CardioChek® Plus

Comparison Study Summary

March 25, 2015

1 PROTOCOL

This study was conducted on March 25, 2015. It consisted of a comparative analysis of the CardioChek® Plus analyzer using CardioChek Plus Lipid +eGlu™ Smart Bundle™ test strips. This study compared the CardioChek Plus analyzer to a Roche Cobas Integra 400 plus analyzer at the PTS Diagnostics site (Integra), a Roche Cobas analyzer at the customer site (Cobas) and the Cholestech LDX analyzer using twenty one (21) participants. Fifteen (15) participants were fasting.

At the test site a phlebotomist performed a venipuncture blood draw collecting one (1) serum clot tube and one (1) lithium heparin tube. The serum tube was allowed to clot for 30 minutes and centrifuged. Each serum sample was split into two aliquots. One aliquot was tested at the evaluation site on the Roche Cobas analyzer. The second aliquot was transported by overnight courier to PTS Diagnostics for analysis on the Roche Integra. The lithium heparin tube was used for precision testing. Because of expanding capillary-venous glycemic gradients as blood glucose increases after eating, for the purpose of this evaluation, only fasting patients will be utilized for the glucose.

Immediately following the venous draw a PTS Diagnostics employee executed a fingerstick, and immediately dosed the electrochemical glucose strip on the CardioChek Plus analyzer. The drop of blood was wiped from the finger and two (2) 40µl capillary tubes were collected. The first capillary tube was collected by a PTS Diagnostics employee and dosed onto the CardioChek lipid panel strip. The second capillary tube was collected by the evaluation site employee and dosed on the LDX cassette.

	Testing Range
Total Cholesterol	136-278
HDL Cholesterol	39-101
Triglycerides	42-204
Glucose	80-188

Testing range based on Roche Cobas Integra analyzer testing
All results are in mg/dL

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, the Integra analyzer, and the Cobas analyzer.

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

Total cholesterol:	±10%
HDL cholesterol:	±12%
Triglycerides:	±15%
Glucose ≤75 mg/dL:	±15 mg/dL
Glucose ≥75 mg/dL:	±20%

The average difference calculated from the actual individual paired % bias with the **Integra** analyzer. ((Comparator Result – Integra Lab Result) ÷ Integra Lab Result) X100) are as follows:

Average of Paired % Biases			
vs Integra	**Cobas**	**CardioChek Plus**	**LDX**
Total Cholesterol	1.5%	-5.4%	-12.2%
HDL Cholesterol	-2.4%	-2.2%	-12.0%
Triglycerides	1.4%	0.7%	-5.4%
Fasting Glucose	2.0%	3.2%	-7.1%

The average difference calculated from the actual individual paired % bias with the **Cobas** analyzer. ((Comparator Result – Cobas Lab Result) ÷ Cobas Lab Result) X100) are as follows:

Average of Paired % Biases		
vs Cobas	**CardioChek Plus**	**LDX**
Total Cholesterol	-6.8%	-13.4%
HDL Cholesterol	0.3%	-9.9%
Triglycerides	-0.8%	-7.1%
Fasting Glucose	1.2%	-8.9%

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

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. These data are then used to calculate the predicted biases for each analyte at specific clinical decision points. Predicted bias data was not provided for glucose due to the lack of values spanning the dynamic range of the assay.

Actual predicted % differences with the reference analyzers are calculated as:
((Comparator Result – Reference Lab Result) ÷ Reference Lab Result) X100)

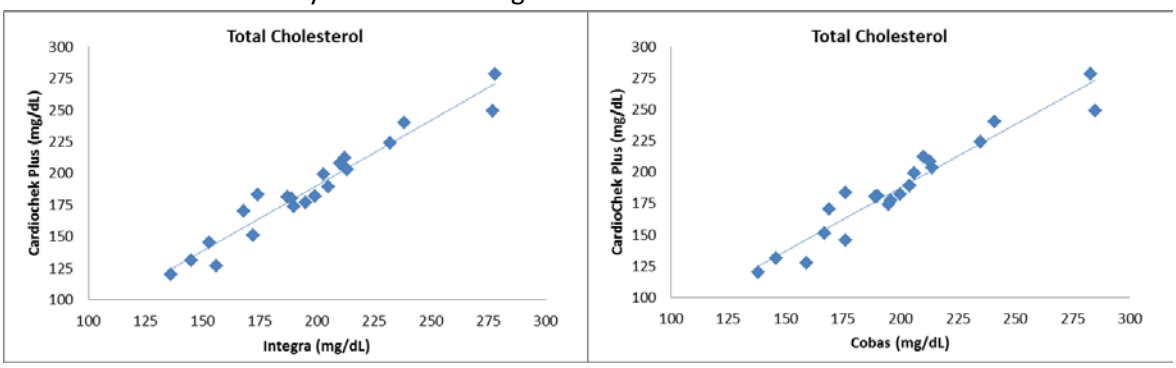
3 TOTAL CHOLESTEROL

Total Cholesterol (mg/dL)			
vs Integra	**Cobas**	**CardioChek Plus**	**LDX**
N	21	21	21
Slope	1.00	1.03	0.86
Intercept	2.9	-16.3	3.1
R	0.990	0.969	0.976
vs Cobas		**CardioChek Plus**	**LDX**
Slope		1.01	0.84
Intercept		-15.4	5.3
R		0.960	0.959

%Total Cholesterol Predicted Biases (mg/dL)						
Integra	**Cobas**	**% Bias**	**CardioChek Plus**	**% Bias**	**LDX**	**% Bias**
160	163	1.8%	149	-7.0%	141	-11.8%
200	203	1.4%	190	-4.9%	176	-12.2%
240	243	1.2%	231	-3.6%	210	-12.5%
280	283	1.0%	273	-2.6%	245	-12.7%
Average % bias		**1.4%**		**-4.5%**		**-12.3%**

Total Cholesterol Predicted Biases (mg/dL)				
vs Cobas	**CardioChek Plus**	**% Bias**	**LDX**	**% Bias**
160	147	-8.3%	140	-12.8%
200	187	-6.4%	173	-13.5%
240	228	-5.1%	207	-13.9%
280	268	-4.2%	240	-14.2%
Average % bias		**-6.0%**		**-13.6%**

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



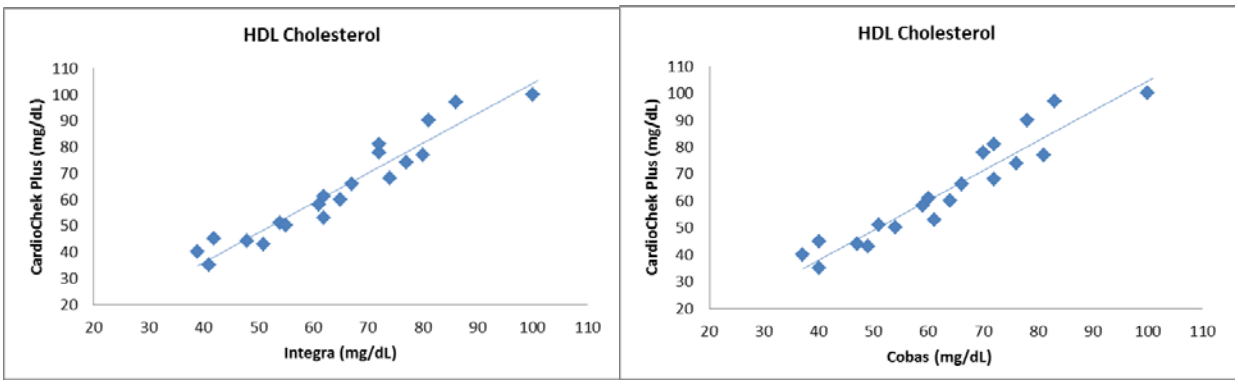
4 HDL CHOLESTEROL

HDL Cholesterol (mg/dL)			
vs Integra	Cobas	CardioChek Plus	LDX
N	21	20	21
Slope	1.02	1.14	0.84
Intercept	-2.6	-9.8	2.3
R	0.998	0.961	0.927
vs Cobas		CardioChek Plus	LDX
Slope		1.11	0.83
Intercept		-6.4	4.6
R		0.952	0.926

HDL Cholesterol Predicted Biases (mg/dL)						
Integra	Cobas	% Bias	CardioChek Plus	% Bias	LDX	% Bias
40	38	-4.7%	36	-10.7%	36	-9.9%
60	59	-2.5%	58	-2.5%	53	-11.9%
80	79	-1.4%	81	1.6%	70	-12.8%
100	99	-0.7%	104	4.0%	87	-13.4%
	Average % bias	**-2.3%**		**-1.9%**		**-12.0%**

HDL Cholesterol Predicted Biases (mg/dL)				
vs Cobas	CardioChek Plus	% Bias	LDX	% Bias
40	38	-4.9%	38	-5.9%
60	60	0.4%	54	-9.8%
80	82	3.0%	71	-11.7%
100	105	4.6%	87	-12.9%
	Average % bias	**0.8%**		**-10.1%**

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



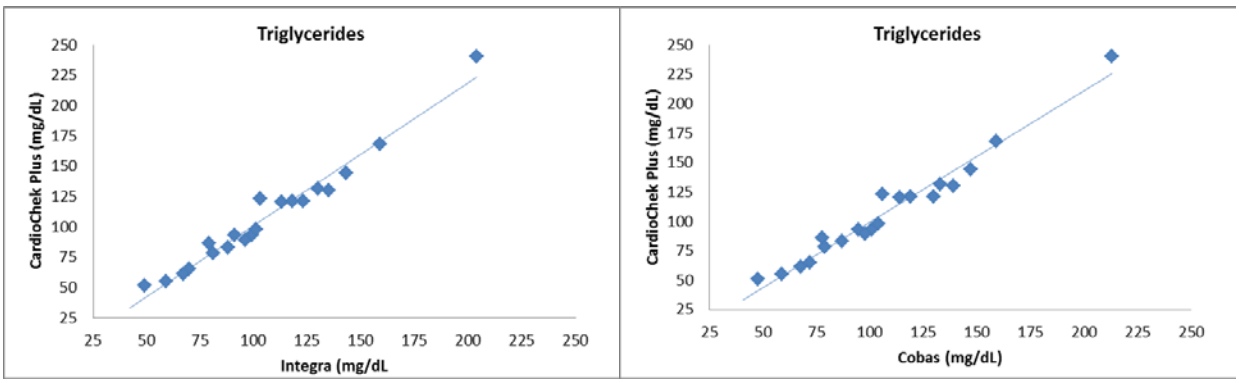
5 TRIGLYCERIDES

Triglycerides (mg/dL)			
vs Integra	Cobas	CardioChek Plus	LDX
N	21	20	18
Slope	1.05	1.17	1.12
Intercept	-3.2	-16.1	-18.3
R	0.999	0.983	0.972
vs Cobas		CardioChek Plus	LDX
Slope		1.11	1.06
Intercept		-12.2	-14.1
R		0.982	0.968

Triglycerides Predicted Biases (mg/dL)						
Integra	Cobas	% Bias	CardioChek Plus	% Bias	LDX	% Bias
100	102	1.8%	101	1.2%	94	-6.0%
150	154	2.9%	160	6.5%	150	0.1%
200	207	3.4%	218	9.2%	206	3.1%
250	259	3.7%	277	10.8%	262	5.0%
	Average % bias	**2.9%**		**6.9%**		**0.5%**

Triglycerides Predicted Biases (mg/dL)				
vs Cobas	CardioChek Plus	% Bias	LDX	% Bias
100	99	-0.8%	92	-7.8%
150	155	3.3%	145	-3.1%
200	211	5.3%	198	-0.8%
250	266	6.5%	252	0.6%
	Average % bias	**3.6%**		**-2.8%**

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



6 FASTING GLUCOSE

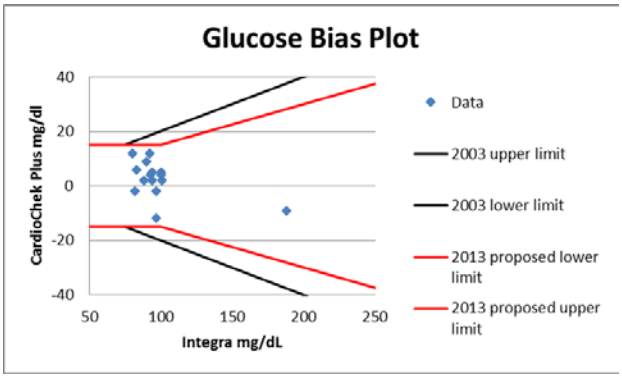
Fasting Glucose (mg/dL)			
vs Integra	**Cobas**	**CardioChek Plus**	**LDX**
N	15	15	15
Slope	1.05	0.86	0.90
Intercept	-3.0	16.3	2.7
R	0.998	0.968	0.982
vs Cobas		**CardioChek Plus**	**LDX**
Slope		0.82	0.85
Intercept		18.8	5.5
R		0.969	0.981

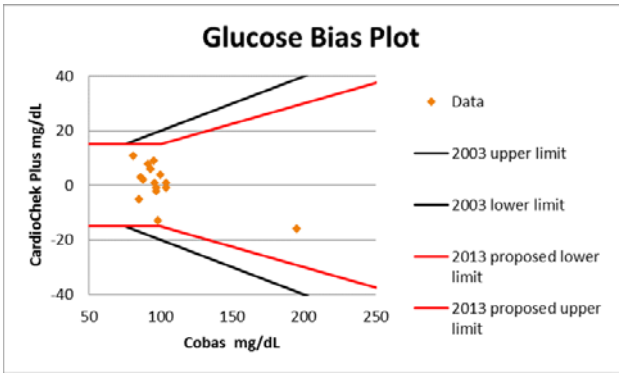
Glucose ISO Guidelines

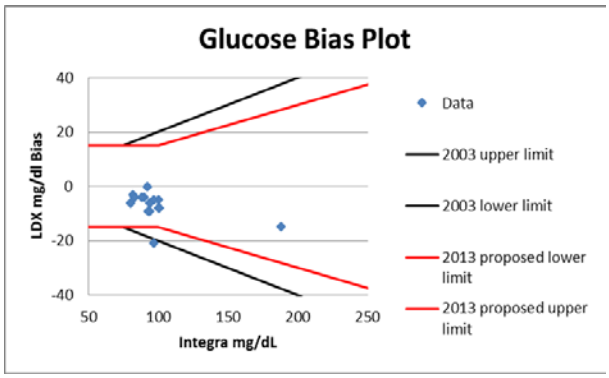
Glucose evaluated according to the current 2003 ISO 15197 Standard:

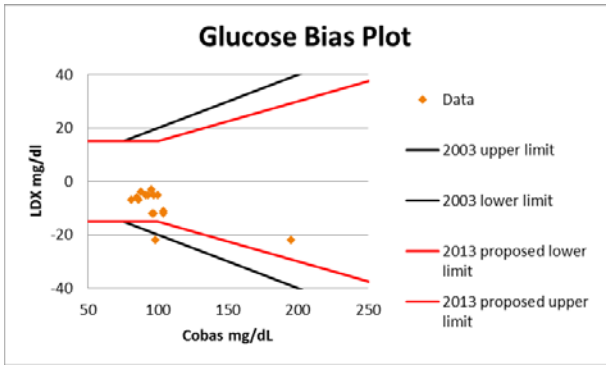
Values up to 75 mg/dL ±15mg/dL

Values 75 mg/dL ± 20%









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 (top table below) applying strict limits to quantify "Agreement". This means that a sample yielding cholesterol results of 199 and 200 mg/dL on the four test systems was rated as a 1 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 analyzer and the reference laboratory result**.** In no instance was a "2 Category Difference" observed in this clinical evaluation for Total Cholesterol, HDL Cholesterol, Triglycerides, or Glucose.

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

Risk Classification Agreement Between Methods and Integra										
	Total Cholesterol			HDL Cholesterol		Triglycerides			Fasting 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
Cobas	19	2	0	21	0	21	0	0	15	0
CardioChek Plus	18	3	0	19	2	21	0	0	15	0
LDX	14	7	0	20	1	21	0	0	15	0

Risk Classification Agreement Between Methods and Cobas										
	Total Cholesterol			HDL Cholesterol		Triglycerides			Fasting 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
CardioChek Plus	18	3	0	19	2	21	0	0	15	0
LDX	12	9	0	20	1	21	0	0	15	0

8 PRECISION

CardioChek Plus analyzer SN 5110789 (mg/dL)				
Sample ID	3	3	3	3
Analyte	CHOL	HDL	TRIG	eGLU
1	150	75	78	79
2	152	76	76	77
3	160	75	74	80
4	164	74	80	81
5	159	73	81	79
6	157	74	75	84
7	152	72	85	80
8	149	76	83	78
9	152	72	80	76
10	150	74	72	83
Number	10	10	10	10
Average	154.5	74.1	78.4	79.7
SD	5.1	1.4	4.1	2.5
%CV	3.3	2.0	5.3	3.1

CardioChek Plus analyzer SN 5110789 (mg/dL)				
Sample ID	7	7	7	7
Analyte	CHOL	HDL	TRIG	eGLU
1	165	42	98	89
2	157	41	93	86
3	181	43	99	90
4	173	44	97	91
5	177	43	96	92
6	178	44	97	85
7	167	41	91	86
8	170	42	96	88
9	172	39	97	90
10	168	42	93	86
Number	10	10	10	10
Average	170.8	42.1	95.7	88.3
SD	7.1	1.5	2.5	2.5
%CV	4.1	3.6	2.7	2.8

CardioChek Plus analyzer SN 5110789 (mg/dL)				
Sample ID	17	17	17	17
Analyte	CHOL	HDL	TRIG	eGLU
1	211	79	72	96
2	210	84	72	93
3	215	81	75	92
4	205	83	78	89
5	205	86	70	90
6	204	81	70	95
7	206	80	72	86
8	200	83	70	91
9	199	78	75	88
10	201	80	71	90
Number	10	10	10	10
Average	205.6	81.5	72.5	91
SD	5.1	2.5	2.7	3.1
%CV	2.5	3.0	3.7	3.4

9 RAW DATA – TOTAL CHOLESTEROL (mg/dL)

Sample #	Integra	Cobas	CardioChek Plus	LDX
1	205	204	189	191
2	212	210	212	191
3	172	167	151	153
4	145	146	131	129
5	213	214	203	192
6	168	169	170	146
7	195	196	177	172
8	187	190	181	146
9	232	235	224	221
10	277	285	249	238
11	189	189	180	171
12	153	176	145	131
13	174	176	183	155
14	278	283	278	238
15	199	200	182	169
16	190	195	174	169
17	238	241	240	203
18	210	213	208	180
19	156	159	127	143
20	136	138	120	118
21	203	206	199	172

10 Raw Data – HDL Cholesterol (mg/dL)

Sample #	Integra	Cobas	CardioChek Plus	LDX
1	42	40	45	42
2	62	60	61	51
3	77	76	74	64
4	41	40	35	32
5	65	64	60	55
6	72	70	78	60
7	48	47	44	43
8	74	72	68	57
9	81	78	90	77
10	100	100	100	83
11	61	59	58	51
12	80	81	77	86
13	39	37	40	32
14	67	66	66	56
15	62	61	53	53
16	54	51	51	63
17	86	83	97	73
18	101	101	>100	86
19	51	49	43	45
20	55	54	50	46
21	72	72	81	65

The above highlighted data was not used within the calculations due to being outside the measuring range of the analyte.

11 RAW DATA – TRIGLYCERIDES (mg/dL)

Sample #	Integra	Cobas	CardioChek Plus	LDX
1	159	159	168	169
2	103	106	123	104
3	81	79	78	73
4	99	101	93	100
5	88	87	83	82
6	70	72	65	59
7	101	104	98	93
8	135	139	130	107
9	143	147	144	143
10	123	130	121	116
11	67	68	61	58
12	59	59	55	<45
13	91	95	93	88
14	204	213	240	217
15	130	133	131	118
16	118	119	121	109
17	79	78	86	72
18	113	114	120	127
19	42	41	<50	<45
20	49	48	51	<45
21	96	98	89	81

The above highlighted data was not used within the calculations due to being outside the measuring range of the analyte.

12 RAW DATA – GLUCOSE (mg/dL)

Sample #	Integra	Cobas	CardioChek Plus	LDX
1	92	95	104	92
2	90	91	99	86
3	80	82	86	82
4	140	147	153	157
5	94	97	96	85
6	188	195	179	173
7	93	96	97	84
8	97	98	85	76
9	82	85	80	79
10	101	104	109	95
11	101	104	103	93
12	83	86	89	79
13	100	104	105	92
14	94	99	104	86
15	100	100	104	95
16	80	81	92	74
17	94	93	99	88
18	89	89	95	93
19	97	97	95	92
20	75	76	85	83
21	88	88	90	84

Samples 3, 4, 10, 14, 18 and 20 are non-fasting.

13 OVERVIEW OF EVALUATION

Technical Service Specialist (TSS)
Maria Shafai, MT (ASCP)

Third Party Comparison: (X-axis)
Roche Integra
Roche Cobas

Reagents Used
CardioChek Plus Smart Bundle Lot Q404
Multi-Chemistry Controls Lot: MC20
HDL Cholesterol Controls Lot: HC19

Accuracy Instruments: (Y-axis)
CardioChek Plus analyzer SN 5111282

Precision Instruments:
CardioChek Plus analyzer SN 5110789

14 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 analyzer 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 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 system 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 system for all four analytes. In summation, the data as a whole demonstrate clinical equivalency between all methods used.

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

PTS Diagnostics Approval Signature

April 1, 2015
Date

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