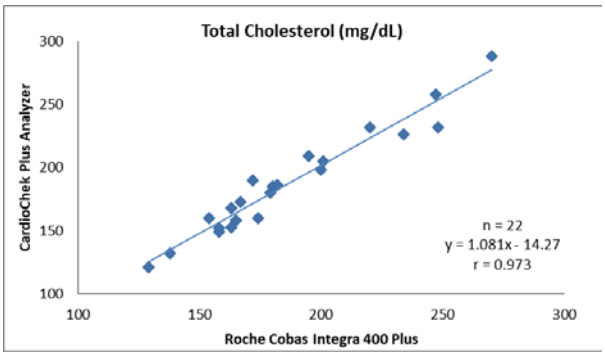
3 TOTAL CHOLESTEROL

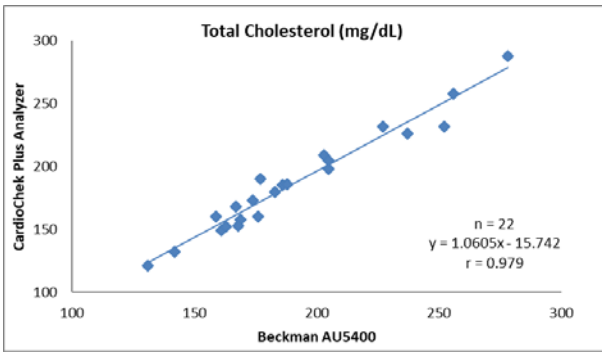
Total Cholesterol (mg/dL)			
vs. Integra	**AU5400**	**CardioChek Plus Analyzer**	**LDX**
N	23	22	22
Slope	1.02	1.08	1.05
Intercept	0.5	-14.3	-13.2
R	0.999	0.973	0.992
vs. AU5400		**CardioChek Plus Analyzer**	**LDX**
N		22	22
Slope		1.06	1.03
Intercept		-15.7	-13.5
R		0.979	0.993

Total Cholesterol Predicted Biases (mg/dL)						
Integra	**AU5400**	**% Bias**	**CardioChek Plus Analyzer**	**% Bias**	**LDX**	**% Bias**
160	164	2.7%	159	-0.8%	155	-3.0%
200	205	2.7%	202	1.0%	197	-1.3%
240	246	2.6%	245	2.2%	239	-0.2%
280	287	2.6%	288	3.0%	282	0.6%
Average % bias		**2.7%**		**1.3%**		**-1.0%**

Total Cholesterol Predicted Biases (mg/dL)				
AU5400	**CardioChek Plus Analyzer**	**% Bias**	**LDX**	**% Bias**
160	154	-3.8%	151	-5.7%
200	196	-1.8%	192	-4.1%
240	239	-0.5%	233	-2.9%
280	281	0.4%	274	-2.1%
Average % bias		**-1.4%**		**-3.7%**

Predicted biases are based on the linear regression line of the data collected.





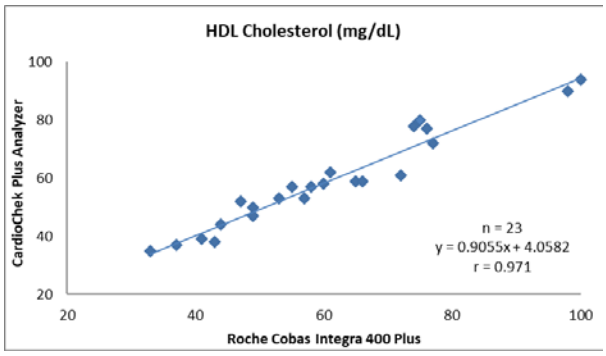
4 HDL CHOLESTEROL

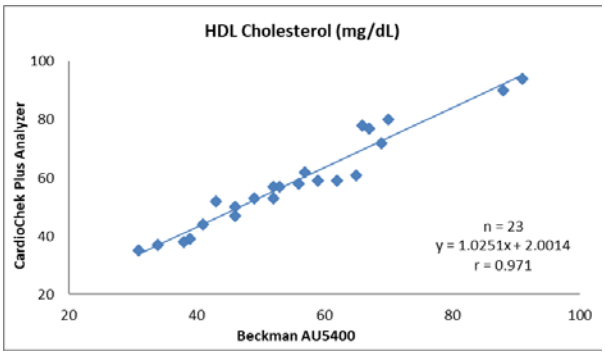
HDL Cholesterol (mg/dL)			
vs. Integra	**AU5400**	**CardioChek Plus Analyzer**	**LDX**
N	23	23	23
Slope	0.88	0.91	0.92
Intercept	2.2	4.1	2.7
R	0.997	0.971	0.977
vs. AU5400		**CardioChek Plus Analyzer**	**LDX**
N		23	23
Slope		1.03	1.05
Intercept		2.0	0.6
R		0.971	0.977

HDL Cholesterol Predicted Biases (mg/dL)						
Integra	**AU5400**	**% Bias**	**CardioChek Plus Analyzer**	**% Bias**	**LDX**	**% Bias**
40	37	-6.5%	40	0.7%	40	-0.8%
60	55	-8.3%	58	-2.7%	58	-3.1%
80	73	-9.2%	76	-4.4%	77	-4.2%
100	90	-9.8%	95	-5.4%	95	-4.9%
	Average % bias	**-8.5%**		**-2.9%**		**-3.2%**

HDL Cholesterol Predicted Biases (mg/dL)				
AU5400	**CardioChek Plus Analyzer**	**% Bias**	**LDX**	**% Bias**
40	43	7.5%	42	6.2%
60	64	5.8%	63	5.6%
80	84	5.0%	84	5.4%
100	105	4.5%	105	5.2%
	Average % bias	**5.7%**		**5.6%**

Predicted biases are based on the linear regression line of the data collected.





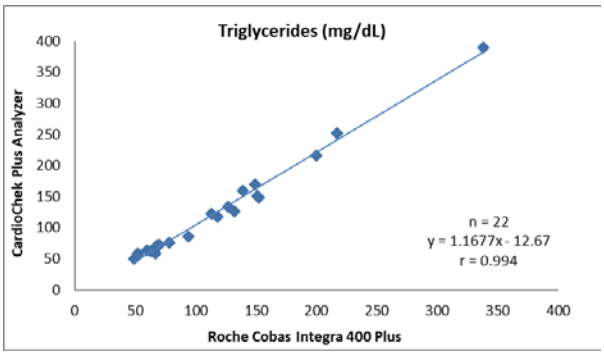
5 TRIGLYCERIDES

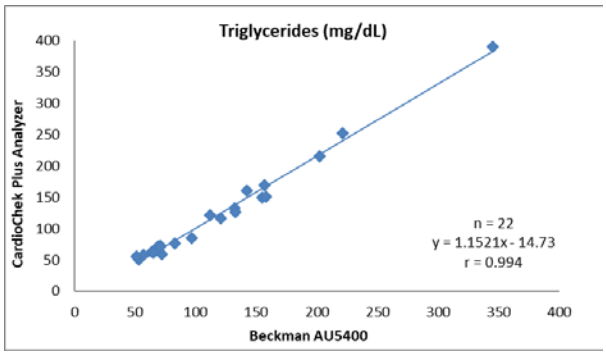
Triglycerides (mg/dL)			
vs. Integra	**AU5400**	**CardioChek Plus Analyzer**	**LDX**
N	23	22	22
Slope	1.01	1.17	0.99
Intercept	1.9	-12.7	-2.9
R	1.000	0.994	0.999
vs. AU5400		**CardioChek Plus Analyzer**	**LDX**
N		22	22
Slope		1.15	0.97
Intercept		-14.7	-5.1
R		0.994	0.998

Triglycerides Predicted Biases (mg/dL)						
Integra	**AU5400**	**% Bias**	**CardioChek Plus Analyzer**	**% Bias**	**LDX**	**% Bias**
100	103	3.2%	104	4.1%	96	-4.4%
150	154	2.5%	162	8.3%	145	-3.4%
200	204	2.2%	221	10.4%	194	-2.9%
250	255	2.0%	279	11.7%	243	-2.6%
	Average % bias	**2.5%**		**8.6%**		**-3.3%**

Triglycerides Predicted Biases (mg/dL)				
AU5400	**CardioChek Plus Analyzer**	**% Bias**	**LDX**	**% Bias**
100	100	0.5%	92	-7.6%
150	158	5.4%	141	-5.9%
200	216	7.8%	190	-5.1%
250	273	9.3%	239	-4.6%
	Average % bias	**5.8%**		**-5.8%**

Predicted biases are based on the linear regression line of the data collected.





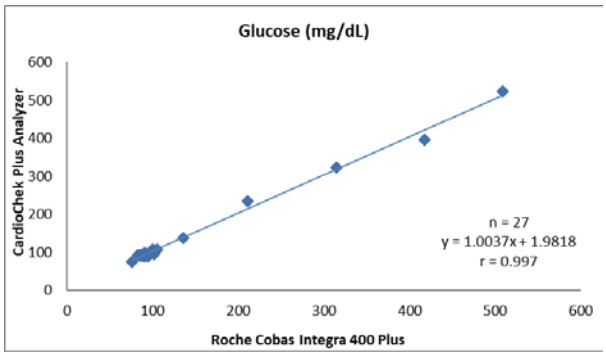
6 GLUCOSE

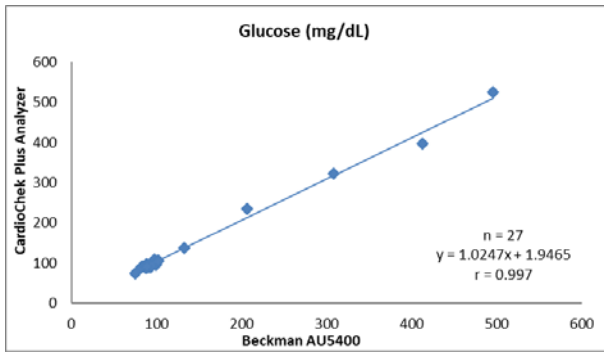
Glucose (mg/dL)			
vs. Integra	AU5400	CardioChek Plus Analyzer	LDX
N	27	27	23
Slope	0.98	1.00	0.86
Intercept	0.1	2.0	12.3
R	1.000	0.997	0.917
vs. AU5400		CardioChek Plus Analyzer	LDX
N		27	23
Slope		1.02	0.90
Intercept		1.9	10.6
R		0.997	0.915

Glucose Predicted Biases (mg/dL)						
Integra	AU5400	% Bias	CardioChek Plus Analyzer	% Bias	LDX	% Bias
100	98	-2.0%	102	2.4%	99	-1.3%
150	147	-2.0%	153	1.7%	142	-5.4%
200	196	-2.0%	203	1.4%	185	-7.5%
250	245	-2.0%	253	1.2%	228	-8.7%
	Average % bias	**-2.0%**		**1.6%**		**-5.7%**

Glucose Predicted Biases (mg/dL)				
AU5400	CardioChek Plus Analyzer	% Bias	LDX	% Bias
100	104	4.4%	101	0.6%
150	156	3.8%	146	-2.9%
200	207	3.4%	191	-4.7%
250	258	3.2%	236	-5.8%
	Average % bias	**3.7%**		**-3.2%**

Predicted biases are based on the linear regression line of the data collected.





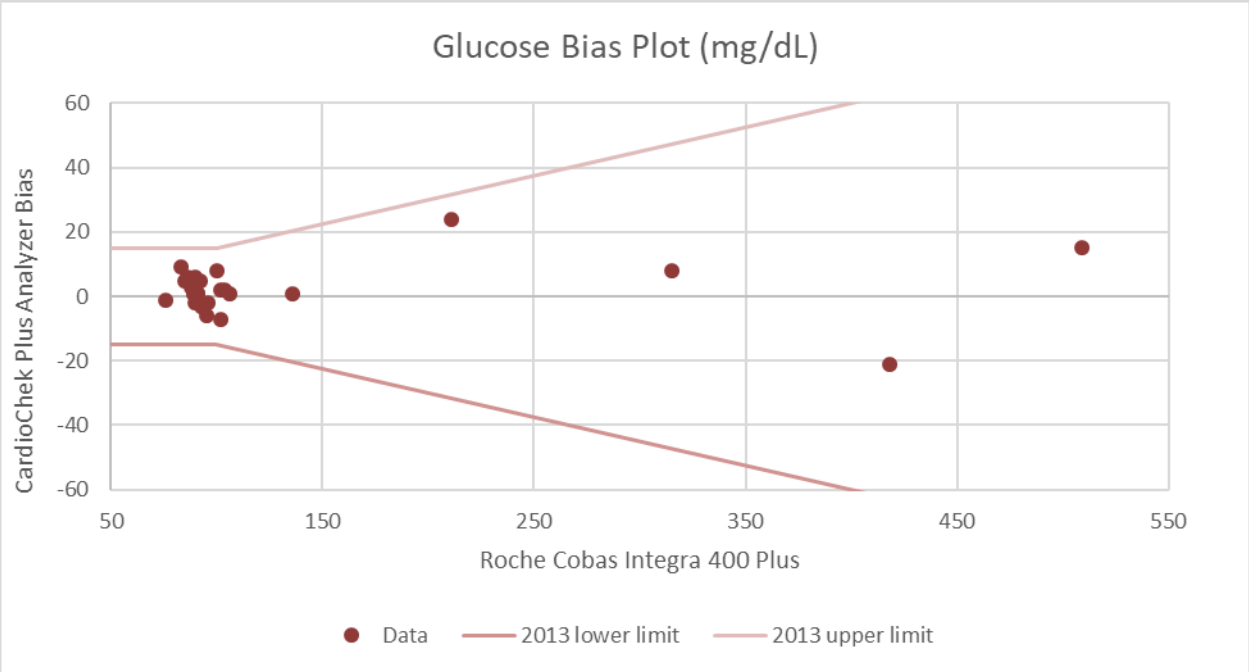
6 GLUCOSE, CONTINUED

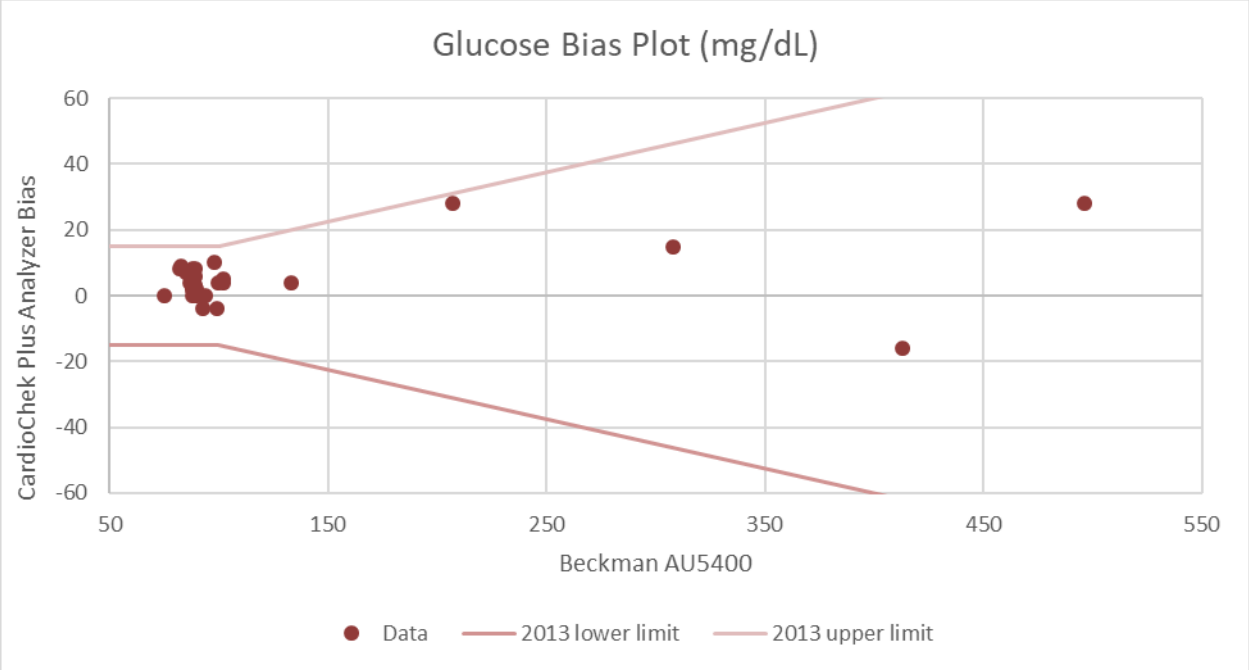
Glucose ISO 15197 Guidelines

Glucose evaluated according to the 2013 ISO Standard:

Values <100 mg/dL ±15mg/dL

Values ≥100 mg/dL ±15%

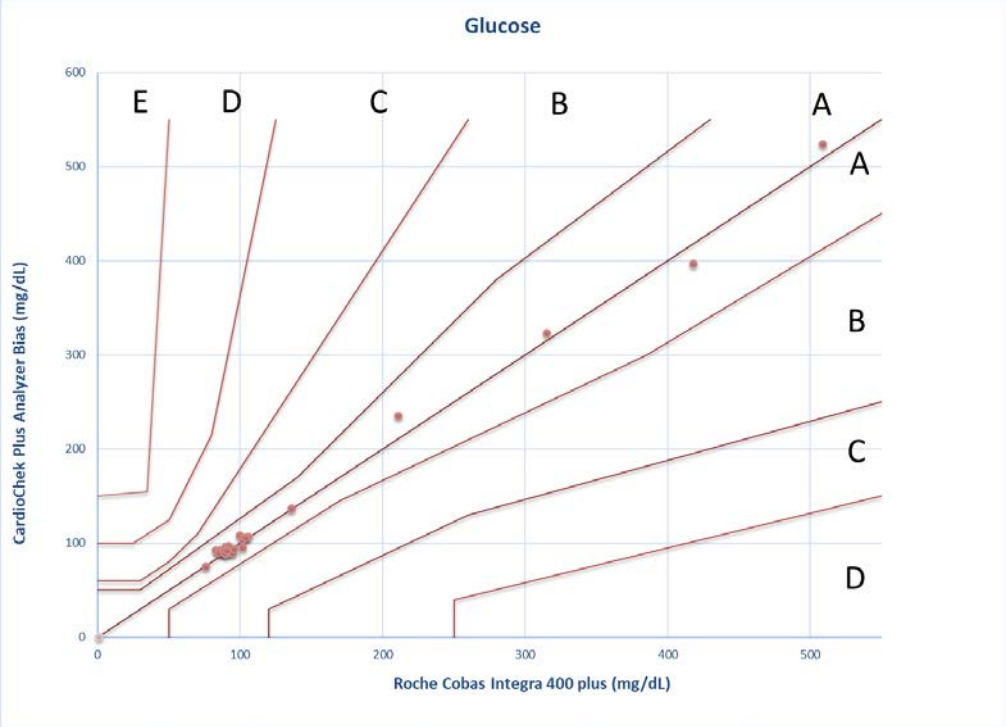


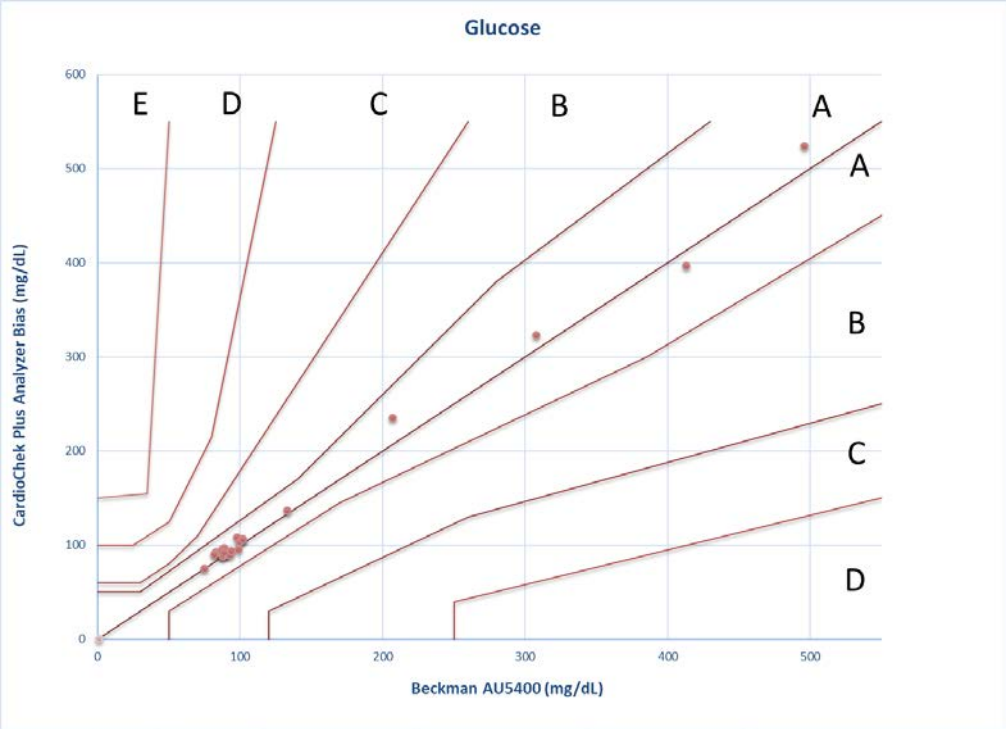


6 GLUCOSE, CONTINUED

Consensus Error Grid (CEG)

99% of results must be within zones A & B of the Consensus Error Grid (CEG) for type 1 diabetes





7 RISK CLASSIFICATION

Each result was categorized based on traditional risk categories for each of the analytes (top table below). From these analyses, a clinical agreement table was compiled (bottom tables below) applying strict limits to quantify "Agreement." This means that a sample yielding total cholesterol results of 199 and 200 mg/dL on the two test systems was rated as a one-category difference despite the clinical insignificance of the discrepancy. These results are shown as the number of values where there is clinical agreement (Agree), a one-category difference (1 Cat Diff), or a two-category difference (2 Cat Diff) between the CardioChek Plus and the reference laboratory result**.** In no instance was a two-category difference observed in this clinical evaluation for total cholesterol, HDL cholesterol, triglycerides, or glucose.

Risk Classification (mg/dL)											
Categories Compared	**Total Cholesterol**			**HDL Cholesterol**		**Triglycerides**			**Glucose**		
	<200	200 - 240	>240	<40	≥40	<150	150 - 200	>200	<100	100 - 125	≥126

Risk Classification Agreement Between Methods and Integra											
	Total Cholesterol			**HDL Cholesterol**		**Triglycerides**			**Glucose**		
All Samples	**Agree**	**1 Cat Diff**	**2 Cat Diff**	**Agree**	**1 Cat Diff**	**Agree**	**1 Cat Diff**	**2 Cat Diff**	**Agree**	**1 Cat Diff**	**2 Cat Diff**
AU5400	22	1	0	21	2	21	2	0	25	2	0
CardioChek Plus Analyzer *glucose spikes included	20	3	0	21	2	19	4	0	26	1	0
LDX	21	2	0	23	0	20	3	0	21	2	0

Risk Classification Agreement Between Methods and AU5400											
	Total Cholesterol			**HDL Cholesterol**		**Triglycerides**			**Glucose**		
All Samples	**Agree**	**1 Cat Diff**	**2 Cat Diff**	**Agree**	**1 Cat Diff**	**Agree**	**1 Cat Diff**	**2 Cat Diff**	**Agree**	**1 Cat Diff**	**2 Cat Diff**
CardioChek Plus Analyzer *glucose spikes included	21	2	0	23	0	21	2	0	26	1	0
LDX	20	3	0	21	2	20	3	0	21	2	0

8 PRECISION

CardioChek Plus Analyzer SN 5138926				
Sample ID	15	15	15	15
Analyte	Cholesterol	HDL	Triglycerides	Glucose
1	124	71	58	92
2	127	73	56	96
3	114	76	57	97
4	121	67	55	90
5	112	76	66	91
6	125	73	53	91
7	118	74	59	91
8	127	74	59	96
9	130	69	56	89
10	111	72	58	92
Number	10	10	10	10
Average	120.9	72.5	57.7	92.5
SD	6.8	2.9	3.5	2.8
%CV	5.6	4.0	6.0	3.0

CardioChek Plus Analyzer SN 5139801				
Sample ID	11	11	11	11
Analyte	Cholesterol	HDL	Triglycerides	Glucose
1	187	33	417	103
2	197	33	406	110
3	187	31	408	103
4	187	34	417	112
5	186	34	384	115
6	189	33	396	109
7	193	32	404	109
8	199	34	399	111
9	199	30	385	115
10	198	31	388	115
Number	10	10	10	10
Average	192.2	32.5	400.4	110.2
SD	5.6	1.4	12.2	4.5
%CV	2.9	4.4	3.0	4.1

8 PRECISION, CONTINUED

CardioChek Plus Analyzer SN 5139629				
Sample ID	6	6	6	6
Analyte	Cholesterol	HDL	Triglycerides	Glucose
1	267	58	87	105
2	271	57	82	107
3	279	56	91	110
4	272	56	95	105
5	287	58	94	109
6	276	62	91	109
7	266	60	91	109
8	291	59	88	107
9	280	59	87	105
10	283	63	94	105
Number	10	10	10	10
Average	277.2	58.8	90	107.1
SD	8.4	2.3	4.0	2.0
%CV	3.0	4.0	4.5	1.9

9 OVERVIEW OF EVALUATION

PTS Diagnostics Technical Support

PTS Technical Support(877) 870-5610
customerservice@ptsdiagnostics.com

Third-Party Comparison: (X-axis)

PTS Diagnostics: Roche Cobas Integra 400 plus
Quest Diagnostics: Beckman AU5400

Reagents Used: Accuracy and Precision Testing

PTS Panels Smart Bundle: Lot Q716
PTS Panels Multi-Chemistry Controls: Lot MC28
LDX Reagent: 412174

Accuracy Test Instruments: (Y-axis)

CardioChek Plus Analyzer: SN5138926, v.1.09
LDX Analyzers: AA135747 & AA150854

Precision Test Instruments:

CardioChek Plus Analyzers: SN5138926, SN5139801, 5139629, v.1.09

10 REGRESSION STATISTICS SUMMARY

Statistical Definitions

Slope: The slope of a line in the plane containing the *x* and *y* axes is generally represented by the letter *m*, and is defined as the change in the *y* coordinate divided by the corresponding change in the *x* coordinate, between two distinct points on the line. (A perfect slope is "1")

Intercept: Where a straight line crosses the Y axis of a graph. (A perfect intercept is "0")

R Value: A statistic that gives a measure of how closely two variables are related, also known as the correlation coefficient. It represents the extent to which variations in one variable are related to variations in another or "goodness of fit."

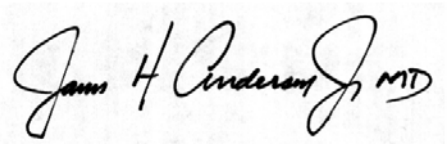
Comparison Key Aspects

Any method comparison must be approached with a clear understanding of variables that affect the test results. The known variation of chemistry analytical systems must always be considered when evaluating observed bias. Such variation is not only evident between POCT and laboratory systems but also between laboratory systems. Even in the most closely aligned systems, two methods may "correlate" but rarely "match." Identity is not a prerequisite for acceptance, but rather an understanding of the bias at clinical decision limits for the analyte in question and the clinical consequences of these biases. The critical evaluation criterion is the placement of a given patient into appropriate risk categories by each system. In this analysis, a point by point comparison was made for each patient evaluating the risk classification category for each result.

Data Summary

In this evaluation, the CardioChek Plus test system produced clinically equivalent values for total cholesterol, HDL cholesterol, triglycerides, and glucose compared to those reported for the same patients' samples analyzed in a reference laboratory. The linear regression results between the methods indicate a good correlation between the CardioChek Plus analyzer point-of-care method and the reference laboratory method(s) for total cholesterol, HDL cholesterol, triglycerides, and glucose. The risk classification tables demonstrate that the CardioChek Plus analyzer accurately identifies patient risk category with a high level of correlation with reference methods. The multiple-repetition analyses confirm good precision of the CardioChek Plus analyzer for all four analytes. In summation, the data demonstrates clinical equivalency between all methods used.

James H. Anderson Jr., MD, FFPM, FACE
Medical Director



PTS Diagnostics Approval Signature

6 DEC 2017
Date