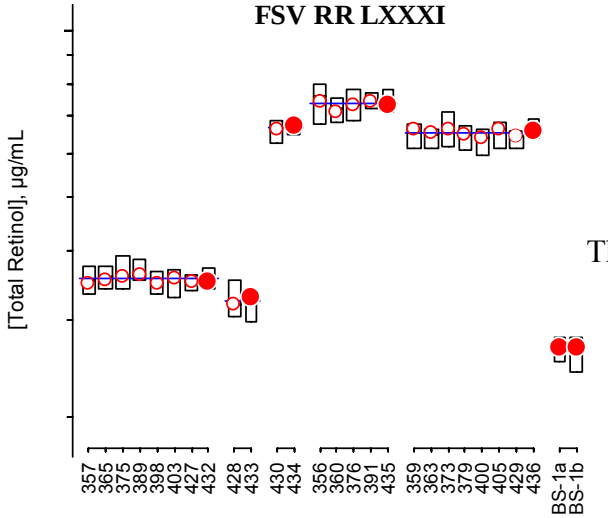
NISTIR 7880-48

NIST Micronutrients Measurement Quality Assurance Program Winter and Summer 2017 Comparability Studies

Results for Round Robins LXXXI and LXXXII Fat-Soluble Vitamins and Carotenoids in Human Serum



David L. Duewer
Jeanice B. Thomas

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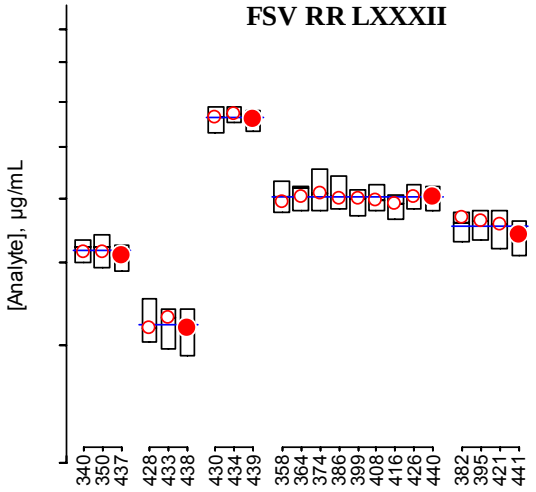

National Institute of Standards and Technology
U.S. Department of Commerce

NISTIR 7880-48

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Results for Round Robins LXXXI and LXXXII Fat-Soluble Vitamins and Carotenoids in Human Serum

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Chemical Sciences Division
Material Measurement Laboratory

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January 2018

U.S. Department of Commerce
Wilbur L. Ross, Jr., Secretary

National Institute of Standards and Technology
Walter Copan, NIST Director and Undersecretary of Commerce for Standards and Technology

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Abstract

The National Institute of Standards and Technology coordinates the Micronutrients Measurement Quality Assurance Program (MMQAP) for laboratories that measure fat-soluble vitamins and carotenoids in human serum and plasma. This report describes the design of and results for the Winter and Summer 2017 MMQAP measurement comparability improvement studies: 1) Round Robin LXXXI Fat-Soluble Vitamins and Carotenoids in Human Serum (RR81) and 2) Round Robin LXXXII Fat-Soluble Vitamins and Carotenoids in Human Serum (RR82). To avoid increasing participation fees, the overhead costs for these programs were minimized by shipping the materials for both studies in the same package in February 2017. Participants were requested not to analyze the Summer samples before June 5, 2017 but to provide their measurement results by September 4, 2017. Participants were reminded of the due-date by e-mail in early August 2017.

Keywords

Human Serum
Retinol, α-Tocopherol, γ-Tocopherol, Total and *Trans*-β-Carotene

Table of Contents

Introduction

Beginning in 1984, the National Institute of Standards and Technology (NIST) coordinated the Micronutrients Measurement Quality Assurance Program (MMQAP) for laboratories that measure fat- and water-soluble vitamins and carotenoids in human serum and plasma. The MMQAP provided participants with measurement comparability assessment through use of interlaboratory studies, Standard Reference Materials (SRMs) and control materials, and methods development and validation. Serum-based samples with assigned values for the target analytes (retinol, alpha-tocopherol, gamma/beta-tocopherol, *trans*- and total beta-carotene, and total ascorbic acid) and performance-evaluation standards were distributed by NIST to laboratories for analysis.

Participants used the methodology of their choice to determine analyte content in the control and study materials. Participants provided their data to NIST, where it was compiled and evaluated for trueness relative to the NIST value, within-laboratory precision, and concordance within the participant community. NIST provided the participants with a technical summary report concerning their performance for each exercise and suggestions for methods development and refinement. Participants who had concerns regarding their laboratory's performance were encouraged to consult with the MMQAP coordinators.

All MMQAP interlaboratory studies consisted of individual units of batch-prepared samples that were distributed to each participant. For historical reasons these studies are referred to as "Round Robins". The MMQAP program and the nature of its studies are described elsewhere. [1,2]

Note: MMQAP Fat-Soluble Vitamins and Carotenoids in Human Serum Round Robin LXXXII (hereafter referred to as RR82) was the final MMQAP-coordinated study. Future studies of considerably different focus and design will be coordinated through the Health Assessment Measurements Quality Assurance Program (HAMQAP). Information about HAMQAP and other NIST Quality Assurance Programs is available at https://qa.nist.gov.

Round Robin LXXXI: Fat-Soluble Vitamins and Carotenoids in Human Serum

Participants in the MMQAP Fat-Soluble Vitamins and Carotenoids in Human Serum Round Robin LXXXI comparability study (hereafter referred to as RR81) received five liquid-frozen human serum test samples for analysis plus two liquid-frozen bovine serum optional samples. Unless multiple vials were previously requested, participants received one vial of each serum. These sera were shipped on dry ice to participants in February 2017 in the same shipping package as the RR82 materials but in separate clearly labeled plastic bags. Participants were requested to provide their measurement results by May 15, 2017. The communication materials included in the sample shipment are provided in Appendix A.

Participants were requested to report values for all fat-soluble vitamin-related analytes of interest to their organizations. Not all participants report values for the target analytes, and many participants report values for non-target analytes.

The final report delivered to every participant in RR81 consists of three documents:

- A cover letter for the current study, a brief description of the other two documents, and a discussion of our analysis of the overall results that may be of broad interest. This cover letter is reproduced as Appendix B.
- The "All-Lab Report" that lists all of the reported measurement results, a number of consensus statistics for analytes reported by more than one participant, and the mean median and pooled SD from any prior distributions of the serum. This report also provides a numerical "score card" for each participant's measurement comparability for the more commonly reported analytes. This All-Lab Report is reproduced as Appendix C.

- An "Individualized Report" that graphically analyzes each participant's results for all analytes reported by at least five participants. This report also provides a graphical summary of their measurement comparability. The graphical tools used in the Individualized Report are described in detail elsewhere [2]. An example Individualized Report is reproduced as Appendix D.

Round Robin LXXXII: Fat-Soluble Vitamins and Carotenoids in Human Serum

Participants in RR82 received five liquid-frozen human serum test samples for analysis. Unless multiple vials were previously requested, participants received one vial of each serum. These sera were shipped on dry ice to participants in February 2017 in the same shipping package as the RR81 materials but in separate clearly labeled plastic bags. Participants were requested not to analyze any of the RR82 samples before June 5, 2017 but to provide their measurement results by September 4, 2017. The communication materials included in the sample shipment are provided in Appendix A.

Participants were requested to report values for all fat-soluble vitamin-related analytes of interest to their organizations. Not all participants report values for the target analytes, and many participants report values for non-target analytes.

The final report delivered to every participant in RR82 consists of three documents:

- A cover letter for the current study, a brief description of the other two documents, and a discussion of our analysis of overall results that may be of broad interest. This cover letter is reproduced as Appendix E.

- The "All-Lab Report" that summarizes all of the reported measurement results and provides several consensus statistics. This All-Lab Report is reproduced as Appendix F.

- An "Individualized Report" that graphically analyzes each participant's results for all analytes reported by at least five participants. This report also provides a graphical summary of their measurement comparability. The graphical tools used in the Individualized Report are described in detail elsewhere [2]. An example Individualized Report is reproduced as Appendix G.

References

1 Duewer DL, Brown Thomas J, Kline MC, MacCrehan WA, Schaffer R, Sharpless KE, May WE, Crowell JA. NIST/NCI Micronutrients Measurement Quality Assurance Program: Measurement Repeatabilities and Reproducibilities for Fat-Soluble Vitamin-Related Compounds in Human Sera. Anal Chem 1997;69(7):1406-1413.

2 Duewer DL, Kline MC, Sharpless KE, Brown Thomas J, Gary KT, Sowell AL. Micronutrients Measurement Quality Assurance Program: Helping Participants Use Interlaboratory Comparison Exercise Results to Improve Their Long-Term Measurement Performance. Anal Chem 1999;71(9):1870-1878.

Appendix A. Shipping Package Inserts for RR81 and RR82

The following items were included in each package shipped to the Round Robin LXXXI (RR81) and LXXXII (RR82) participants:

- Combined cover letter for RRR81 and RR82.
- Datasheets for
    - five human serum test samples for RR81,
    - two bovine serum optional samples for RR81, and
    - five human serum test samples for RR82.
- Packing List and Shipment Receipt Confirmation form for RR81 and RR82 samples.

This RR81 samples were enclosed in a bubble-wrapped sealed plastic bag that was labeled:

NIST MMQAP-FSV: **RR LXXXI**
Micronutrients Measurement Fat-Soluble Vitamins
Quality Assurance Program

Winter 2017 Samples

Results due on or before:
May 15, 2017

The RR82 samples were enclosed in a bubble-wrapped sealed plastic bag that was labeled:

NIST MMQAP-FSV: **RR LXXXII**
Micronutrients Measurement Fat-Soluble Vitamins
Quality Assurance Program

Summer 2017 Samples

Analyze after: **June 5, 2017**

Results due on or before:
September 4, 2017

The Packing List and Shipment Receipt Confirmation form was placed at the top of the shipping box, between the cardboard covering and the foam insulation.

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

February 27, 2017

Dear Colleague:

Enclosed are samples for the fat-soluble vitamins and carotenoids in serum studies for the 2017 NIST Micronutrients Measurement Quality Assurance Program. Sample details are provided below.

Comparability study/Round Robin (RR)	Sample description	Results due
RR81	Sera 432 - 436	May 15, 2017
RR81 Exploratory (Bovine Serum)	Serum BS-1a and BS-1b	May 15, 2017
RR82	Sera 437 - 441	September 4, 2017

RR81 and RR82 consist of one vial each of five liquid-frozen serum samples for analysis. As an exploratory study for the development of a candidate reference material for carotenoids, we also enclose two vials of a bovine serum to be analyzed along with the RR81 human samples. All samples should be stored in the dark at or below –20 °C upon receipt. A form for each study is included for reporting your results. Please report one value for each analyte for each serum sample on the appropriate data sheet. If a value obtained is below your limit of quantification, please indicate this result on the form as "*nq*" (*Not Quantified*) or "<*x*" where *x* is your established limit of quantification. Results are due to NIST for each study as indicated above. Results received more than two weeks after the due date may not be included in the study's summary report. The feedback report concerning each study will be distributed in June and October 2017, respectively. Please contact us immediately if this schedule is problematic for your laboratory.

Samples should be allowed to stand at room temperature under subdued light until thawed. We recommend that sample mixing be facilitated with 3 to 5 min agitation in an ultrasonic bath or at least 15 min at room temperature with intermittent swirling. (CAUTION: Vigorous shaking will cause foaming and possibly interfere with accurate measurement. The rubber stopper contains phthalate esters that may leach into the sample upon intermittent contact of the liquid sample with the stopper. These esters absorb strongly in the UV region and elute near retinol in most LC systems creating analytical problems.) **Water should not be added to the samples.**

For consistency, we request that laboratories use the following absorptivities (dL/g · cm): retinol, 1843 at 325 nm (ethanol); retinyl palmitate, 975 at 325 nm (ethanol); α-tocopherol, 75.8 at 292 nm (ethanol); γ-tocopherol, 91.4 at 298 nm (ethanol); α-carotene, 2800 at 444 nm (hexane); β-carotene, 2560 at 450 nm (ethanol), 2592 at 452 nm (hexane); and lycopene, 3450 at 472 nm (hexane).

Please report your results by e-mail to david.duewer@nist.gov or fax to 301-977-0685. If you have questions or comments regarding the studies, please contact us at 301-975-3120 (Jeanice); jbthomas@nist.gov or 301-975-3935 (Dave); david.duewer@nist.gov.

Sincerely,

Jeanice B. Thomas, M.B.A.
Research Chemist
Chemical Sciences Division, NIST

David L. Duewer, Ph.D.
Research Chemometrician
Chemical Sciences Division, NIST

Enclosures

NIST

Participant #: _____ Date: _____

Round Robin LXXXI: Human Sera

NIST Micronutrients Measurement Quality Assurance Program

Analyte	432	433	434	435	436	Units*
total retinol						
trans-retinol						
retinyl palmitate						
α-tocopherol						
γ/β-tocopherol						
δ-tocopherol						
total β-carotene						
trans-β-carotene						
total cis-β-carotene						
total α-carotene						
total lycopene						
trans-lycopene						
total β-cryptoxanthin						
total α-cryptoxanthin						
total lutein						
total zeaxanthin						
total lutein&zeaxanthin						
astaxanthin						
total coenzyme Q10						
phylloquinone (K_1)						
25-hydroxyvitamin D						
phytoene						
phytofluene						

* We prefer **µg/mL**

Were the samples frozen when received? Yes | No

Comments:

Mail: M^{2}QAP
NIST, Stop 8392
Gaithersburg, MD 20899-8392

Please return results by
15-May-2017

Fax: 301-977-0685
Email: David.Duewer@NIST.gov

Participant #: _____ Date: _____

Round Robin LXXXI Exploratory: Bovine Serum

NIST Micronutrients Measurement Quality Assurance Program

Analyte	BS-1a	BS-1b	Units*
total retinol			
trans-retinol			
retinyl palmitate			
α-tocopherol			
γ/β-tocopherol			
δ-tocopherol			
total β-carotene			
trans-β-carotene			
total cis-β-carotene			
total α-carotene			
total lycopene			
trans-lycopene			
total β-cryptoxanthin			
total α-cryptoxanthin			
total lutein			
total zeaxanthin			
total lutein&zeaxanthin			
astaxanthin			
total coenzyme Q10			
phylloquinone (K_1)			
25-hydroxyvitamin D			
phytoene			
phytofluene			

We prefer **µg/mL**

Were the samples frozen when received? Yes | No

Comments:

Mail: M^{2}QAP
NIST, Stop 8392
Gaithersburg, MD 20899-8392

Please return results by
15-May-2017

Fax: 301-977-0685
Email: David.Duewer@NIST.gov

Participant #: _____ Date: _____

Round Robin LXXXII: Human Sera

NIST Micronutrients Measurement Quality Assurance Program

Analyte	437	438	439	440	441	Units*
total retinol						
trans-retinol						
retinyl palmitate						
α-tocopherol						
γ/β-tocopherol						
δ-tocopherol						
total β-carotene						
trans-β-carotene						
total cis-β-carotene						
total α-carotene						
total lycopene						
trans-lycopene						
total β-cryptoxanthin						
total α-cryptoxanthin						
total lutein						
total zeaxanthin						
total lutein&zeaxanthin						
astaxanthin						
total coenzyme Q10						
phylloquinone (K_1)						
25-hydroxyvitamin D						
phytoene						
phytofluene						

* We prefer **µg/mL**

Were the samples frozen when received? Yes | No

Comments:

Mail: M^{2}QAP
NIST, Stop 8392
Gaithersburg, MD 20899-8392

Please return results by
4-September-2017

Fax: 301-977-0685
Email: David.Duewer@NIST.gov

Participant #: _____ Date: _____

Round Robins LXXXI and LXXXII: Human Sera

NIST Micronutrients Measurement Quality Assurance Program

Packing List and Shipment Receipt Confirmation Form

This box contains one (or more) sets of samples for both RR81 and RR82

There are five RR81 samples per (blue-labeled) set. They are:

Serum	Form	Reconstitute?	Vial/Cap
#432	Liquid frozen	No	2 mL amber / red
#433	Liquid frozen	No	3 mL amber / black
#434	Liquid frozen	No	3 mL amber / gold
#435	Liquid frozen	No	2 mL amber / metallic green
#436	Liquid frozen	No	2 mL amber / green

There are two RR81 Exploratory samples per (blue-labeled) set. They are:

Serum	Form	Reconstitute?	Vial/Cap
BS-1a	Liquid frozen	No	plastic / purple
BS-1b	Liquid frozen	No	plastic / purple

There are five RR82 samples per (orange-labeled) set. They are:

Serum	Form	Reconstitute?	Vial/Cap
#437	Liquid frozen	No	2 mL amber / silver
#438	Liquid frozen	No	3 mL amber / black
#439	Liquid frozen	No	3 mL amber / gold
#440	Liquid frozen	No	3 mL amber / blue
#441	Liquid frozen	No	2 mL clear / forest green

Please 1) Open the sample sets immediately
2) Check that each sets contains the appropriate samples
3) Store the sera at -20 ˚C or below until analysis
4) Email (david.duewer@nist.gov) or fax (301-977-0685) us the following info:

1) Date this shipment arrived: _____

2) Are all ten sera vials intact? Yes | No If "No", which one(s) were damaged?

3) Did the samples arrive frozen? Yes | No

4) At what temperature are you storing the serum samples? _____ ˚C

Your prompt return of this information is appreciated.

Mail: M^2QAP
NIST, Stop 8392
Gaithersburg, MD 20899-8392

Please return this sheet as soon as possible after checking the samples

Fax: 301-977-0685
Email: David.Duewer@NIST.gov

Appendix B. Final Report for RR81

The following three pages are the final report for RR81 as provided to all participants:

- Cover letter.
- An information sheet that:
  - describes the contents of the "All-Lab" report,
  - describes the content of the "Individualized" report,
  - describes the nature of the test samples and details their previous distributions, if any, and
  - summarizes aspects of the study that we believe may be of interest to the participants.

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-8390

June 20, 2017

Dear Colleague:

Enclosed is the summary report of the results for "Round Robin" LXXXI (RR81) of the 2017 NIST Micronutrients Measurement Quality Assurance Program (MMQAP) for the fat-soluble vitamins and carotenoids in human serum. Included in this report are: 1) a summary of data and measurement comparability scores for all laboratories, 2) a detailed graphical analysis of your results; and 3) a graphical summary of your measurement comparability. RR81 (Sera 432 to 436) consisted of one vial each of five liquid-frozen serum samples. Also, included in this report are the results for the RR81 Exploratory study (BS-1a and BS-1b) which consisted of two vials of bovine serum. Details regarding the samples can be found in the enclosed report.

Your overall measurement comparability is summarized in the "Score Card" summary, page 7 of the All Lab Report. Combined results rated 1 to 3 are within 1 to 3 standard deviations of the assigned value, respectively; those rated 4 are >3 standard deviations from the assigned value. Similar information is presented graphically in the "target plots" that are the last page of your Individualized Report. If you have concerns regarding your laboratory's performance, please contact us for consultation.

If you have questions or concerns regarding this report, please contact David Duewer at 301-975-3935; e-mail: david.duewer@nist.gov or me at 301-975-3120; e-mail: jbthomas@nist.gov; or fax: 301-978-0685.

Sincerely,

Jeanice Brown Thomas, MBA
Research Chemist
Chemical Sciences Division
Material Measurement Laboratory

David L. Duewer, Ph.D.
Research Chemometrician
Chemical Sciences Division
Material Measurement Laboratory

Enclosures

The NIST MMQAP Round Robin LXXXI (RR81) report consists of:

Page	All-Lab Report
1-5	A listing of all results and statistics for analytes reported by more than one participant.
6	The legend for the list of results and statistics.
7	The text Comparability Summary (Score Card) of measurement performance.

Page	Individualized Report
1	Your values, the number of labs reporting values, and our assigned values.
2 to n	"Four Plot" summaries of your current and past measurement performance, one page for each analyte you report that is also reported by at least eight other participants.
n+1	The graphical Comparability Summary (Target Plot) of measurement performance.

Samples. Five different liquid-frozen human serum samples were distributed to each participant in RR81. Two tubes of the same bovine serum were distributed as optional samples.

Serum	Description	Prior Distributions
432	Fresh-frozen, native, multi-donor, prepared in 2009. This is Level 1 of SRM 968e.	#357:RR66-9/09, #365:RR67-3/10, #375 RR69-3/11, #389:RR72-9/12, #398:RR74-9/13, #403:RR75-3/14, #427:RR80-9/16
433	Fresh-frozen, native, multi-donor, prepared in 2015 This is the candidate SRM 968f-Level 1.	#428:RR80-9/16
434	Fresh-frozen, native, multi-donor, prepared in 2015 This is the candidate SRM 968f-Level 2.	#430:RR80-9/16
435	Liquid-frozen, native, multi-donor, prepared in 2008	#356:RR65-3/09, #360:RR66-9/09, #376:RR69-3/11, #391:RR72-9/12
436	Fresh-frozen, native, multi-donor, prepared in 2009. This is Level 3 of SRM 968e.	#359:RR66-9/09, #363:RR67-3/10, #373:RR69-3/11, #379:RR70-9/11, #400:RR74-9/13, #405:RR75-3/14, #429:RR80-9/16
BS-1a BS-1b	Fresh-frozen, native, single-donor *bovine* serum, purchased in 2016. These were optional samples.	First distribution

Results

1) Stability: There has been no significant change in the concentration nor variability of any analyte in any of the human sera.

2) Bovine Serum BS-1, samples "a" and "b": This material was distributed to evaluate the suitability of bovine sera as high β-carotene reference materials. We thank all who evaluated these samples.

No one reported analytical difficulties. The results for the duplicate samples were very similar for all analytes for all participants. For Total Retinol (Figure 1A) and α-Tocopherol (Figure 1B) the analytical variability as a function of analyte level is consistent with what we expect for human sera. However, the observed variability for β-Carotene is much greater than expected (Figure 1C). Further studies would be required to evaluate whether this variability results from matrix differences that impact chromatography/integration or from our limited experience with very high β-Carotene levels in sera.

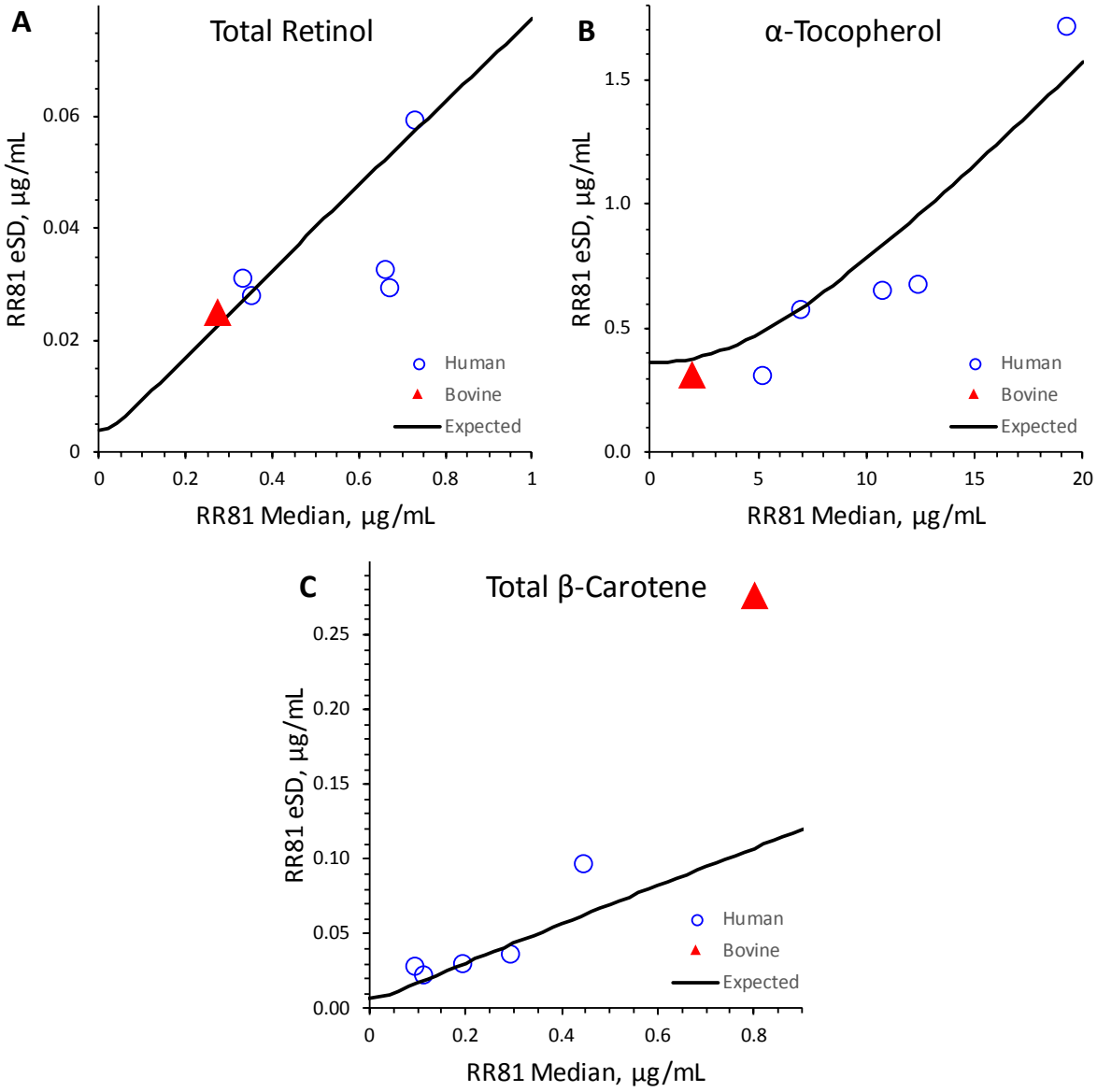


Figure 1: Robust Standard Deviation (eSD) as Functions of Robust Location (Median). The lines denote the empirical relationships observed in the MMQAP studies from 1985 through 1995 as documented in Duewer et al, NIST/NCI Micronutrients Measurement Quality Assurance Program: Measurement Repeatabilities and Reproducibilities for Fat Soluble Vitamin Related Compounds in Human Sera, Anal Chem 1997; 69:1406-1413.

Appendix C. "All-Lab Report" for RR81

The following seven pages are the "All-Lab Report" for RR81 as provided to all participants, with two exceptions:

- the participant identifiers (Lab) have been altered and
- the order in which the participant results are listed has been altered.

The data summary in the "All-Lab Report" has been altered to ensure confidentiality of identification codes assigned to laboratories.

Round Robin LXXXI Laboratory Results

	Total Retinol, µg/mL							Retinyl Palmitate, µg/mL							α-Tocopherol, µg/mL							γ/β-Tocopherol, µg/mL						
Lab	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b
FSV-BA	0.350	0.330	0.660	0.720	0.650	0.280	0.280																					
FSV-BD	0.358	0.298	0.672	0.814	0.660	0.277	0.262								7.20	5.30	13.10	11.80	20.5	1.90	1.70							
FSV-BE	0.350	0.330	0.670	0.760	0.660										6.40	4.90	12.20	10.40	19.1			1.50	<1.0	2.30	2.20	2.10		
FSV-BH	0.299	0.265	0.586	0.613	0.541	0.250	0.246								6.49	4.67	12.02	9.47	18.0	2.00	2.07	1.72	1.02	2.54	2.21	2.11	0.058	0.077
FSV-BJ	0.342	0.309	0.657	0.730	0.641	0.267	0.264								6.20	4.47	11.90	9.91	19.1	1.86	1.73	1.75	0.99	2.38	2.26	2.18	0.015	0.015
FSV-BL	0.370	0.340	0.690	0.800	0.690	0.320	0.290								7.30	5.20	12.10	11.20	19.8	1.70	1.70							
FSV-BM	0.290	0.270	0.560	0.620	0.690	0.240	0.240								6.80	5.30	13.60	11.70	24.7	1.30	1.20							
FSV-BN	0.395	0.364	0.736	0.811	0.708	0.304	0.305								7.18	5.41	12.93	11.00	19.4	2.27	2.33							
FSV-BR	0.345	0.331	0.660	0.708	0.674	0.239	0.235								7.31	5.17	13.14	11.12	20.7	1.47	1.35							
FSV-BS															7.17	7.17	12.78	10.37	18.5	1.99	2.17							
FSV-BT	0.353	0.292	0.687	0.726	0.637	0.259	0.252								6.70	5.22	11.93	10.81	17.5	2.26	2.31	1.68	1.22	2.59	2.14	2.27	0.262	0.255
FSV-BU	0.326	0.293	0.622	0.567	0.617	0.228	0.233								6.48	4.56	12.31	10.74	20.0	1.02	0.96	1.60	0.97	2.46	2.19	2.16	*nd*	*nd*
FSV-BW	0.346	0.336	0.674	0.753	0.647	0.260	0.262	*nd*	*nd*	*nd*	0.021	0.166	*nd*	*nd*	6.83	5.07	12.33	10.40	20.1	1.96	1.94							
FSV-CD	0.330	0.380	0.570	0.660	0.530	0.210	0.170								6.68	5.94	11.31	10.20	16.7	1.91	1.65	1.75	1.25	2.36	2.29	2.03	<0.2	<0.2
FSV-CE	0.371	0.337	0.667	0.729	0.655	0.276	0.279								7.07	5.23	12.40	10.32	19.8	2.10	2.12							
FSV-CF	0.393	0.339	0.701	0.781	0.711	0.275	0.281								7.00	5.40	12.00	11.10	18.2	2.30	2.50							
FSV-CG	0.317	0.297	0.553	0.606	0.561	2.430	0.234								7.51	5.69	13.91	12.38	23.9	3.64	3.99	1.69	1.09	2.61	2.41	2.59	0.183	0.210
FSV-CI	0.352	0.312	0.673	0.711	0.659	0.229	0.228	<0.02	<0.02	0.030	0.042	0.094	<0.02	<0.02	7.05	5.42	12.72	10.72	19.7	2.40	2.06	1.94	1.16	2.70	2.39	2.40	<0.2	<0.2
FSV-CZ	0.406	0.355	0.722	0.846	0.633										7.32	5.14	12.59	11.71	19.0			2.07	1.05	2.40	2.66	1.97		
FSV-DV	0.350	0.322	0.594	0.758	0.785										6.20	4.50	10.80	9.20	17.4									
FSV-EE																												
FSV-FZ	0.330	0.290	0.650	0.720	0.640	0.260	0.260	0.014	0.018	0.057	0.033	0.090	0.036	0.034	6.80	5.00	12.30	10.60	18.9	1.90	1.90	1.80	1.10	2.60	2.50	2.30	0.100	0.200
FSV-GD	0.359	0.330	0.682	0.743	0.668	0.276	0.274								7.00	5.25	12.78	10.85	20.3	1.94	1.95	1.92	1.14	2.69	2.47	2.42	0.087	0.083
FSV-GE	0.358	0.352	0.779	0.796	0.750	0.301	0.278								6.49	4.90	11.45	9.37	14.9	2.14	1.94							
FSV-GF															8.80	5.90	15.20	12.00	21.5	2.70	2.70							
FSV-GG																												
FSV-GJ	0.376	0.326	0.649	0.727	0.672	0.275	0.299								6.40	5.00	10.80	10.40	16.8	1.90	1.90							
FSV-GK	1.657	1.589	3.656	3.794	3.153	1.291	1.249	0.001	0.001	0.024	0.061	0.149	0.005	0.005	13.93	11.49	26.20	24.45	40.9	4.96	5.10	2.42	1.88	3.66	3.57	3.43	0.745	0.750
FSV-GL	0.381	0.341	0.686	0.770	0.657	0.268	0.269								6.51	4.88	11.37	9.63	17.2	1.88	1.72	1.26	0.70	1.69	1.52	1.52	0.064	0.075
n	25	25	25	25	25	22	22	2	2	3	4	4	2	2	26	26	26	26	26	23	23	13	12	13	13	13	8	8
Min	0.290	0.265	0.553	0.567	0.530	0.210	0.170	0.001	0.001	0.024	0.021	0.090	0.005	0.005	6.20	4.47	10.80	9.20	14.9	1.02	0.96	1.26	0.70	1.69	1.52	1.52	0.015	0.015
Median	0.352	0.330	0.670	0.730	0.659	0.272	0.263	0.008	0.010	0.030	0.038	0.121	0.020	0.019	6.92	5.21	12.32	10.73	19.2	1.96	1.94	1.75	1.09	2.54	2.29	2.18	0.094	0.142
Max	1.657	1.589	3.656	3.794	3.153	2.430	1.249	0.014	0.018	0.057	0.061	0.166	0.036	0.034	13.93	11.49	26.20	24.45	40.9	4.96	5.10	2.42	1.88	3.66	3.57	3.43	0.745	0.750
eSD	0.028	0.031	0.030	0.059	0.033	0.025	0.026			0.009	0.016	0.044			0.58	0.31	0.68	0.65	1.7	0.27	0.36	0.22	0.13	0.22	0.17	0.22	0.085	0.100
eCV	8	9	4	8	5	9	10			32	42	36			8	6	6	6	9	14	18	13	12	9	8	10	90	71
N_{past}	30	28	28	29	30			7		4	8	8			30	30	30	30	30			17	16	16	17	18		
$Median_{past}$	0.356	0.320	0.661	0.740	0.650			0.011		0.038	0.045	0.093			6.75	5.00	12.35	10.54	18.8			1.79	1.08	2.59	2.40	2.23		
SD_{past}	0.025	0.034	0.043	0.060	0.047			0.004		0.016	0.008	0.022			0.48	0.41	1.39	0.80	1.3			0.15	0.11	0.27	0.24	0.22		
NAV	0.352	0.330	0.670	0.730	0.659	0.267				0.030	0.038	0.121			6.92	5.21	12.32	10.73	19.2	1.95		1.75	1.09	2.54	2.29	2.18	0.118	
NAU	0.029	0.031	0.053	0.059	0.052	0.026									0.58	0.49	0.95	0.83	1.7	0.32		0.22	0.13	0.25	0.23	0.22	0.093	

C2

Round Robin LXXXI Laboratory Results

	δ-Tocopherol, µg/mL							Total β-Carotene, µg/mL							trans-β-Carotene, µg/mL							Total cis-β-Carotene, µg/mL						
Lab	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b
FSV-BA																												
FSV-BD																												
FSV-BE								0.140	0.160	0.280	0.430	0.630	1.220	1.160														
FSV-BH								0.072	0.088	0.166	0.234	0.373	0.624	0.605	0.075	0.093	0.176	0.247	0.393	0.705	0.687	0.003	0.005	0.010	0.013	0.020	0.081	0.082
FSV-BJ								0.075	0.097	0.245	0.317	0.561	0.800	0.720														
FSV-BL																												
FSV-BM																												
FSV-BN								0.126	0.144	0.236	0.338	0.532	1.007	1.007														
FSV-BR																												
FSV-BS								≥0.089	≥0.116	≥0.164	≥0.227	≥0.331	≥0.436	≥0.456	0.089	0.116	0.164	0.227	0.331	0.436	0.456							
FSV-BT								0.106	0.126	0.208	0.287	0.424	0.772	0.790	0.097	0.108	0.189	0.266	0.392	0.670	0.693	0.010	0.018	0.019	0.022	0.032	0.102	0.097
FSV-BU								0.102	*na*	0.194	0.297	0.467	0.844	0.858														
FSV-BW								0.066	0.103	0.178	0.287	0.495	1.115	1.063														
FSV-CD								0.100	0.130	0.190	0.310	0.390	0.780	0.640														
FSV-CE								0.089	0.100	0.166	0.226	0.399	0.557	0.530														
FSV-CF																												
FSV-CG	0.093	0.071	0.075	0.090	0.068	0.085	0.086	0.086	0.101	0.205	0.299	0.561	1.220	1.223	0.081	0.094	0.192	0.280	0.533	1.068	1.074	0.005	0.005	0.013	0.018	0.028	0.152	0.149
FSV-CI																												
FSV-CZ								0.144	0.126	0.134	0.170	0.345																
FSV-DV																												
FSV-EE																												
FSV-FZ																												
FSV-GD								0.091	0.111	0.189	0.275	0.426	0.814	0.797	0.079	0.097	0.166	0.242	0.375	0.716	0.702	*0.012*	*0.014*	*0.023*	*0.033*	*0.051*	*0.098*	*0.095*
FSV-GE								0.075	0.070	0.086	0.140	0.209	0.440	0.494														
FSV-GF																												
FSV-GG																												
FSV-GJ																												
FSV-GK	*nd*	*nd*	*nd*	0.962	0.535	*nd*	*nd*	≥0.062	≥0.139	≥0.337	≥0.655	≥0.972	≥1.696	≥1.799	0.062	0.139	0.337	0.655	0.972	1.696	1.799							
FSV-GL								0.114	0.141	0.205	0.316	0.474	0.807	0.794														
n	1	1	1	2	2	1	1	14	13	14	14	14	13	13	6	6	6	6	6	6	6	4	4	4	4	4	4	4
Min				0.090	0.068			0.066	0.070	0.086	0.140	0.209	0.440	0.494	0.062	0.093	0.164	0.227	0.331	0.436	0.456	0.003	0.005	0.010	0.013	0.020	0.081	0.082
Median	0.093	0.071	0.075	0.526	0.301	0.085	0.086	0.096	0.111	0.192	0.292	0.447	0.807	0.794	0.080	0.103	0.182	0.257	0.392	0.710	0.698	0.008	0.010	0.016	0.020	0.030	0.100	0.096
Max				0.962	0.535			0.144	0.160	0.280	0.430	0.630	1.220	1.223	0.097	0.139	0.337	0.655	0.972	1.696	1.799	0.012	0.018	0.023	0.033	0.051	0.152	0.149
eSD								0.029	0.022	0.031	0.036	0.096	0.271	0.280	0.010	0.013	0.019	0.028	0.058	0.233	0.187	0.005	0.007	0.007	0.006	0.009	0.016	0.011
eCV								30	20	16	12	22	34	35	13	13	11	11	15	33	27	65	71	43	32	31	16	12
N_{past}	9			5	8			20	15	15	20	21			6	6	6	7	7			7			6	7		
$Median_{past}$	0.110			0.266	0.210			0.091	0.111	0.177	0.275	0.402			0.084	0.100	0.179	0.249	0.360			0.006			0.014	0.020		
SD_{past}	0.025			0.023	0.030			0.013	0.014	0.024	0.031	0.060			0.008	0.022	0.019	0.017	0.050			0.003			0.004	0.004		
NAV								0.096	0.111	0.192	0.292	0.447	0.801		0.080	0.103	0.182	0.257	0.392	0.704		0.008	0.010	0.016	0.020	0.030	0.098	
NAU								0.029	0.022	0.031	0.043	0.096	0.276		0.011	0.013	0.021	0.028	0.058	0.211								

C3

Round Robin LXXXI Laboratory Results

	Total α-Carotene, µg/mL							Total Lycopene, µg/mL							trans-Lycopene, µg/mL							Total β-Cryptoxanthin, µg/mL						
Lab	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b
FSV-BA																												
FSV-BD																												
FSV-BE																												
FSV-BH	0.005	0.019	0.008	0.041	0.011	0.013	0.014	0.232	0.162	0.719	0.393	1.141	0.023	0.024								0.061	0.032	0.057	0.075	0.061	0.060	0.056
FSV-BJ	0.014	0.027	0.007	0.050	0.005	0.006	0.004	0.264	0.156	0.993	0.587	1.128	0.045	0.008								0.051	0.016	0.042	0.067	0.033	0.024	0.014
FSV-BL																												
FSV-BM																												
FSV-BN	0.033	0.052	0.044	0.097	0.057	0.140	0.138	0.259	0.188	0.700	0.408	1.077	0.054	0.053								0.068	0.044	0.050	0.076	0.046	0.056	0.057
FSV-BR																												
FSV-BS	0.038	0.052	0.056	0.073	0.064	0.038	0.038	0.183	0.160	0.430	0.255	0.386	*nd*	*nd*	0.117	0.108	0.233	0.159	0.193	*nd*	*nd*	0.048	0.033	0.028	0.047	0.022	0.041	0.044
FSV-BT	0.010	0.024	0.012	0.046	0.014	0.016	0.013	0.136	0.103	0.361	0.207	0.532	0.005	0.003	0.121	0.091	0.317	0.186	0.480	0.003	0.002	0.043	0.025	0.041	0.054	0.044	0.054	0.057
FSV-BU	0.018	*na*	*nd*	0.050	0.019	*nd*	0.015	0.220	*na*	0.592	0.368	0.963	*nd*	0.017								0.051	*na*	0.047	0.066	0.036	0.059	0.061
FSV-BW	*nd*	0.020	*nd*	*nd*	*nd*	*nd*	*nd*	0.398	0.260	1.336	0.616	2.209	*nd*	*nd*														
FSV-CD	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.340	0.280	0.820	0.540	1.160	<0.05	<0.05								0.060	<0.05	<0.05	0.070	<0.05	<0.05	<0.05
FSV-CE																												
FSV-CF																												
FSV-CG	0.004	0.024	0.011	0.059	0.017	0.033	0.034	0.200	0.142	0.690	0.395	1.358	0.056	0.048	0.107	0.076	0.362	0.206	0.606	0.021	0.018	0.057	0.030	0.053	0.077	0.064	0.095	0.092
FSV-CI																												
FSV-CZ																												
FSV-DV																												
FSV-EE																												
FSV-FZ																												
FSV-GD	0.010	0.026	0.012	0.053	0.014	0.022	0.024	0.206	0.151	0.541	0.333	0.880	*nd*	*nd*														
FSV-GE								0.150	0.113	0.274	0.193	0.558	*na*	*na*														
FSV-GF																												
FSV-GG																												
FSV-GJ																												
FSV-GK	0.010	0.032	0.021	0.083	0.034	0.135	0.139	0.199	0.179	0.617	0.398	1.034	0.035	0.046	0.105	0.075	0.296	0.203	0.485	0.012	0.038	0.119	0.061	0.139	0.206	0.170	0.248	0.279
FSV-GL	0.031	0.065	0.022	0.101	0.038	0.190	0.207	0.527	0.401	1.429	0.792	2.071	0.051	0.042														
n	10	10	9	10	10	9	10	13	12	13	13	13	7	8	4	4	4	4	4	3	3	9	7	8	9	8	8	8
Min	0.004	0.019	0.007	0.041	0.005	0.006	0.004	0.136	0.103	0.274	0.193	0.386	0.005	0.003	0.105	0.075	0.233	0.159	0.193	0.003	0.002	0.043	0.016	0.028	0.047	0.022	0.024	0.014
Median	0.012	0.027	0.012	0.056	0.018	0.033	0.029	0.220	0.161	0.690	0.395	1.077	0.045	0.033	0.112	0.084	0.306	0.195	0.483	0.012	0.018	0.057	0.032	0.049	0.070	0.045	0.058	0.057
Max	0.038	0.065	0.056	0.101	0.064	0.190	0.207	0.527	0.401	1.429	0.792	2.209	0.056	0.053	0.121	0.108	0.362	0.206	0.606	0.021	0.038	0.119	0.061	0.139	0.206	0.170	0.248	0.279
eSD	0.010	0.009	0.007	0.019	0.015	0.030	0.023	0.058	0.034	0.221	0.208	0.292	0.015	0.023	0.009	0.012	0.049	0.015	0.093			0.009	0.010	0.010	0.009	0.021	0.015	0.013
eCV	79	35	62	33	82	90	79	26	21	32	53	27	34	70	8	14	16	8	19			16	32	21	13	46	25	22
N_{past}	13	12	11	17	14			15	13	13	15	15			6	4	4	7	7			13	10	10	15	14		
$Median_{past}$	0.008	0.023	0.011	0.047	0.016			0.216	0.142	0.57	0.37	0.93			0.113	0.076	0.311	0.181	0.427			0.051	0.027	0.039	0.060	0.032		
SD_{past}	0.003	0.005	0.006	0.013	0.008			0.029	0.033	0.09	0.05	0.15			0.019	0.023	0.035	0.025	0.083			0.010	0.007	0.009	0.014	0.013		
NAV	0.012	0.027	0.012	0.056	0.018	0.031		0.220	0.161	0.690	0.395	1.077	0.039		0.112	0.084	0.306	0.195	0.483	0.015		0.057	0.032	0.049	0.070	0.045	0.057	
NAU	0.010	0.009	0.007	0.019	0.015	0.027		0.058	0.041	0.221	0.208	0.292	0.020									0.014	0.010	0.012	0.016	0.021	0.014	

C4

Round Robin LXXXI Laboratory Results

Lab	Total α-Cryptoxanthin, µg/mL							Total Lutein, µg/mL							Total Zeaxanthin, µg/mL							Total Lutein&Zeaxanthin, µg/mL						
	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b
FSV-BA																												
FSV-BD																												
FSV-BE																												
FSV-BH								0.060	0.024	0.068	0.051	0.101	0.013	0.011	0.047	0.011	0.040	0.038	0.029	0.004	0.004	0.107	0.035	0.107	0.089	0.130	0.017	0.015
FSV-BJ								0.091	0.037	0.113	0.085	0.147	0.008	0.007														
FSV-BL																												
FSV-BM																												
FSV-BN																						0.121	0.054	0.136	0.098	0.161	0.022	0.021
FSV-BR																												
FSV-BS								0.067	0.053	0.082	0.057	0.102	0.016	0.021	0.016	0.008	0.016	0.013	0.013	0.003	0.002	0.083	0.061	0.098	0.070	0.115	0.019	0.023
FSV-BT	0.012	0.008	0.015	0.015	0.021	0.044	0.046	0.082	0.037	0.090	0.067	0.103	0.017	0.016	0.036	0.016	0.031	0.028	0.025	0.006	0.008	0.118	0.053	0.121	0.095	0.128	0.023	0.024
FSV-BU																						0.111	*na*	0.096	0.087	0.131	0.014	*nd*
FSV-BW																												
FSV-CD	<0.02	<0.02	<0.02	0.030	<0.02	0.110	0.090															0.130	0.070	0.130	0.100	0.140	<0.05	<0.05
FSV-CE																												
FSV-CF																												
FSV-CG																						0.109	0.053	0.125	0.101	0.153	0.018	0.016
FSV-CI																												
FSV-CZ																												
FSV-DV																												
FSV-EE																												
FSV-FZ																												
FSV-GD																												
FSV-GE																												
FSV-GF																												
FSV-GG																												
FSV-GJ																												
FSV-GK								0.104	0.029	0.151	0.095	0.191	0.002	0.003	0.070	0.027	0.079	0.074	0.072	0.019	0.016	0.174	0.056	0.230	0.169	0.262	0.021	0.019
FSV-GL																												
n	1	1	1	2	1	2	2	5	5	5	5	5	5	5	4	4	4	4	4	4	4	8	7	8	8	8	7	6
Min				0.015		0.044	0.046	0.060	0.024	0.068	0.051	0.101	0.002	0.003	0.016	0.008	0.016	0.013	0.013	0.003	0.002	0.083	0.035	0.096	0.070	0.115	0.014	0.015
Median	0.012	0.008	0.015	0.023	0.021	0.077	0.068	0.082	0.037	0.090	0.067	0.103	0.013	0.011	0.042	0.013	0.035	0.033	0.027	0.005	0.006	0.115	0.054	0.123	0.097	0.136	0.019	0.020
Max				0.030		0.110	0.090	0.104	0.053	0.151	0.095	0.191	0.017	0.021	0.070	0.027	0.079	0.074	0.072	0.019	0.016	0.174	0.070	0.230	0.169	0.262	0.023	0.024
eSD								0.022	0.012	0.033	0.024	0.003	0.006	0.008	0.023	0.006	0.017	0.018	0.012	0.002	0.004	0.010	0.002	0.021	0.009	0.019	0.003	0.005
eCV								27	34	37	36	3	46	74	55	45	49	56	44	43	72	9	4	17	10	14	17	26
N_{past}	7			7	6			7	4	4	8	7			7			7	7			14	10	10	15	15		
$Median_{past}$	0.018			0.022	0.023			0.078	0.045	0.092	0.068	0.123			0.034			0.032	0.026			0.111	0.050	0.119	0.098	0.146		
SD_{past}	0.003			0.007	0.008			0.015	0.002	0.013	0.021	0.023			0.011			0.017	0.012			0.018	0.008	0.009	0.018	0.030		
NAV								0.082	0.037	0.090	0.067	0.103	0.012		0.042	0.013	0.035	0.033	0.027	0.006		0.115	0.054	0.123	0.097	0.136	0.019	
NAU								0.022	0.012	0.033	0.024	0.020	0.007									0.024	0.011	0.026	0.020	0.028	0.004	

C5

Round Robin LXXXI Laboratory Results

	Coenzyme Q10, µg/mL							Phylloquinone (K1), ng/mL							25-hydroxyvitamin D, µg/mL							Phytoene, µg/mL						
Lab	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b	432	433	434	435	436	BS-1a	BS-1b
FSV-BA																												
FSV-BD															*na*	*na*	*na*	*na*	*na*	0.078	0.077							
FSV-BE	0.810	0.610	1.450	1.090	1.580			0.329	0.227	0.693	0.694	1.679																
FSV-BH															0.010	0.016	0.022	0.016	0.025	0.090	0.089							
FSV-BJ	0.863	0.514	1.178	0.709	1.143	0.417	0.427																					
FSV-BL																												
FSV-BM																												
FSV-BN																												
FSV-BR																				0.038	0.037							
FSV-BS																						*nd*	*nd*	0.156	*nd*	0.173	*nd*	*nd*
FSV-BT	0.620	0.436	1.204	0.755	1.318	0.353	0.348																					
FSV-BU																												
FSV-BW	0.900	0.460	1.310	0.680	1.380	0.230	0.200																					
FSV-CD																												
FSV-CE	0.846	0.483	1.159	0.830	1.401	0.401	0.415																					
FSV-CF																												
FSV-CG																												
FSV-CI	0.890	0.490	1.240	0.800	1.420	0.350	0.370	0.396	0.304	0.877	1.006	1.913	0.651	0.645														
FSV-CZ	1.208	0.564	1.447	0.904	1.832																							
FSV-DV																												
FSV-EE	0.846	0.469	1.188	0.759	1.390	0.346	0.357																					
FSV-FZ																												
FSV-GD	0.882	0.517	1.320	0.824	1.560	0.350	0.354																					
FSV-GE															0.009	0.020	0.017	0.017	0.020	*na*	*na*							
FSV-GF	0.860	0.440	1.140	0.750	*nd*	0.360	0.370																					
FSV-GG	0.900	0.500	1.400	1.000	1.500	0.400	0.400								0.007	0.013	0.017	0.012	0.023	0.069	0.069							
FSV-GJ								0.340	0.230	0.780	0.900	2.110	0.480	0.500														
FSV-GK																						0.035	0.053	0.162	0.079	0.263	0.057	0.040
FSV-GL	1.001	0.483	1.302	0.891	1.487	0.733	0.706								0.008	0.014	0.019	0.018	0.022	0.064	0.072							
n	12	12	12	12	11	10	10	3	3	3	3	3	2	2	4	4	4	4	4	5	5	1	1	2	1	2	1	1
Min	0.620	0.436	1.140	0.680	1.143	0.230	0.200	0.329	0.227	0.693	0.694	1.679	0.480	0.500	0.007	0.013	0.017	0.012	0.020	0.038	0.037			0.156		0.173		
Median	0.873	0.487	1.271	0.812	1.420	0.357	0.370	0.340	0.230	0.780	0.900	1.913	0.566	0.573	0.009	0.015	0.018	0.016	0.022	0.069	0.072	0.035	0.053	0.159	0.079	0.218	0.057	0.040
Max	1.208	0.610	1.450	1.090	1.832	0.733	0.706	0.396	0.304	0.877	1.006	2.110	0.651	0.645	0.010	0.020	0.022	0.018	0.025	0.090	0.089			0.162		0.263		
eSD	0.040	0.040	0.130	0.105	0.119	0.040	0.039								0.001	0.002	0.002	0.002	0.002	0.014	0.006							
eCV	5	8	10	13	8	11	10								9	11	9	11	8	21	8							
N_{past}	9	10	10	8	9										10				13									
$Median_{past}$	0.86	0.490	1.19	0.88	1.38										0.008				0.018									
SD_{past}	0.10	0.043	0.14	0.15	0.25										0.003				0.009									
NAV	0.873	0.487	1.271	0.812	1.420	0.363		0.340	0.230	0.780	0.900	1.913	0.569		0.009	0.015	0.018	0.016	0.022	0.071								
NAU	0.131	0.073	0.191	0.122	0.213	0.039														0.011								

C6

Round Robin LXXXI Laboratory Results

Analytes Reported By One Laboratory

Values in µg/mL

Analyte	Code	432	433	434	435	436	BS-1a	BS-1b
Phytofluene	FSV-GK	0.037	0.038	0.219	0.098	0.493	0.009	0.022

Table Legend

Term	Definition
N	Number of (non-NIST) quantitative values reported for this analyte
Min	Minimum (non-NIST) quantitative value reported
Median	Median (non-NIST) quantitative value reported
Max	Maximum (non-NIST) quantitative value reported
eSD	Adjusted median absolute deviation from the median of the non-NIST results
eCV	Coefficient of Variation for (non-NIST) results: 100*eSD/Median
N_{past}	Mean of N(s) from past RR(s)
$Median_{past}$	Mean of Median(s) from past RR(s)
SD_{past}	Pooled SD from past RR(s)
NAV	NIST Assigned Value: ' Median for analytes reported by ≥ 5 labs
NAU	NIST Assigned Uncertainty: the maximum of (0.05*NAV, SD, SDpast, eSD)
	The expected long-term SD, eSD, is defined in:
	Duewer et al., Anal Chem 1997;69(7):1406-1413.
na	Not analyzed
nd	Not detected (i.e., no detectable peak for analyte)
<x	Concentration at or below the limit of quantification, x
≥x	Concentration greater than or equal to x
italics	Not explicitly reported but calculated by NIST from reported values

Round Robin LXXXI Laboratory Results

Comparability Summary

Lab	TR	aT	g/bT	bC	aC	TLy	TbX	L&Z	Q10
FSV-BA	1								
FSV-BD	1	1							
FSV-BE	1	1	1	3					2
FSV-BH	2	1	1	1	1	1	1	1	
FSV-BJ	1	2	1	2	1	1	1		1
FSV-BL	1	1							
FSV-BM	2	2							
FSV-BN	2	1		2	3	1	1	1	
FSV-BR	1	1							
FSV-BS		3		2	4	2	2	2	
FSV-BT	1	1	1	1	1	2	1	1	2
FSV-BU	2	1	1	1	1	1	1	1	
FSV-BW	1	1		1		3			1
FSV-CD	2	2	1	1	4	2	1	1	
FSV-CE	1	1		1					1
FSV-CF	1	1							
FSV-CG	2	2	1	1	1	1	1	1	
FSV-CI	1	1	1						1
FSV-CZ	2	1	2	2					2
FSV-DV	2	2							
FSV-FZ	1	1	1						
FSV-GD	1	1	1	1	1	1			1
FSV-GE	2	2		3		2			
FSV-GF		3							1
FSV-GJ	1	2							
FSV-GK	4	4	4	4	2	1	4	4	
FSV-GL	1	2	4	1	3	4			1
n	25	26	13	16	11	13	9	8	10

	TR	aT	g/bT	bC	aC	TLy	TbX	L&Z	Q10
% 1	60	58	77	56	55	54	78	75	70
% 2	36	31	8	25	9	31	11	13	30
% 3	0	8	0	13	18	8	0	0	0
% 4	4	4	15	6	18	8	11	13	0

Label	Definition
Lab	Participant code
TR	Total Retinol
aT	α-Tocopherol
g/bT	γ/β-Tocopherol
bC	Total β-Carotene
aC	Total α-Carotene
TLy	Total Lycopene
TbX	Total β-Cryptoxanthin
L&Z	Total Lutein & Zeaxanthin
Q10	Coenzyme Q10

n	number of participants providing quantitative data
% 1	Percent of CS = 1 (within 1 SD of medians)
% 2	Percent of CS = 2 (within 2 SD of medians)
% 3	Percent of CS = 3 (within 3 SD of medians)
% 4	Percent of CS = 4 (3 or more SD from medians)

"Comparability Score"

The Comparability Score (CS) summarizes your measurement performance for a given analyte relative to the consensus medians in this study. CS is the average distance (in units of standard deviation) of your measurement performance characteristics from the consensus performance. CS is calculated when the number of quantitative values you reported, N_{you}, is at least two and at least six participants reported quantitative values for the analyte.

We define CS as follows:

$$CS = \text{MINIMUM}\left(4, \text{INTEGER}\left(1 + \sqrt{C^2 + AP^2}\right)\right)$$

$$C = \text{Concordance} = \frac{\sum_{i=1}^{N_{you}} \frac{You_i - Median_i}{NAU_i}}{N_{you}}$$

$$AP = \text{Apparent Precision} = \sqrt{\frac{\sum_{i=1}^{N_{you}} \left(\frac{You_i - Median_i}{NAU_i}\right)^2}{N_{you} - 1}}$$

NAU = NIST Assigned Uncertainty

For further details, please see

Duewer DL, Kline MC, Sharpless KE, Brown Thomas J, Gary KT. Micronutrients Measurement Quality Assurance Program: Helping participants use interlaboratory comparison exercise results to improve their long-term measurement performance. Anal Chem 1999;71(9):1870-8.

Appendix D. Representative Individualized Report for RR81

Each participant in RR81 received an "Individualized Report" reflecting their reported results. Each report included a detailed analysis for analytes that were assayed by at least five participants. The following analytes met this criterion:

- Total Retinol
- α-Tocopherol
- γ/β-Tocopherol
- Total β-Carotene
- *trans*-β-Carotene
- Total α-Carotene
- Total Lycopene
- Total β-Cryptoxanthin
- Total Lutein
- Total Lutein & Zeaxanthin
- Coenzyme Q10

The following thirteen pages are the "Individualized Report" for the analytes evaluated by participant FSV-BT.

Individualized Round Robin LXXXI Report: FSV-BT

Summary

	#432			#433			#434			#435			#436			BS-1a			BS-1b		
Analyte	You	NAV	n	You	NAV	n	You	NAV	n	You	NAV	n	You	NAV	n	You	NAV	n	You	NAV	n
Total Retinol	0.353	0.352	25	0.292	0.330	25	0.687	0.670	25	0.726	0.730	25	0.637	0.659	25	0.259	0.267	22	0.252	0.267	22
α-Tocopherol	6.70	6.92	26	5.22	5.21	26	11.93	12.32	26	10.81	10.73	26	17.45	19.24	26	2.26	1.95	23	2.31	1.95	23
γ/β-Tocopherol	1.676	1.750	13	1.216	1.093	12	2.589	2.539	13	2.144	2.290	13	2.274	2.180	13	0.262	0.118	8	0.255	0.118	8
Total β-Carotene	0.106	0.096	14	0.126	0.111	13	0.208	0.192	14	0.287	0.292	14	0.424	0.447	14	0.772	0.801	13	0.790	0.801	13
trans-β-Carotene	0.097	0.080	6	0.108	0.103	6	0.189	0.182	6	0.266	0.257	6	0.392	0.392	6	0.670	0.704	6	0.693	0.704	6
Total cis-β-Carotene	0.010	0.008	4	0.018	0.010	4	0.019	0.016	4	0.022	0.020	4	0.032	0.030	4	0.102	0.098	4	0.097	0.098	4
Total α-Carotene	0.010	0.012	10	0.024	0.027	10	0.012	0.012	9	0.046	0.056	10	0.014	0.018	10	0.016	0.031	9	0.013	0.031	10
Total Lycopene	0.136	0.220	13	0.103	0.161	12	0.361	0.690	13	0.207	0.395	13	0.532	1.077	13	0.005	0.039	7	0.003	0.039	8
trans-Lycopene	0.121	0.112	4	0.091	0.084	4	0.317	0.306	4	0.186	0.195	4	0.480	0.483	4	0.003	0.015	3	0.002	0.015	3
Total β-Cryptoxanthin	0.043	0.057	9	0.025	0.032	7	0.041	0.049	8	0.054	0.070	9	0.044	0.045	8	0.054	0.057	8	0.057	0.057	8
Total α-Cryptoxanthin	0.012		1	0.008		1	0.015		1	0.015		2	0.021		1	0.044		2	0.046		2
Total Lutein	0.082	0.082	5	0.037	0.037	5	0.090	0.090	5	0.067	0.067	5	0.103	0.103	5	0.017	0.012	5	0.016	0.012	5
Total Zeaxanthin	0.036	0.042	4	0.016	0.013	4	0.031	0.035	4	0.028	0.033	4	0.025	0.027	4	0.006	0.006	4	0.008	0.006	4
Total Lutein&Zeaxanthin	0.118	0.115	8	0.053	0.054	7	0.121	0.123	8	0.095	0.097	8	0.128	0.136	8	0.023	0.019	7	0.024	0.019	6
Coenzyme Q10	0.620	0.873	12	0.436	0.487	12	1.204	1.271	12	0.755	0.812	12	1.318	1.420	11	0.353	0.363	10	0.348	0.363	10

D2

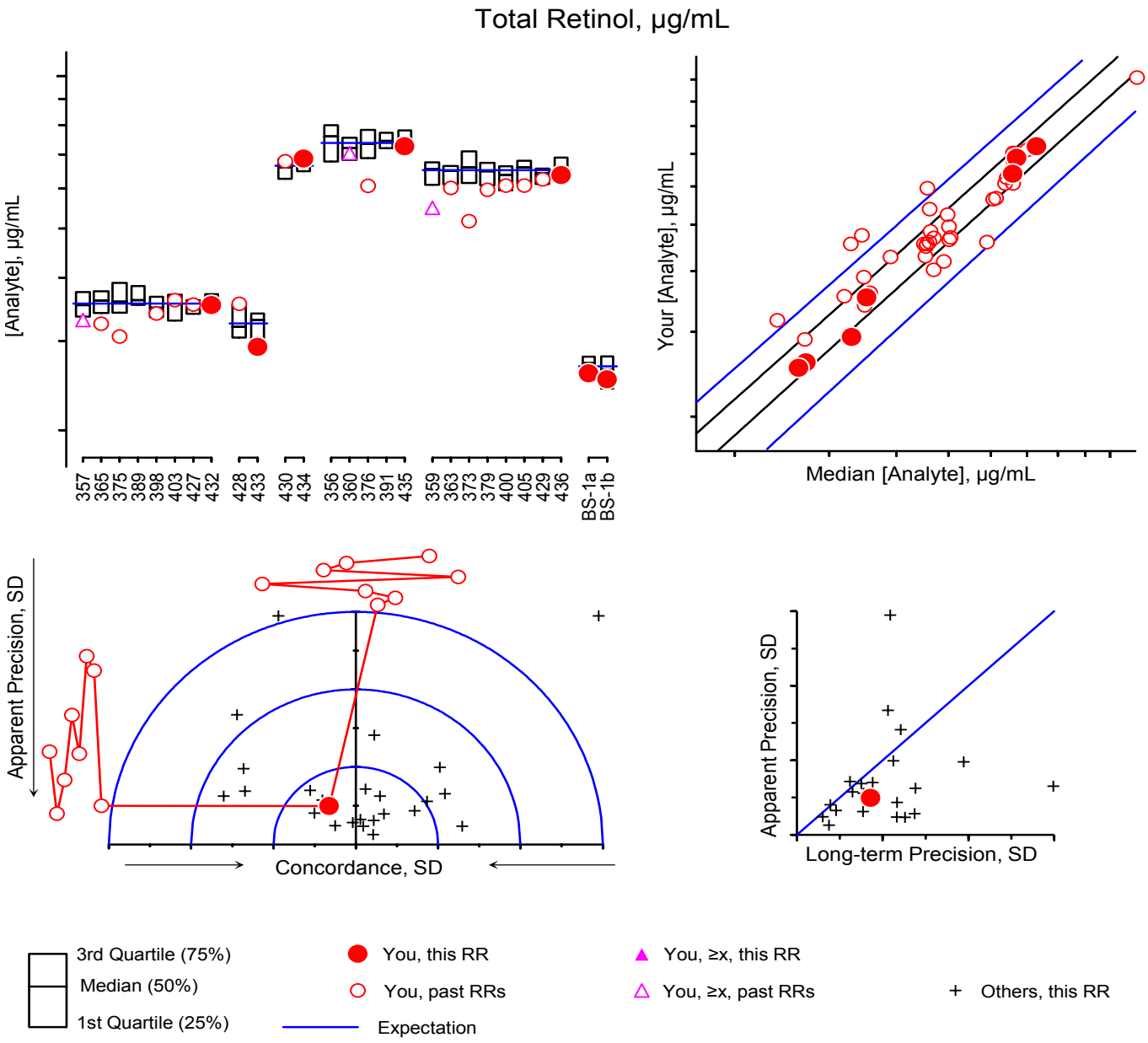
You : Your reported values for the listed analytes (micrograms/milliliter)
NAV : NIST Assigned Values, here equal to this RR's median
n : Number of non-NIST laboratories reporting quantitative values for this analyte in this serum

Please check our records against your records. Send corrections and/or updates to...

Micronutrients Measurement Quality Assurance Program
National Institute of Standards and Technology
100 Bureau Drive Stop 8392
Gaithersburg, MD 20899-8392 USA

Tel: (301) 975-3935
Fax: (301) 977-0685
Email: david.duewer@nist.gov

Individualized RR LXXXI Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
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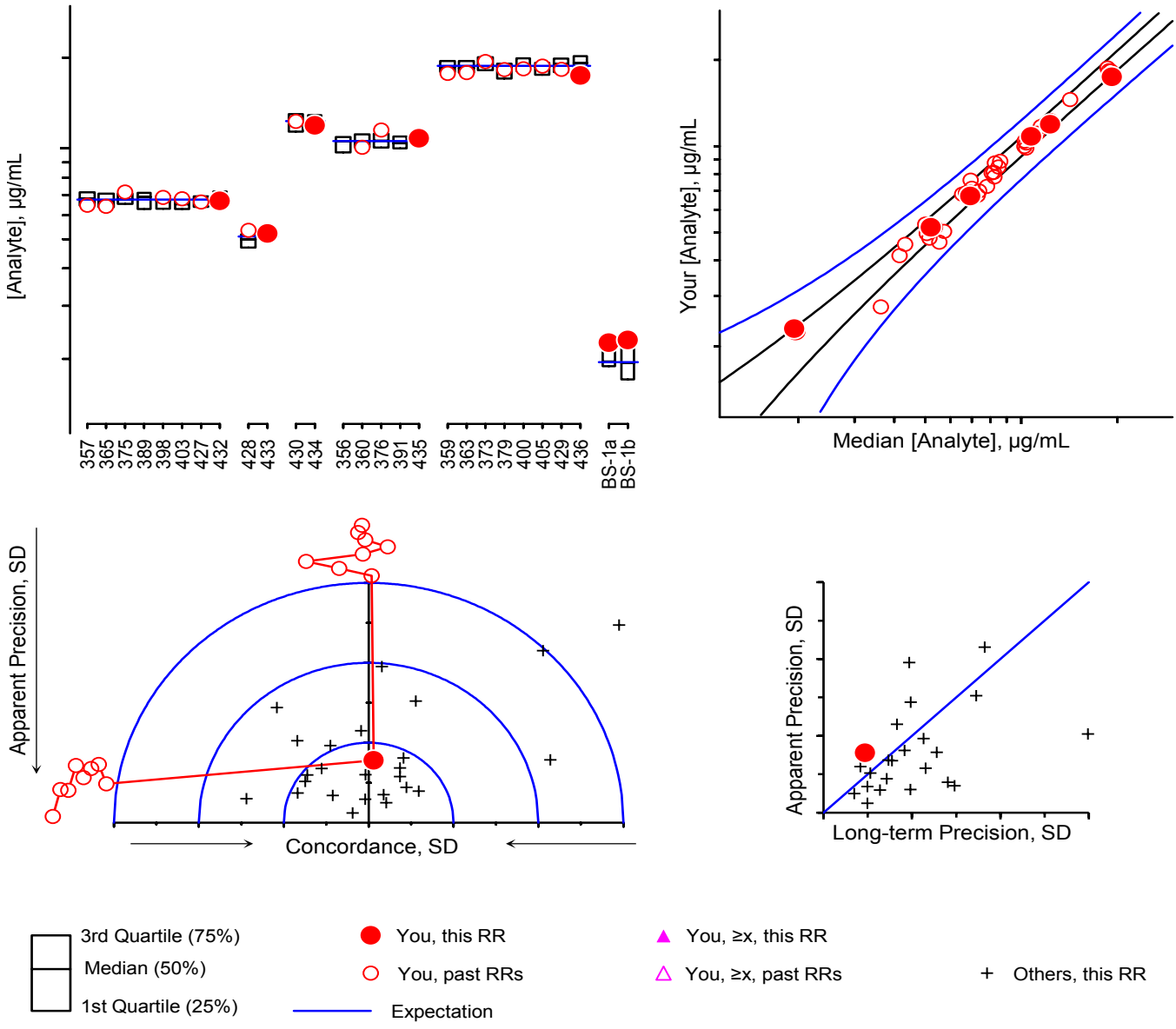
#433	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428
#434	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430
#435	Fresh-frozen, native, multi-donor	65#356, 66#360, 69#376, 71#391
#436	Fresh-frozen, native, multi-donor: SRM968e-III	RR66#359, RR67#363, RR69#373, RR70#379, RR74#400, RR75#405, RR80#429
BS-1a	Fresh-frozen bovine serum	First distribution, Optional sample
BS-1b	Same material as BS-1a	

Individualized RR LXXXI Report: FSV-BT

α-Tocopherol, µg/mL



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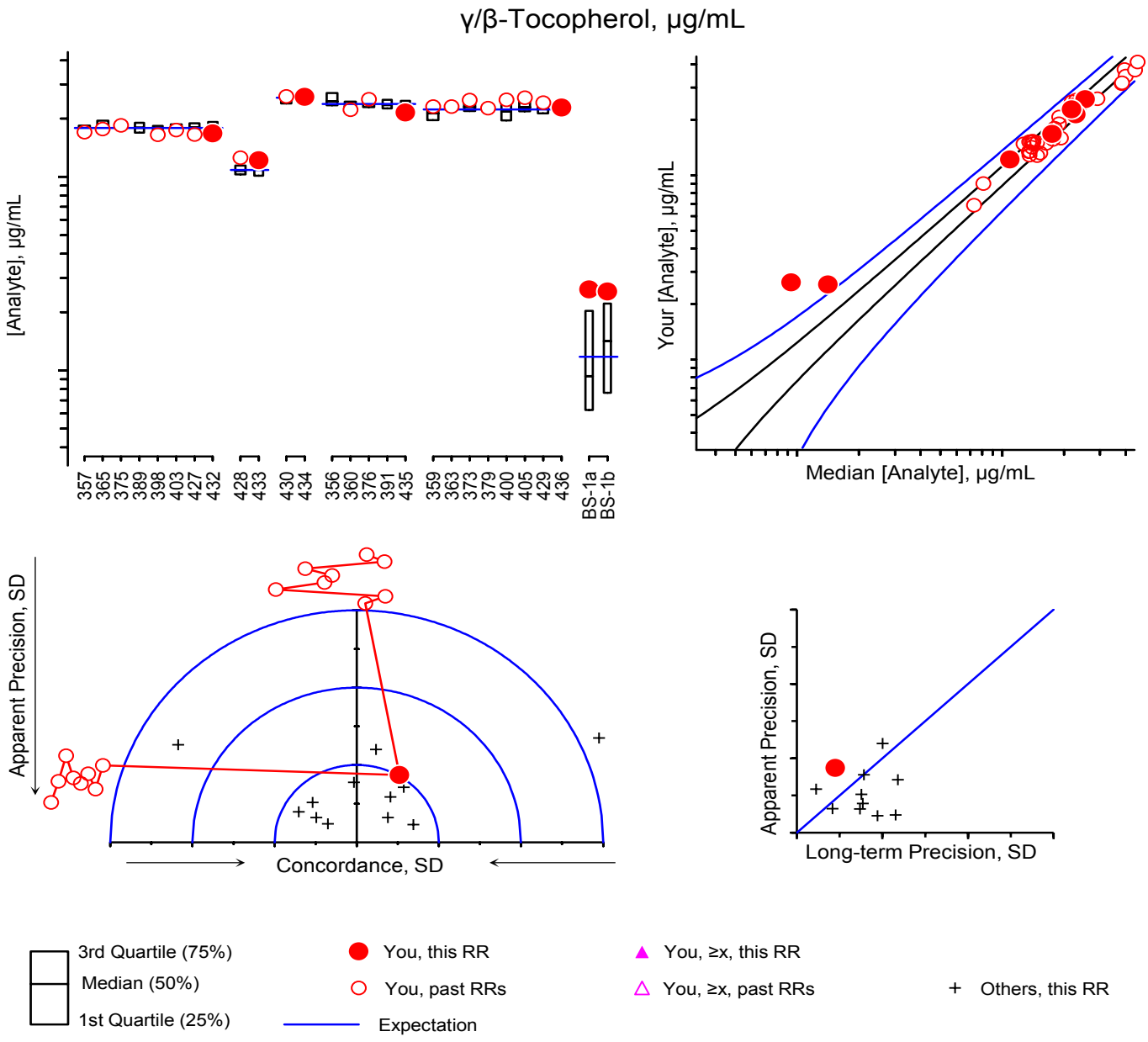
#436	Fresh-frozen, native, multi-donor: SRM968e-III	RR66#359, RR67#363, RR69#373, RR70#379, RR74#400, RR75#405, RR80#429
BS-1a	Fresh-frozen bovine serum	First distribution, Optional sample
BS-1b	Same material as BS-1a	

Individualized RR LXXXI Report: FSV-BT



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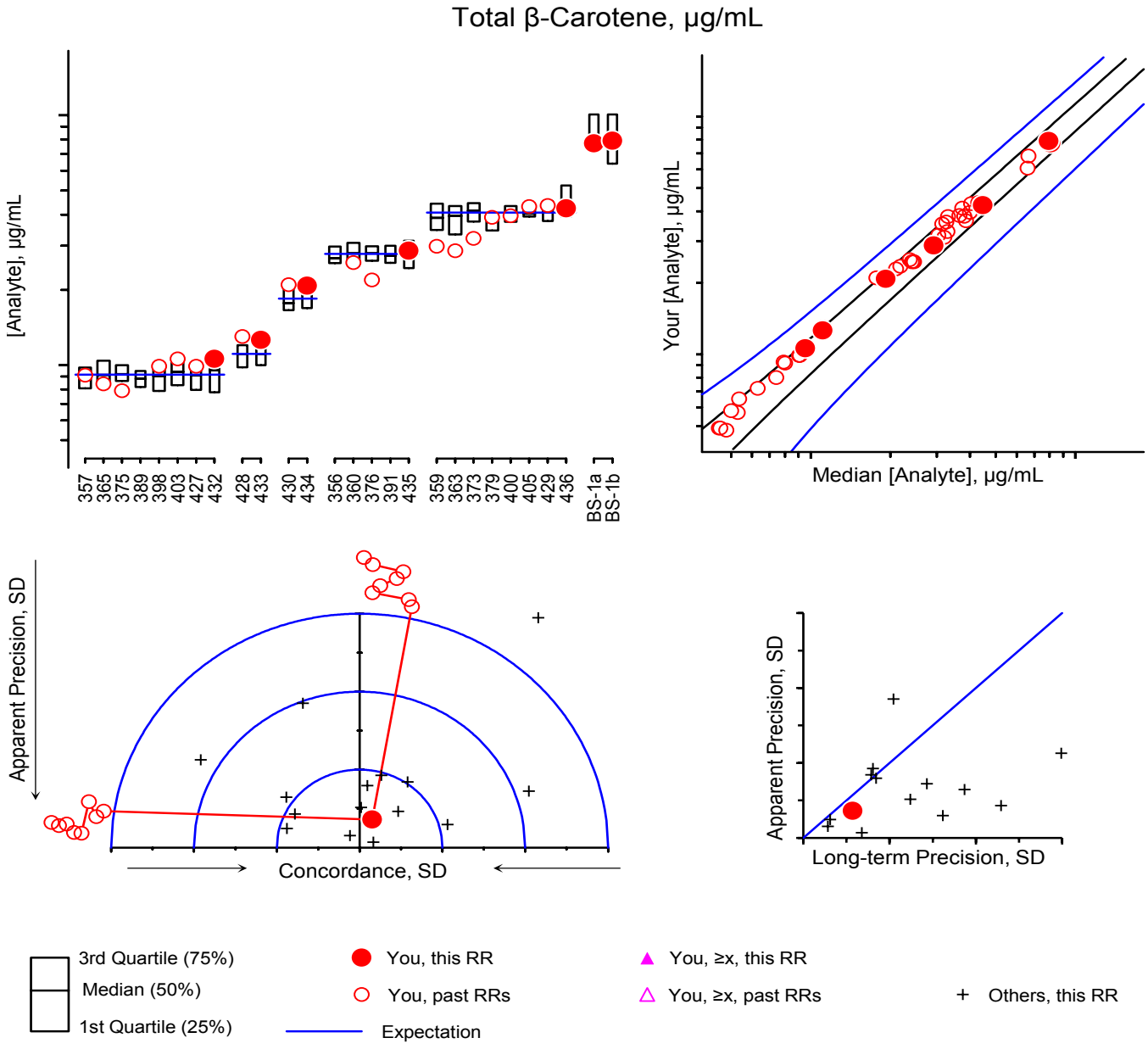
Individualized RR LXXXI Report: FSV-BT



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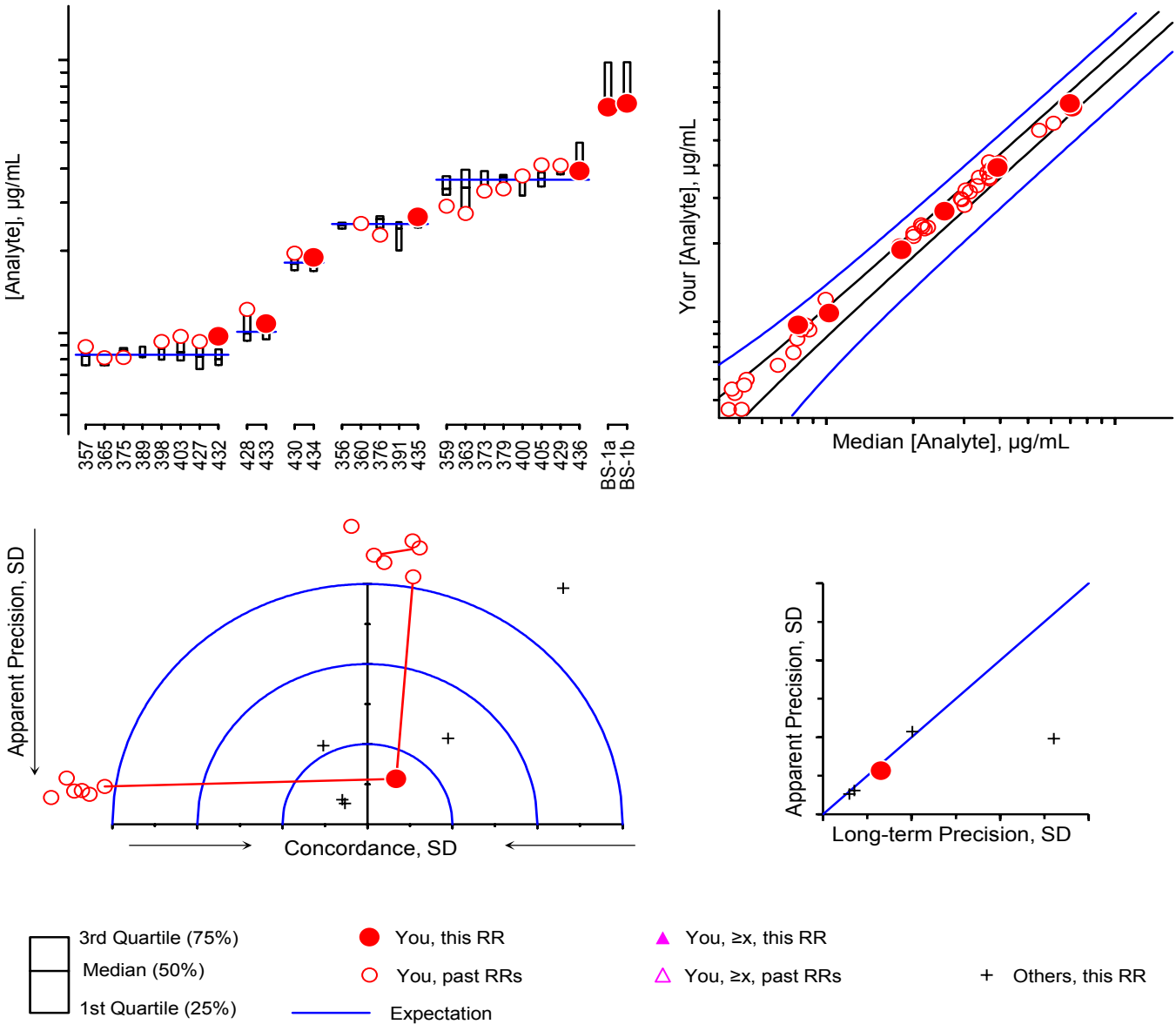
BS-1a	Fresh-frozen bovine serum	First distribution, Optional sample
BS-1b	Same material as BS-1a	

Individualized RR LXXXI Report: FSV-BT

trans-β-Carotene, µg/mL



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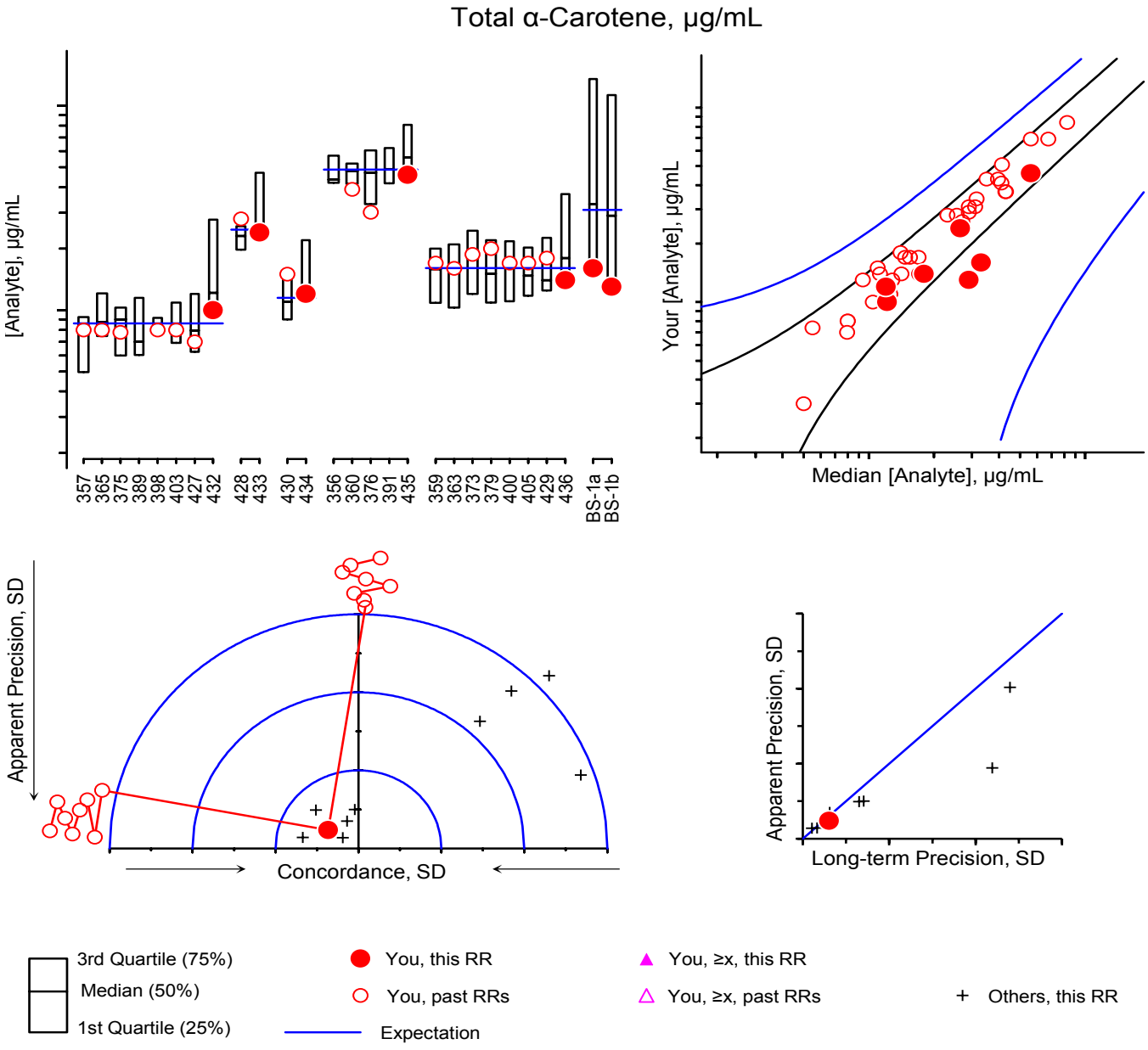
Individualized RR LXXXI Report: FSV-BT



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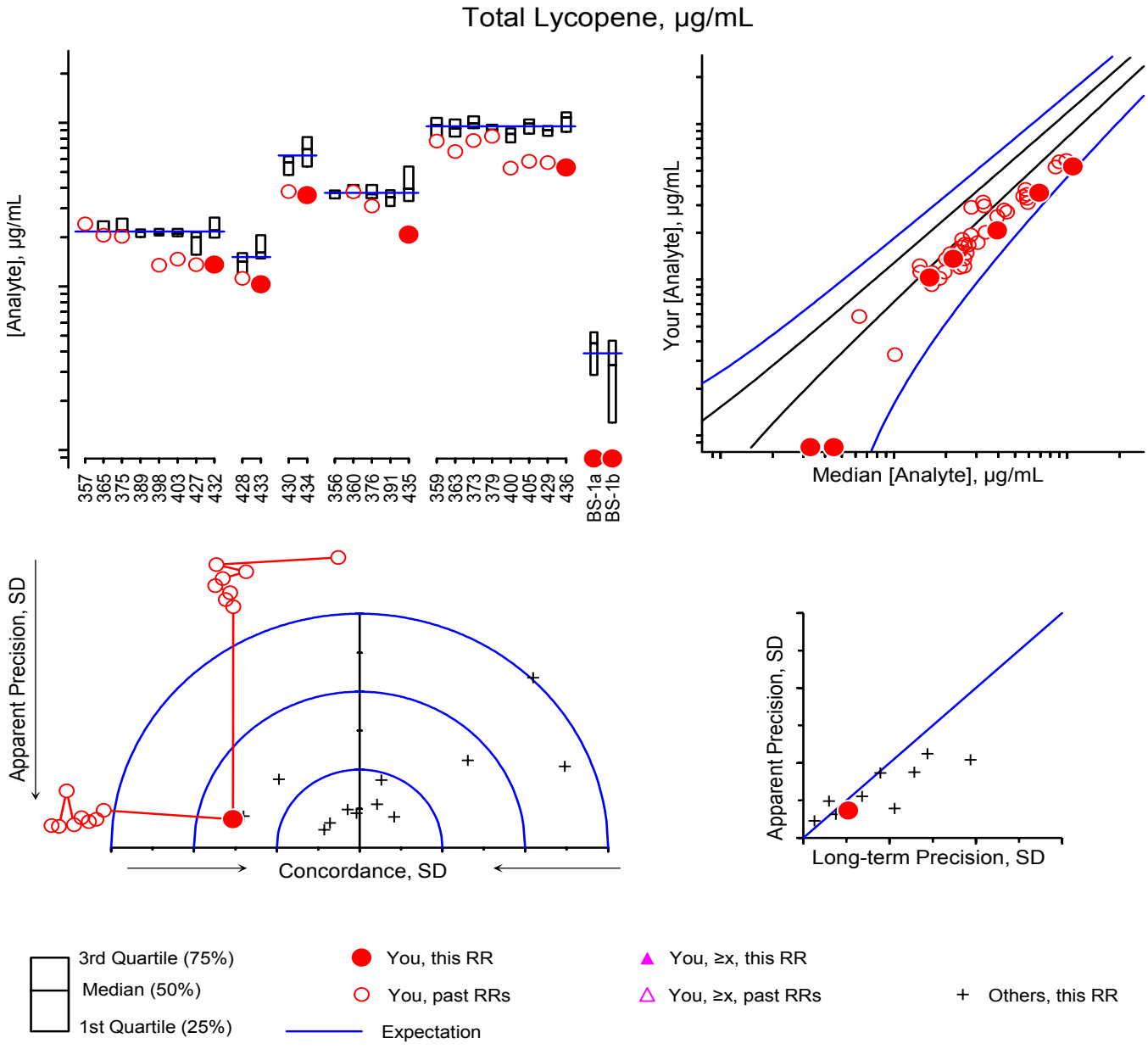
Individualized RR LXXXI Report: FSV-BT



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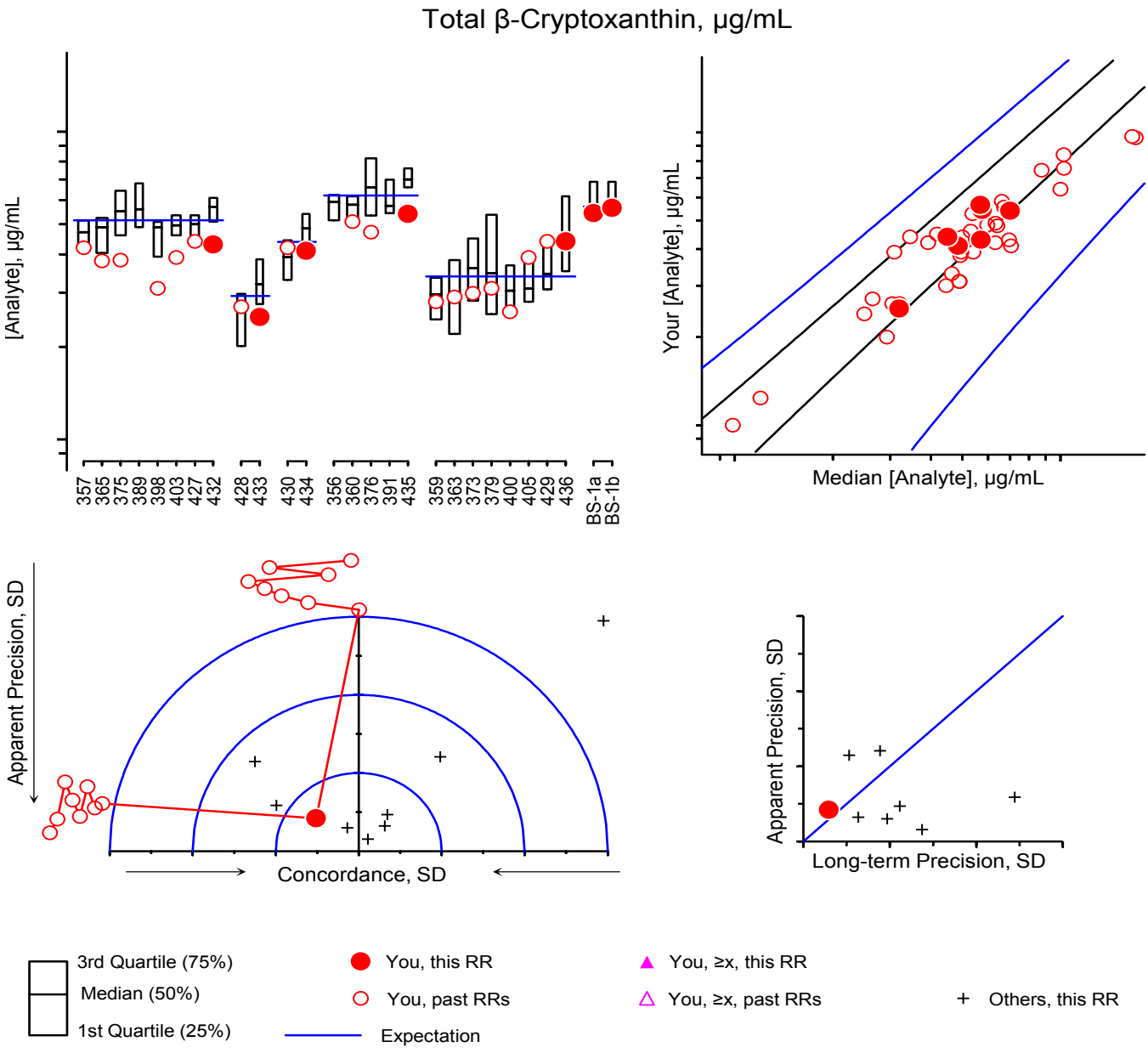
Serum	Comments	History
#432	Fresh-frozen, native, multi-donor: SRM 968e-I	RR66#357, RR67#365, RR69#375, RR72#389, RR74#398, RR75#403, RR80#427
#433	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428
#434	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430
#435	Fresh-frozen, native, multi-donor	65#356, 66#360, 69#376, 71#391
#436	Fresh-frozen, native, multi-donor: SRM968e-III	RR66#359, RR67#363, RR69#373, RR70#379, RR74#400, RR75#405, RR80#429
BS-1a	Fresh-frozen bovine serum	First distribution, Optional sample
BS-1b	Same material as BS-1a	

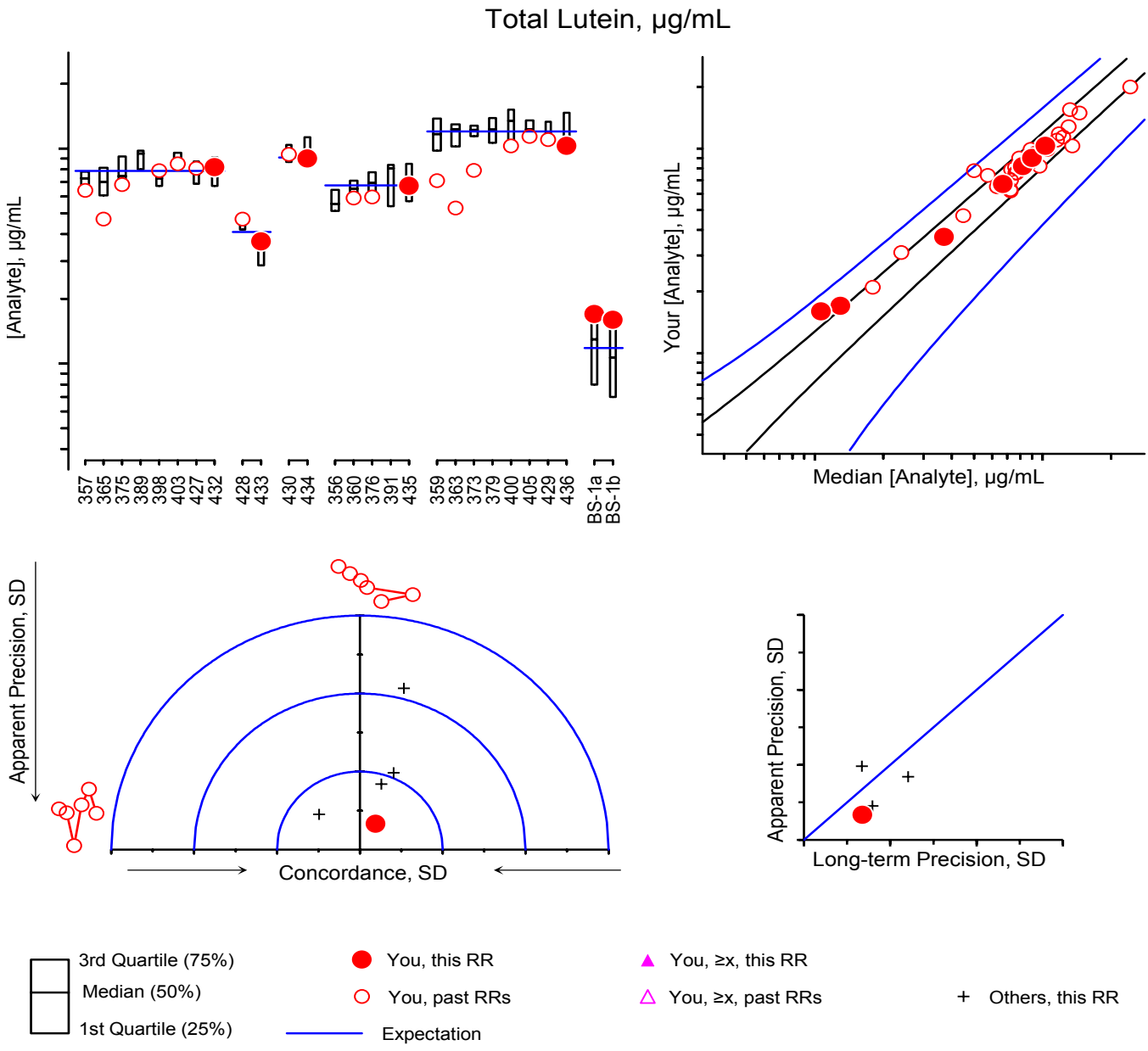
Individualized RR LXXXI Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#432	Fresh-frozen, native, multi-donor: SRM 968e-I	RR66#357, RR67#365, RR69#375, RR72#389, RR74#398, RR75#403, RR80#427
#433	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428
#434	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430
#435	Fresh-frozen, native, multi-donor	65#356, 66#360, 69#376, 71#391
#436	Fresh-frozen, native, multi-donor: SRM968e-III	RR66#359, RR67#363, RR69#373, RR70#379, RR74#400, RR75#405, RR80#429
BS-1a	Fresh-frozen bovine serum	First distribution, Optional sample
BS-1b	Same material as BS-1a	

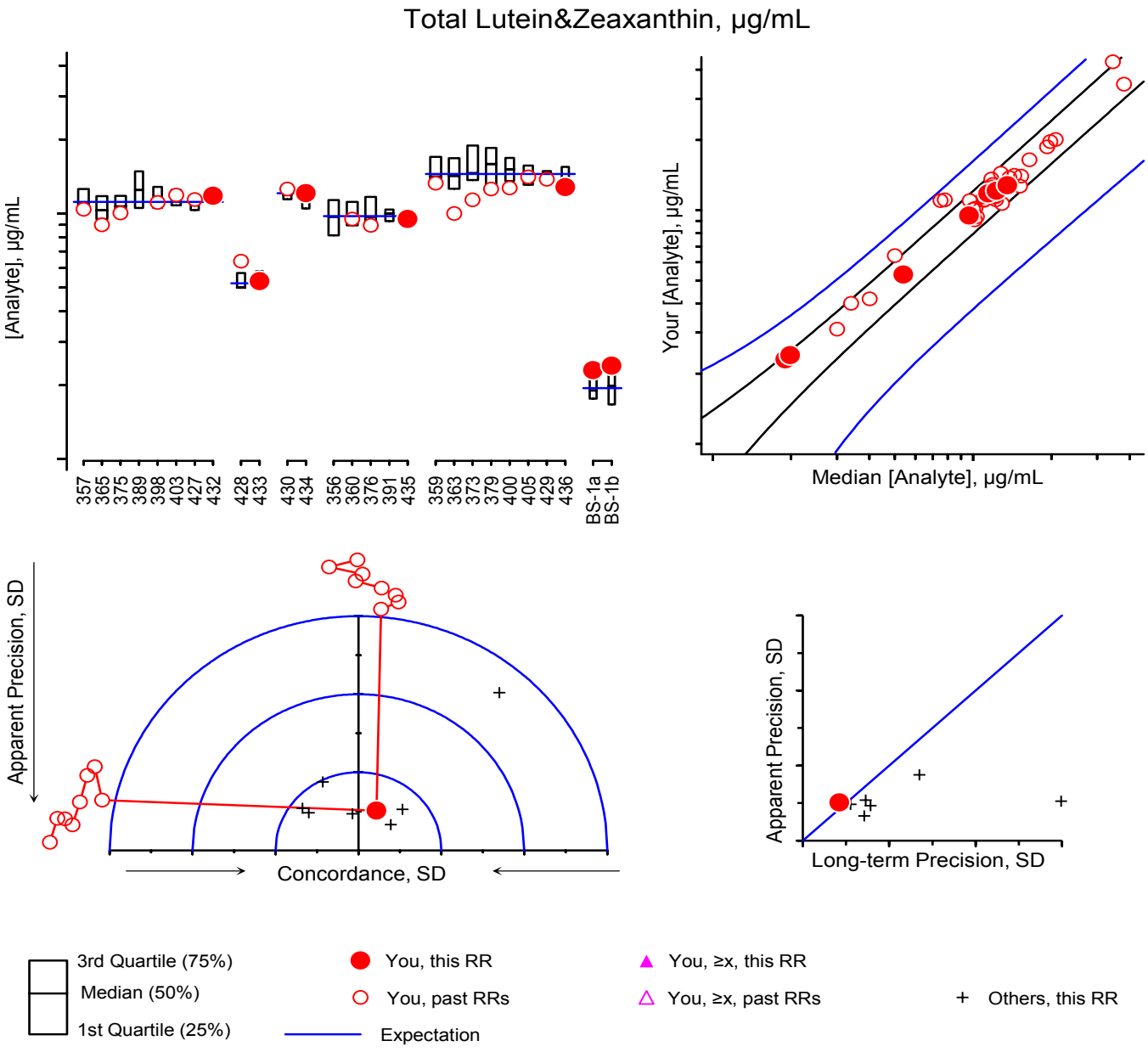
Individualized RR LXXXI Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#432	Fresh-frozen, native, multi-donor: SRM 968e-I	RR66#357, RR67#365, RR69#375, RR72#389, RR74#398, RR75#403, RR80#427
#433	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428
#434	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430
#435	Fresh-frozen, native, multi-donor	65#356, 66#360, 69#376, 71#391
#436	Fresh-frozen, native, multi-donor: SRM968e-III	RR66#359, RR67#363, RR69#373, RR70#379, RR74#400, RR75#405, RR80#429
BS-1a	Fresh-frozen bovine serum	First distribution, Optional sample
BS-1b	Same material as BS-1a	

Individualized RR LXXXI Report: FSV-BT

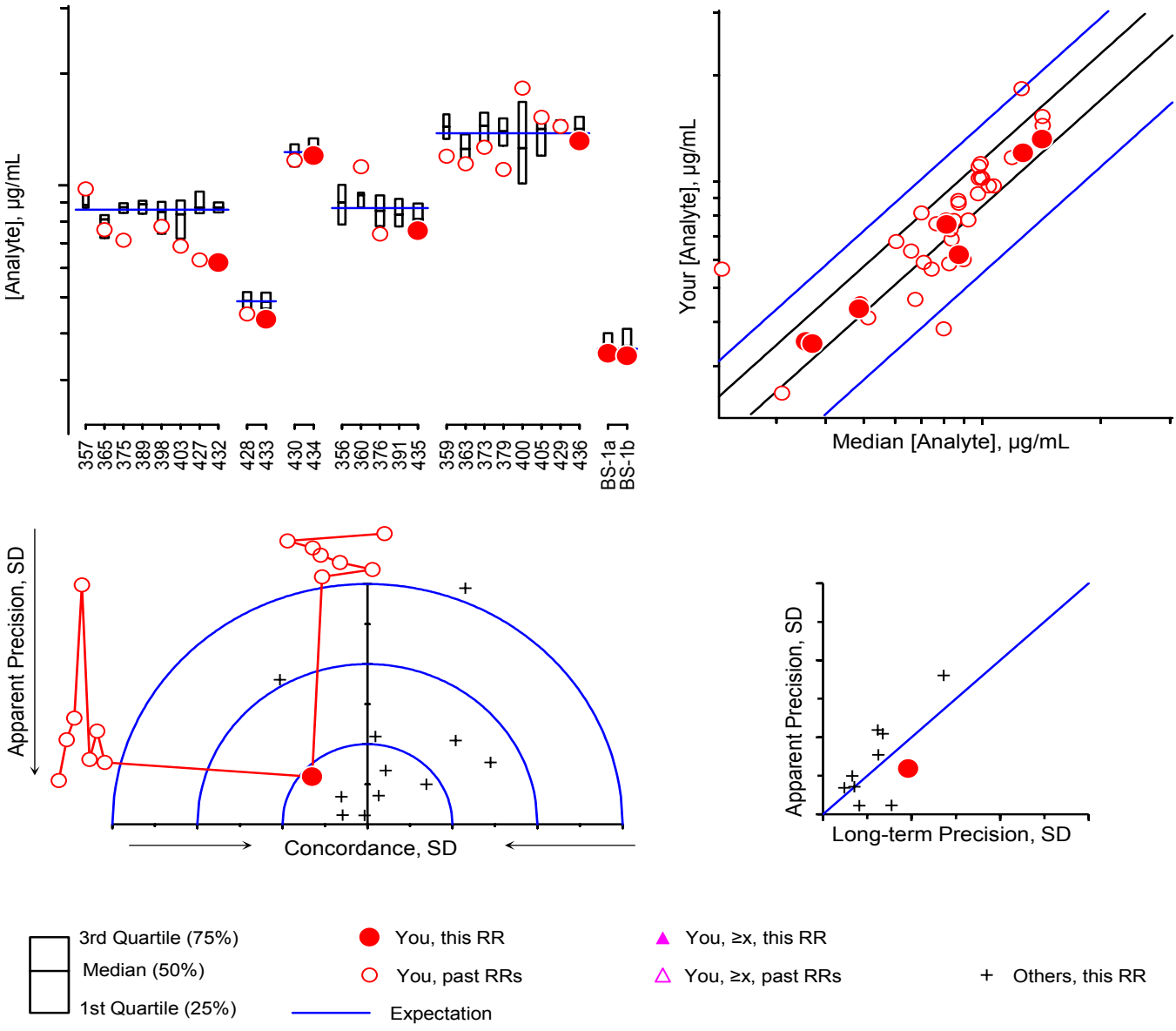


For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#432	Fresh-frozen, native, multi-donor: SRM 968e-I	RR66#357, RR67#365, RR69#375, RR72#389, RR74#398, RR75#403, RR80#427
#433	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428
#434	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430
#435	Fresh-frozen, native, multi-donor	65#356, 66#360, 69#376, 71#391
#436	Fresh-frozen, native, multi-donor: SRM968e-III	RR66#359, RR67#363, RR69#373, RR70#379, RR74#400, RR75#405, RR80#429
BS-1a	Fresh-frozen bovine serum	First distribution, Optional sample
BS-1b	Same material as BS-1a	

Individualized RR LXXXI Report: FSV-BT

Coenzyme Q10, µg/mL

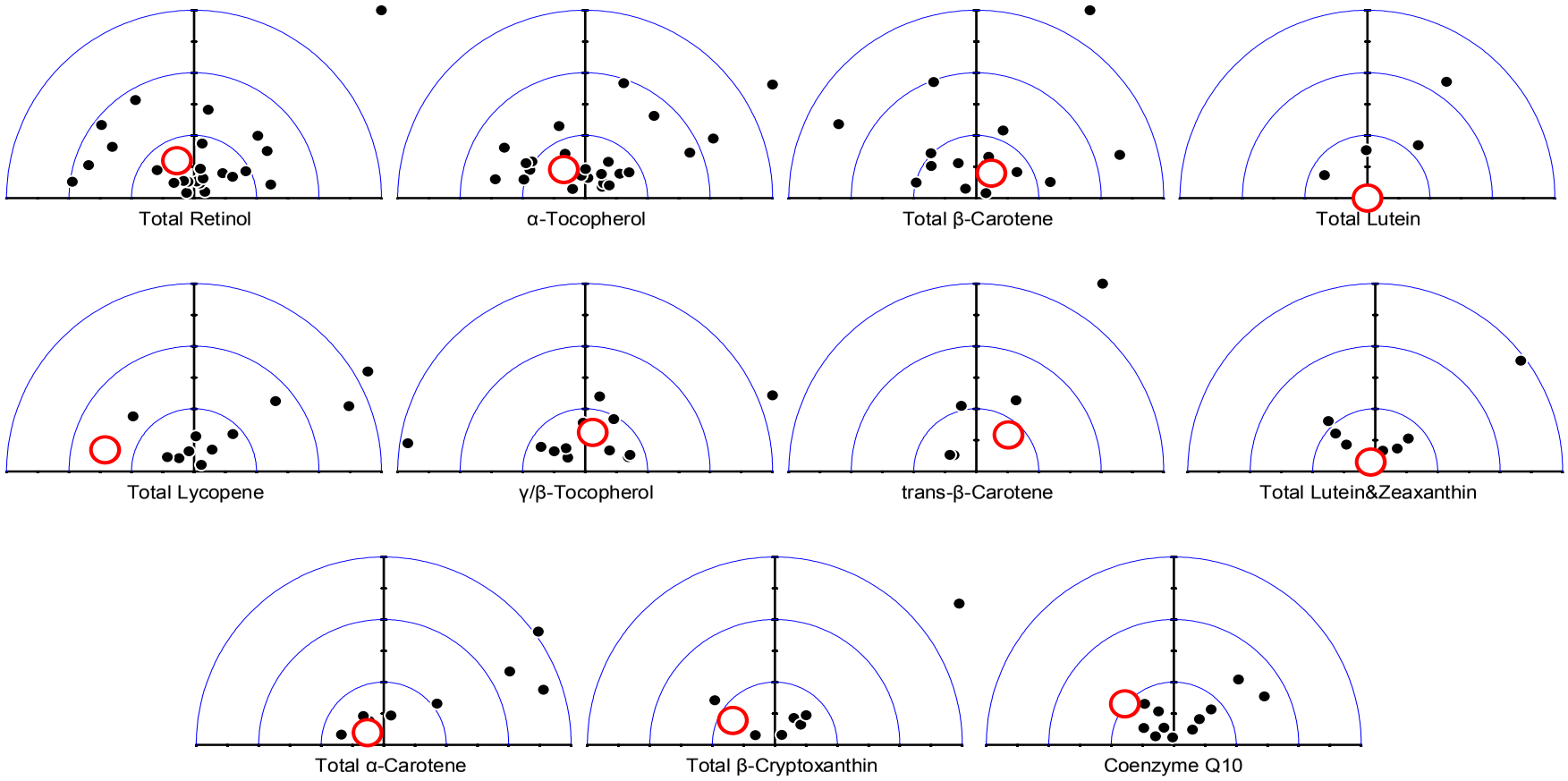


For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#432	Fresh-frozen, native, multi-donor: SRM 968e-I	RR66#357, RR67#365, RR69#375, RR72#389, RR74#398, RR75#403, RR80#427
#433	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428
#434	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430
#435	Fresh-frozen, native, multi-donor	65#356, 66#360, 69#376, 71#391
#436	Fresh-frozen, native, multi-donor: SRM968e-III	RR66#359, RR67#363, RR69#373, RR70#379, RR74#400, RR75#405, RR80#429
BS-1a	Fresh-frozen bovine serum	First distribution, Optional sample
BS-1b	Same material as BS-1a	

Individualized Round Robin LXXXI Report: FSV-BT
Graphical Comparability Summary

D14



Appendix E. Final Report for RR82

The following two pages are the final report for RR82 as provided to all participants:

- Cover letter.
- An information sheet that:
  - describes the contents of the "All-Lab" report,
  - describes the content of the "Individualized" report,
  - describes the nature of the test samples and details their previous distributions, if any, and
  - summarizes aspects of the study that we believe may be of interest to the participants.

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-8390

October 27, 2017

Dear Colleague:

Enclosed is the summary report of the results for "Round Robin" LXXXII (RR82) of the 2017 NIST Micronutrients Measurement Quality Assurance Program (MMQAP) for the fat-soluble vitamins and carotenoids in human serum. Included in this report are: 1) a summary of data and measurement comparability scores for all laboratories, 2) a detailed graphical analysis of your results; and 3) a graphical summary of your measurement comparability. RR82 (Sera 437 to 441) consisted of one vial each of five liquid-frozen serum samples. Details regarding the samples can be found in the enclosed report.

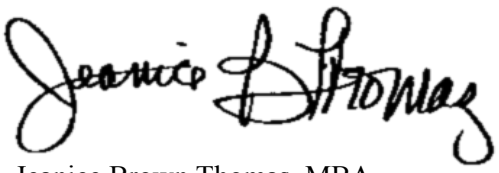
Your overall measurement comparability is summarized in the "Score Card" summary, page 7 of the All Lab Report. Combined results rated 1 to 3 are within 1 to 3 standard deviations of the assigned value, respectively; those rated 4 are >3 standard deviations from the assigned value. Similar information is presented graphically in the "target plots" that are the last page of your Individualized Report. If you have concerns regarding your laboratory's performance, please contact us for consultation.

Please note that this is the *final* summary report for the MMQAP. New QA studies will begin in Spring 2018 as part of the Health Assessment Measurements Quality Assurance Program (HAMQAP). We hope that you will find the HAMQAP useful. As mentioned in previous correspondence, you will be able to sign up for the new program this fall. You will be notified via email when sign-up begins. If you have questions about HAMQAP, please do not hesitate to contact us at hamqap@nist.gov.

If you have questions or concerns regarding this report, please contact David Duewer at 301-975-3935; e-mail: david.duewer@nist.gov or me at 301-975-3120; e-mail: jbthomas@nist.gov; or fax: 301-978-0685.

Thank you for your participation in the MMQAP. It was a pleasure working with you.

Sincerely,



Jeanice Brown Thomas, MBA
Research Chemist
Chemical Sciences Division
Material Measurement Laboratory

David L. Duewer, Ph.D.
Research Chemometrician
Chemical Sciences Division
Material Measurement Laboratory

Enclosures

The NIST MMQAP Round Robin LXXXI (RR82) report consists of:

Page	All-Lab Report
1-4	A listing of all results and statistics for analytes reported by more than one participant.
5	The legend for the list of results and statistics.
6	The text Comparability Summary (Score Card) of measurement performance.

Page	Individualized Report
1	Your values, the number of labs reporting values, and our assigned values.
2 to n	"Four Plot" summaries of your current and past measurement performance, one page for each analyte you report that is also reported by at least eight other participants.
n+1	The graphical Comparability Summary (Target Plot) of measurement performance.

Samples. Five different liquid-frozen human serum samples were distributed to each participant.

Sample	Description	Prior Distributions
437	Fresh-frozen native multi-donor plasma, prepared in 2009. This is SRM 1950.	#340:RR63-3/08, #350:RR64-9/08
438	Fresh-frozen native multi-donor serum, prepared in 2015. This is level 1 of SRM 968f.	#428:RR80-9/16, #433:RR81-3/17
439	Fresh-frozen native multi-donor serum, prepared in 2015. This is level 2 of SRM 968f.	#430:RR80-9/16, #434:RR81-3/17
440	Fresh-frozen native multi-donor serum, prepared in 2009. This is Level 2 of SRM 968e.	#358:RR66-9/09, #364:RR67-3/10, #374:RR69-3/11, #386:RR71-3/12, #399:RR74-9/13, #408:RR76-9/14, #416:RR77-3/15, #426:RR79-3/16
441	Fresh-frozen native multi-donor serum, prepared in 2011. This material has relatively high content of α- and β-carotene.	#382:RR71-3/12, #395:RR73-3/13, #421:RR78-9/15

Results

1) Stability: There has been no significant change in the concentration nor variability of any analyte in the four SRM materials: SRM 1950, SRM 968e-II, SRM 968f-1, and SRM 968f-2.

   Several participants did report lower-than-expected values for α-tocopherol and/or total β-carotene in Sample 441, suggesting that there may have been some degradation in some units of this material. To evaluate this issue, we have examined the results from these participants in detail but have been unable to identify a common cause. Three of the five participants who reported <9.0 μg/mL results for α-tocopherol in Sample 441 also reported total β-carotene. As shown in Figure 1, one of these reported a rather high result for total β-carotene. Of the five participants who reported <0.5 μg/mL for total β-carotene, only two reported low α-tocopherol.

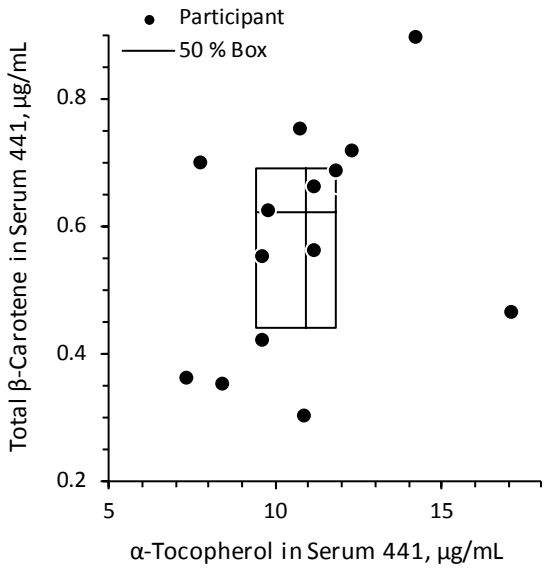


Figure 1: Total β-carotene results in Sample 441 as a function of the α-tocopherol result.
Each dot represents the {α-tocopherol, total β-carotene} results for one participant. The "box" encloses the central 50 % of all reported values (from 25 % to 75 %) for both analytes; the "cross" within the "box" represents the medians.

2) SRM 968f: As some of you know, SRM 968e is sold out. The replacement material, SRM 968f, will be available soon. The SRM has become the model for a redesigned Certificate of Analysis. Therefore, the folk responsible for SRM sales want to resolve several of their protocol issues before releasing the material for sale.

   Samples 438 and 439 are the two levels of SRM 968f. We have used the results you reported in these last MMQAP studies to help assign the values provided in the certificate. We thank you for participating in these studies!

Appendix F. "All-Lab Report" for RR82

The following six pages are the "All-Lab Report" for RR82 as provided to all participants, with the following exceptions:

- the participant identifiers (Lab) have been altered.
- the order in which the participant results are listed has been altered.
- the Legend page has been added.

The data summary in the "All-Lab Report" has been altered to ensure confidentiality of identification codes assigned to laboratories.

Round Robin LXXXII Laboratory Results

F2

	Total Retinol, µg/mL					Retinyl Palmitate, µg/mL					α-Tocopherol, µg/mL					γ/β-Tocopherol, µg/mL					Total β-Carotene, µg/mL				
Lab	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441
FSV-BA	0.390	0.320	0.630	0.480	0.450																				
FSV-BD	0.426	0.284	0.649	0.537	0.419						9.10	5.30	12.8	11.10	7.5										
FSV-BE	0.420	0.320	0.680	0.500	0.490						11.00	6.10	15.8	12.90	11.9	1.90	1.10	2.60	1.50	1.50	0.090	0.131	0.230	0.300	0.66
FSV-BH	0.369	0.283	0.583	0.443	0.386						7.59	4.46	10.7	9.12	9.8	1.71	0.98	2.39	1.31	1.25	0.075	0.096	0.164	0.226	0.62
FSV-BJ	0.405	0.310	0.664	0.497	0.470						8.99	5.09	13.4	11.30	11.2	1.78	1.04	2.62	1.43	1.23	0.053	0.049	0.193	0.187	0.56
FSV-BL	0.430	0.370	0.720	0.540	0.490						8.20	4.70	12.1	10.30	9.5										
FSV-BM	0.363	0.342	0.659	0.440	0.437						8.80	5.50	13.1	10.90	10.9										
FSV-BN	0.392	0.217	0.589	0.501	0.305						7.83	3.34	10.4	9.97	7.4						0.117	0.115	0.184	0.230	0.36
FSV-BR	0.430	0.340	0.670	0.530	0.480						8.44	4.83	12.6	10.85	11.2										
FSV-BS											8.64	4.98	12.4	10.48	10.9						0.063	0.076	0.145	0.136	0.30
FSV-BT	0.489	0.335	0.700	0.520	0.419						7.70	5.12	11.6	9.89	11.9	1.82	1.20	2.52	1.40	1.77	0.087	0.118	0.194	0.246	0.68
FSV-BU	0.453	0.357	0.689	0.530	0.416						7.81	3.87	12.3	10.31	7.8	1.55	0.97	2.47	1.38	1.41	0.074	0.115	0.191	0.248	0.70
FSV-BW	0.425	0.336	0.703	0.523	0.442	0.027	0.032	0.027	0.016	0.053	7.33	4.58	11.9	10.52	8.5						0.045	0.085	0.163	0.197	0.35
FSV-CD	0.390	0.360	0.620	0.480	0.410						8.62	5.65	11.9	10.13	10.8	1.87	1.19	2.55	1.49	1.35	0.080	0.120	0.190	0.260	0.75
FSV-CE	0.400	0.310	0.650	0.490	0.440						8.25	4.81	12.0	10.64	11.2						0.090	0.130	0.200	0.270	0.66
FSV-CF	0.433	0.341	0.734	0.595	0.450						7.30	4.00	10.9	9.60	9.4										
FSV-CG	0.348	0.285	0.558	0.451	0.386						10.54	6.11	15.0	13.61	14.3	1.81	1.11	2.58	1.63	1.53	0.101	0.144	0.233	0.330	0.89
FSV-CI	0.390	0.290	0.630	0.490	0.380	<.02	<.02	0.030	0.030	0.070	7.90	5.10	11.4	10.40	11.5	1.70	1.10	2.50	1.40	1.30					
FSV-CZ	0.410	0.353	0.637	0.478	0.454						6.78	4.11	10.0	8.04	9.7	1.81	1.07	1.98	1.24	1.29	0.061	0.100	0.153	0.182	0.42
FSV-DV	0.469	0.344	0.795	0.505	0.445						7.40	4.60	12.4	8.70	9.1										
FSV-EE																									
FSV-FZ	0.400	0.290	0.660	0.470	0.450	0.082	0.016	0.053	0.046	0.044	8.60	4.90	11.8	10.70	11.2	1.90	1.10	2.50	1.40	1.40					
FSV-GD	0.404	0.320	0.671	0.506	0.467						8.87	5.09	13.0	10.73	12.4	1.82	1.08	2.65	1.43	1.56	0.086	0.108	0.192	0.250	0.72
FSV-GE	0.417	0.270	0.616	0.542	0.509						12.82	7.49	18.1	15.69	17.1						0.074	0.109	0.138	0.214	0.46
FSV-GF											10.10	6.10	15.4	11.80	12.5										
FSV-GG	0.364	0.300	0.669	0.521	0.422						8.59	5.03	12.5	10.98	7.2										
FSV-GJ	0.423	0.352	0.660	0.503	0.470						8.00	4.80	13.3	10.30	12.0										
FSV-GL	0.412	0.333	0.679	0.505	0.408						7.22	4.49	11.6	9.63	9.6	1.72	1.00	2.69	1.33	1.29	0.087	0.131	0.200	0.281	0.55
n	25	25	25	25	25	2	2	3	3	3	26	26	26	26	26	12	12	12	12	12	15	15	15	15	15
Min	0.348	0.217	0.558	0.440	0.305	0.027	0.016	0.027	0.016	0.044	6.78	3.34	10.0	8.04	7.2	1.55	0.97	1.98	1.24	1.23	0.045	0.049	0.138	0.136	0.30
Median	0.410	0.320	0.660	0.503	0.442	0.055	0.024	0.030	0.030	0.053	8.35	4.94	12.4	10.50	10.9	1.81	1.09	2.53	1.40	1.38	0.080	0.115	0.191	0.246	0.62
Max	0.489	0.370	0.795	0.595	0.509	0.082	0.032	0.053	0.046	0.070	12.82	7.49	18.1	15.69	17.1	1.90	1.20	2.69	1.63	1.77	0.117	0.144	0.233	0.330	0.89
eSD	0.030	0.036	0.043	0.034	0.039			0.004	0.021	0.013	0.88	0.53	1.1	0.75	1.9	0.11	0.05	0.10	0.07	0.15	0.015	0.022	0.013	0.047	0.14
eCV	7	11	7	7	9			15	69	25	10	11	9	7	17	6	5	4	5	11	19	19	7	19	22
N_{past}	31	27	27	30	30	9	0	7	7	7	36	28	28	30	29	24	14	15	17	16	22	14	15	20	19
$Median_{past}$	0.422	0.325	0.665	0.503	0.460	0.013		0.038	0.029	0.060	7.95	5.10	12.3	10.30	11.1	1.77	1.08	2.56	1.40	1.41	0.075	0.111	0.185	0.241	0.66
SD_{past}	0.028	0.033	0.037	0.036	0.035	0.004		0.016	0.009	0.011	0.86	0.36	1.1	0.66	1.0	0.15	0.12	0.25	0.12	0.10	0.010	0.019	0.028	0.027	0.10
NAV	0.410	0.320	0.660	0.503	0.442			0.030	0.030	0.053	8.35	4.94	12.4	10.50	10.9	1.81	1.09	2.53	1.40	1.38	0.080	0.115	0.191	0.246	0.62
NAU	0.033	0.036	0.052	0.040	0.039						0.88	0.53	1.1	0.82	1.9	0.19	0.13	0.25	0.16	0.16	0.015	0.022	0.029	0.047	0.14

Round Robin LXXXII Laboratory Results

	trans-β-Carotene, µg/mL					Total cis-β-Carotene, µg/mL					Total α-Carotene, µg/mL					Total Lycopene, µg/mL				
Lab	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441
FSV-BA																				
FSV-BD																				
FSV-BE																				
FSV-BH	0.075	0.096	0.164	0.216	0.590	0.003	0.005	0.008	0.010	0.033	0.022	0.018	0.008	0.025	0.319	0.359	0.170	0.61	0.61	0.304
FSV-BJ											0.017	0.026	0.008	0.032	0.352	0.395	0.125	0.72	0.68	0.271
FSV-BL																				
FSV-BM																				
FSV-BN	0.091	0.089	0.153	0.202	0.319	*0.026*	*0.026*	*0.031*	*0.028*	*0.039*	0.038	0.031	0.035	0.040	0.206	0.290	0.126	0.37	0.47	0.223
FSV-BR																				
FSV-BS											0.038	0.037	0.050	0.068	0.177	0.386	0.180	0.81	1.40	0.323
FSV-BT	0.079	0.110	0.183	0.231	0.644	0.008	0.008	0.011	0.015	0.039	0.026	0.022	0.013	0.030	0.332	0.198	0.102	0.36	0.34	0.178
FSV-BU											0.027	0.026	0.006	0.028	0.430	0.312	0.140	0.55	0.55	0.260
FSV-BW											0.018	0.062	0.006	0.013	1.122	0.220	0.107	0.58	0.50	0.040
FSV-CD											<0.05	<0.05	<0.05	<0.05	0.340	0.430	0.200	0.70	0.75	0.370
FSV-CE																				
FSV-CF																				
FSV-CG	0.096	0.134	0.218	0.308	0.831	0.005	0.010	0.015	0.022	0.061	0.038	0.035	0.017	0.048	0.549	0.414	0.210	0.74	0.77	0.390
FSV-CI																				
FSV-CZ																				
FSV-DV																				
FSV-EE																				
FSV-FZ																				
FSV-GD	0.076	0.095	0.169	0.220	0.631	*0.010*	*0.013*	*0.023*	*0.030*	*0.085*	0.029	0.024	0.013	0.033	0.397	0.339	0.159	0.63	0.63	0.311
FSV-GE																0.327	0.181	0.41	0.52	0.241
FSV-GF																				
FSV-GG																				
FSV-GJ																				
FSV-GL											0.036	0.024	0.014	0.032	0.355	0.307	0.183	0.72	0.70	0.211
n	5	5	5	5	5	5	5	5	5	5	10	10	10	10	11	12	12	12	12	12
Min	0.075	0.089	0.153	0.202	0.319	0.003	0.005	0.008	0.010	0.033	0.017	0.018	0.006	0.013	0.177	0.198	0.102	0.36	0.34	0.040
Median	0.079	0.096	0.169	0.220	0.631	0.008	0.010	0.015	0.022	0.039	0.028	0.026	0.013	0.032	0.352	0.333	0.165	0.62	0.62	0.266
Max	0.096	0.134	0.218	0.308	0.831	0.026	0.026	0.031	0.030	0.085	0.038	0.062	0.050	0.068	1.122	0.430	0.210	0.81	1.40	0.390
eSD	0.006	0.010	0.021	0.016	0.061	0.004	0.004	0.011	0.010	0.009	0.013	0.007	0.007	0.008	0.067	0.071	0.044	0.15	0.16	0.074
eCV	8	11	12	7	10	56	44	70	47	24	48	26	57	25	19	21	27	23	26	28
N_{past}	9	6	6	6	5	5	7	7	5	6	17	11	10	15	15	18	13	13	15	14
$Median_{past}$	0.069	0.101	0.181	0.217	0.597	0.006	0.010	0.016	0.013	0.038	0.027	0.025	0.012	0.032	0.376	0.323	0.152	0.63	0.60	0.279
SD_{past}	0.007	0.018	0.019	0.024	0.086	0.001	0.007	0.007	0.004	0.004	0.006	0.008	0.007	0.010	0.079	0.038	0.033	0.17	0.09	0.059
NAV	0.079	0.096	0.169	0.220	0.631	0.008	0.010	0.015	0.022	0.039	0.028	0.026	0.013	0.032	0.352	0.333	0.165	0.62	0.62	0.266
NAU	0.011	0.013	0.021	0.024	0.066	0.004	0.004	0.011	0.010	0.015	0.013	0.009	0.007	0.011	0.088	0.074	0.044	0.15	0.16	0.074

F3

Round Robin LXXXII Laboratory Results

	trans-Lycopene, µg/mL					Total β-Cryptoxanthin, µg/mL					Total Lutein, µg/mL					Total Zeaxanthin, µg/mL				
Lab	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441
FSV-BA																				
FSV-BD																				
FSV-BE																				
FSV-BH						0.040	0.024	0.035	0.053	0.065	0.052	0.030	0.077	0.072	0.122	0.019	0.008	0.027	0.092	0.137
FSV-BJ						0.031	0.017	0.032	0.044	0.057	0.073	0.032	0.105	0.101	0.130					
FSV-BL																				
FSV-BM																				
FSV-BN	0.165	0.070	0.211	0.266	0.119	0.048	0.043	0.043	0.067	0.059	0.042	0.023	0.044	0.053	0.055	0.020	0.095	0.028	0.027	0.021
FSV-BR																				
FSV-BS	0.143	0.084	0.268	0.525	0.106	0.043	0.035	0.044	0.045	0.050	0.056	0.037	0.083	0.069	0.095	0.028	0.024	0.034	0.030	0.030
FSV-BT	0.179	0.091	0.321	0.308	0.150	0.032	0.024	0.035	0.042	0.050	0.068	0.037	0.085	0.082	0.113	0.020	0.012	0.025	0.023	0.019
FSV-BU						0.040	0.032	0.039	0.063	0.064										
FSV-BW																				
FSV-CD						0.060	<0.05	<0.05	0.050	0.066										
FSV-CE																				
FSV-CF																				
FSV-CG	0.204	0.114	0.349	0.397	0.185	0.062	0.042	0.059	0.087	0.109										
FSV-CI																				
FSV-CZ																				
FSV-DV																				
FSV-EE																				
FSV-FZ																				
FSV-GD																				
FSV-GE																				
FSV-GF																				
FSV-GG																				
FSV-GJ																				
FSV-GL																				
n	4	4	4	4	4	8	7	7	8	8	5	5	5	5	5	4	4	4	4	4
Min	0.143	0.070	0.211	0.266	0.106	0.031	0.017	0.032	0.042	0.050	0.042	0.023	0.044	0.053	0.055	0.019	0.008	0.025	0.023	0.019
Median	0.172	0.087	0.294	0.353	0.135	0.042	0.032	0.039	0.052	0.062	0.056	0.032	0.083	0.072	0.113	0.020	0.018	0.028	0.029	0.025
Max	0.204	0.114	0.349	0.525	0.185	0.062	0.043	0.059	0.087	0.109	0.073	0.037	0.105	0.101	0.130	0.028	0.095	0.034	0.092	0.137
eSD	0.027	0.016	0.060	0.097	0.033	0.012	0.012	0.006	0.013	0.007	0.018	0.007	0.009	0.015	0.025	0.001	0.012	0.002	0.005	0.008
eCV	16	18	20	28	24	28	37	15	24	11	32	22	11	21	22	4	66	8	19	32
N_{past}	8	4	4	6	6	18	9	9	14	13	12	5	5	7	5	10	7	7	6	7
$Median_{past}$	0.146	0.080	0.309	0.285	0.134	0.036	0.029	0.044	0.054	0.067	0.065	0.041	0.091	0.090	0.130	0.021	0.013	0.035	0.029	0.027
SD_{past}	0.017	0.018	0.042	0.046	0.015	0.005	0.009	0.010	0.014	0.011	0.012	0.009	0.025	0.017	0.017	0.007	0.006	0.017	0.011	0.009
NAV	0.172	0.087	0.294	0.353	0.135	0.042	0.032	0.039	0.052	0.062	0.056	0.032	0.083	0.072	0.113	0.020	0.018	0.028	0.029	0.025
NAU						0.012	0.012	0.010	0.013	0.015	0.018	0.007	0.016	0.015	0.025					

F4

Round Robin LXXXII Laboratory Results

	Total Lutein&Zeaxanthin, µg/mL					Coenzyme Q10, µg/mL					Phylloquinone (K1), ng/mL					25-hydroxyvitamin D, µg/mL				
Lab	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441	437	438	439	440	441
FSV-BA																				
FSV-BD																				
FSV-BE						1.00	0.500	1.31	0.69	0.580	0.428	0.243	0.670	0.392	1.678					
FSV-BH	0.071	0.038	0.104	0.164	0.259											0.030	0.015	0.020	0.014	0.020
FSV-BJ						0.69	0.545	1.05	0.97	0.696										
FSV-BL																				
FSV-BM																				
FSV-BN	0.062	0.033	0.072	0.084	0.076											0.016	0.008	0.011	0.010	0.011
FSV-BR																				
FSV-BS	0.084	0.061	0.117	0.099	0.125															
FSV-BT	0.088	0.049	0.110	0.105	0.132	0.66	0.730	0.71	0.74	0.673										
FSV-BU	0.078	0.047	0.094	0.100	0.135															
FSV-BW						0.64	0.430	1.09	0.76	0.410										
FSV-CD	0.080	0.060	0.120	0.120	0.150															
FSV-CE						0.80	0.446	1.18	0.90	0.664										
FSV-CF																				
FSV-CG	0.079	0.048	0.109	0.115	0.144															
FSV-CI						0.80	0.500	1.20	1.00	0.700	0.464	0.302	0.765	0.428	2.052					
FSV-CZ						0.65	0.413	1.13	0.74	0.380										
FSV-DV																				
FSV-EE						0.73	0.501	1.24	0.93	0.635										
FSV-FZ																				
FSV-GD						0.95	0.553	1.51	1.16	0.648										
FSV-GE																				
FSV-GF						0.65	0.400	0.95	0.79	0.470										
FSV-GG						0.90	0.500	1.20	0.90	0.600						0.028	0.014	0.017	0.014	0.019
FSV-GJ											0.370	0.220	0.700	0.350	1.770					
FSV-GL						1.04	0.583	1.64	1.38	0.724										
n	7	7	7	7	7	12	12	12	12	12	3	3	3	3	3	3.000	3.000	3.000	3.000	3.000
Min	0.062	0.033	0.072	0.084	0.076	0.64	0.400	0.71	0.69	0.380	0.370	0.220	0.670	0.350	1.678	0.016	0.008	0.011	0.010	0.011
Median	0.079	0.048	0.109	0.105	0.135	0.77	0.500	1.19	0.90	0.642	0.428	0.243	0.700	0.392	1.770	0.028	0.014	0.017	0.014	0.019
Max	0.088	0.061	0.120	0.164	0.259	1.04	0.730	1.64	1.38	0.724	0.464	0.302	0.765	0.428	2.052	0.030	0.015	0.020	0.014	0.020
eSD	0.007	0.015	0.012	0.015	0.014	0.17	0.079	0.16	0.18	0.084										
eCV	9	31	11	14	11	22	16	14	21	13										
N_{past}	19	9	9	14	13	9	11	11	9	9	0	0	0	0	0	0.000	5.000	5.000	15.000	0.000
$Median_{past}$	0.098	0.052	0.121	0.125	0.159	0.68	0.488	1.23	0.95	0.682							0.015	0.018	0.016	
SD_{past}	0.019	0.006	0.016	0.027	0.047	0.17	0.042	0.14	0.11	0.095							0.002	0.002	0.004	
NAV	0.079	0.048	0.109	0.105	0.135	0.77	0.500	1.19	0.90	0.642	0.428	0.243	0.700	0.392	1.770	0.028	0.014	0.017	0.014	0.019
NAU	0.016	0.015	0.023	0.022	0.028	0.17	0.079	0.18	0.18	0.096										

F5

Round Robin LXXXII Laboratory Results

Analytes Reported By One Laboratory

Values in µg/mL

Analyte	Code	437	438	439	440	441
δ-Tocopherol	FSV-CG	0.083	0.087	0.122	0.136	0.165
Total α-Cryptoxanthin	FSV-BT	0.012	0.008	0.014	0.018	0.015
Phytoene	FSV-BS	*nd*	*nd*	0.083	0.081	0.080
Vitamin D3	FSV-BH	0.0028	0.0008	0.0025	0.0017	*nq*
25-hydroxyvitamin D2	FSV-BH	*nq*	0.0010	*nq*	*nq*	*nq*
25-hydroxyvitamin D3	FSV-BH	0.0302	0.0142	0.0196	0.0141	0.0199
24,25-(OH)2-D3	FSV-BH	0.0022	0.0007	0.0008	0.0006	0.0015

Table Legend

Term	Definition
N	Number of (non-NIST) quantitative values reported for this analyte
Min	Minimum (non-NIST) quantitative value reported
Median	Median (non-NIST) quantitative value reported
Max	Maximum (non-NIST) quantitative value reported
eSD	Adjusted median absolute deviation from the median of the non-NIST results
eCV	Coefficient of Variation for (non-NIST) results: 100*SD/Median
N_{past}	Mean of N(s) from past RR(s)
$Median_{past}$	Mean of Median(s) from past RR(s)
SD_{past}	Pooled SD from past RR(s)
NAV	NIST Assigned Value (Median for analytes reported by ≥ 5 participants)
NAU	NIST Assigned Uncertainty: Maximum of (0.05*NAV, eSD, SDpast, eSDLongTerm) eSDLongTerm is defined in: Duewer et al., Anal Chem 1997;69(7):1406-1413.
nd	Not detected (i.e., no detectable peak for analyte)
nq	Detected but not quantitatively determined
<x	Concentration at or below the limit of quantification, x
italics	Not explicitly reported but calculated by NIST from reported values

Round Robin LXXXII Laboratory Results

Comparability Summary

Lab	TR	aT	g/bT	bC	aC	TLy	TbX	L&Z	Q10
FSV-BA	1								
FSV-BD	1	2							
FSV-BE	1	3	1	1					2
FSV-BH	2	2	1	1	1	1	1	3	
FSV-BJ	1	1	1	2	1	1	1		1
FSV-BL	2	1							
FSV-BM	2	1							
FSV-BN	3	2		2	2	2	1	2	
FSV-BR	1	1							
FSV-BS		1		2	4	3	1	1	
FSV-BT	2	1	2	1	1	2	1	1	3
FSV-BU	1	2	1	1	1	1	1	1	
FSV-BW	1	1		2	4	2			2
FSV-CD	1	1	1	1	3	2	2	1	
FSV-CE	1	1		1					1
FSV-CF	2	2							
FSV-CG	2	3	1	2	2	2	3	1	
FSV-CI	1	1	1						1
FSV-CZ	1	3	2	2					2
FSV-DV	2	2							
FSV-EE									1
FSV-FZ	1	1	1						
FSV-GD	1	1	1	1	1	1			2
FSV-GE	2	4		2		1			
FSV-GF		3							2
FSV-GG	1	2							1
FSV-GJ	1	1							
FSV-GL	1	1	1	1	1	1			2
n	25	26	12	15	11	12	8	7	12

	TR	aT	g/bT	bC	aC	TLy	TbX	L&Z	Q10
% 1	64	54	83	53	55	50	75	71	42
% 2	32	27	17	47	18	42	13	14	50
% 3	4	15	0	0	9	8	13	14	8
% 4	0	4	0	0	18	0	0	0	0

Label	Definition
Lab	Participant code
TR	Total Retinol
aT	α-Tocopherol
g/bT	γ/β-Tocopherol
bC	Total β-Carotene
aC	Total α-Carotene
TLy	Total Lycopene
TbX	Total β-Cryptoxanthin
L&Z	Total Lutein & Zeaxanthin
Q10	Coenzyme Q10

n	number of participants providing quantitative data
% 1	Percent of CS = 1 (within 1 SD of medians)
% 2	Percent of CS = 2 (within 2 SD of medians)
% 3	Percent of CS = 3 (within 3 SD of medians)
% 4	Percent of CS = 4 (3 or more SD from medians)

"Comparability Score"

The Comparability Score (CS) summarizes your measurement performance for a given analyte relative to the consensus medians in this study. CS is the average distance (in units of standard deviation) of your measurement performance characteristics from the consensus performance. CS is calculated when the number of quantitative values you reported, N_{you}, is at least two and at least six participants reported quantitative values for the analyte.

We define CS as follows:

$$CS = \text{MINIMUM}\left(4, \text{INTEGER}\left(1+\sqrt{C^2+AP^2}\right)\right)$$

$$C = \text{Concordance} = \frac{\sum_{i=1}^{N_{you}} \frac{You_i - Median_i}{NAU_i}}{N_{you}}$$

$$AP = \text{Apparent Precision} = \sqrt{\frac{\sum_{i=1}^{N_{you}} \left(\frac{You_i - Median_i}{NAU_i}\right)^2}{N_{you}-1}}$$

NAU = NIST Assigned Uncertainty

For further details, please see

Duewer DL, Kline MC, Sharpless KE, Brown Thomas J, Gary KT. Micronutrients Measurement Quality Assurance Program: Helping participants use interlaboratory comparison exercise results to improve their long-term measurement performance. Anal Chem 1999;71(9):1870-8.

Appendix G. Representative "Individualized Report" for RR82

Each participant in RR82 received an "Individualized Report" reflecting their reported results. Each report included a detailed analysis for analytes that were assayed by at least five participants. The following analytes met this criterion:

- Total Retinol
- α-Tocopherol
- γ/β-Tocopherol
- Total β-Carotene
- *trans*-β-Carotene
- Total α-Carotene
- Total Lycopene
- Total β-Cryptoxanthin
- Total Lutein
- Total Lutein & Zeaxanthin
- Coenzyme Q10

The following twelve pages are the "Individualized Report" for the analytes evaluated by participant FSV-BT.

Individualized Round Robin LXXXII Report: FSV-BT

Summary

	#437			#438			#439			#440			#441		
Analyte	You	NAV	n	You	NAV	n	You	NAV	n	You	NAV	n	You	NAV	n
Total Retinol	0.489	0.410	26	0.335	0.320	26	0.700	0.660	26	0.520	0.503	26	0.419	0.442	26
α-Tocopherol	7.70	8.35	27	5.12	4.94	27	11.63	12.36	27	9.89	10.50	27	11.90	10.90	27
γ/β-Tocopherol	1.824	1.810	13	1.203	1.090	13	2.518	2.534	13	1.396	1.400	13	1.766	1.375	13
Total β-Carotene	0.087	0.080	15	0.118	0.115	15	0.194	0.191	15	0.246	0.246	15	0.683	0.622	15
trans-β-Carotene	0.079	0.079	6	0.110	0.096	6	0.183	0.169	6	0.231	0.220	6	0.644	0.631	6
Total cis-β-Carotene	0.008	0.008	5	0.008	0.010	5	0.011	0.015	5	0.015	0.022	5	0.039	0.039	5
Total α-Carotene	0.026	0.028	10	0.022	0.026	10	0.013	0.013	10	0.030	0.032	11	0.332	0.352	12
Total Lycopene	0.198	0.333	13	0.102	0.165	13	0.364	0.621	13	0.344	0.620	13	0.178	0.266	13
trans-Lycopene	0.179	0.172	5	0.091	0.087	5	0.321	0.294	5	0.308	0.353	5	0.150	0.135	5
Total β-Cryptoxanthin	0.032	0.042	9	0.024	0.032	8	0.035	0.039	8	0.042	0.052	9	0.050	0.062	9
Total α-Cryptoxanthin	0.012		1	0.008		1	0.014		1	0.018		1	0.015		1
Total Lutein	0.068	0.056	5	0.037	0.032	5	0.085	0.083	5	0.082	0.072	5	0.113	0.113	5
Total Zeaxanthin	0.020	0.020	4	0.012	0.018	4	0.025	0.028	4	0.023	0.029	4	0.019	0.025	4
Total Lutein&Zeaxanthin	0.088	0.079	8	0.049	0.048	8	0.110	0.109	8	0.105	0.105	8	0.132	0.135	8
Coenzyme Q10	0.663	0.766	12	0.730	0.500	12	0.705	1.192	12	0.740	0.900	12	0.673	0.642	12

G2

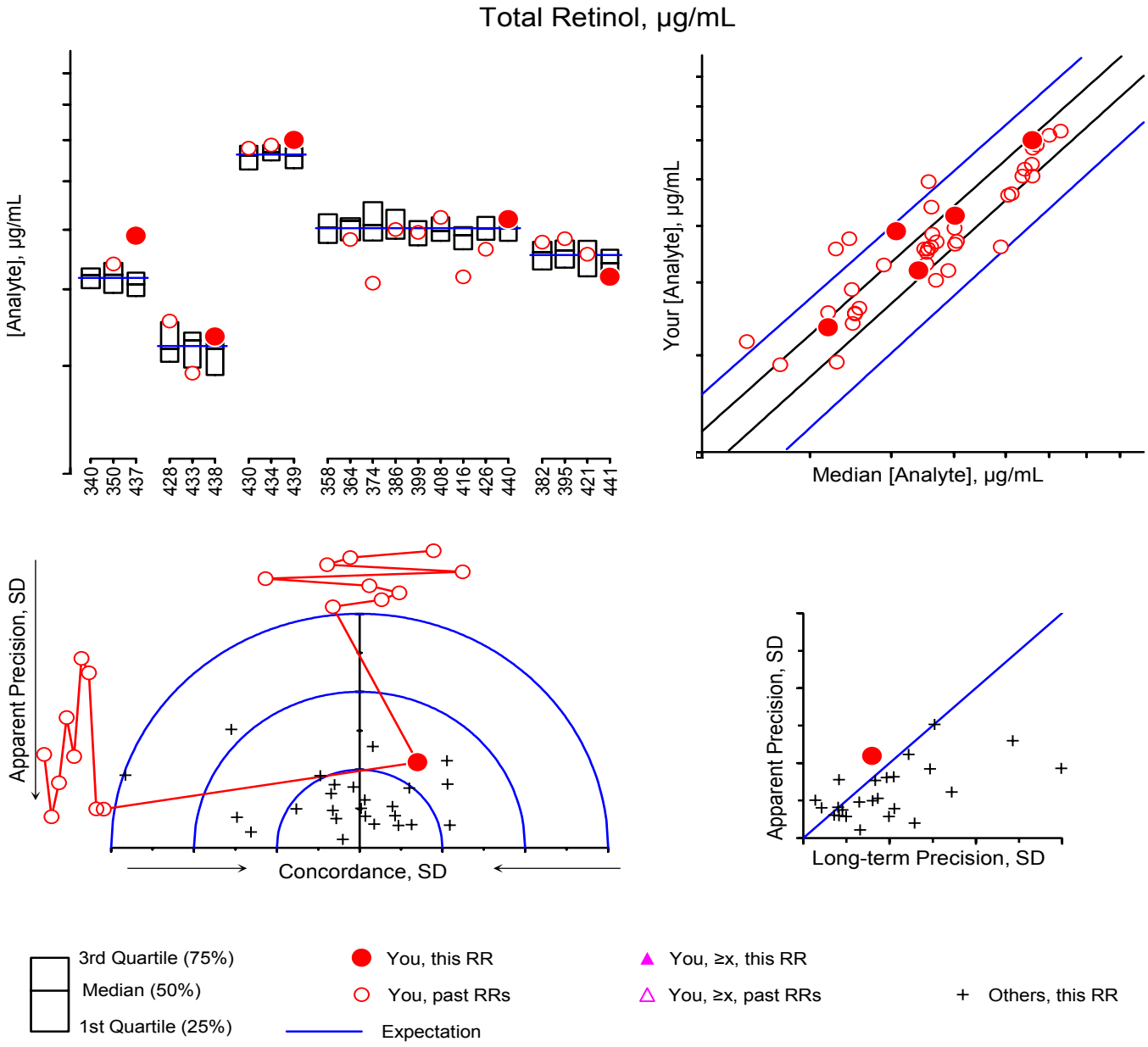
You : Your reported values for the listed analytes (micrograms/milliliter)
NAV : NIST Assigned Values, here equal to this RR's median
n : Number of non-NIST laboratories reporting quantitative values for this analyte in this serum

Please check our records against your records. Send corrections and/or updates to...

Micronutrients Measurement Quality Assurance Program
National Institute of Standards and Technology
100 Bureau Drive Stop 8392
Gaithersburg, MD 20899-8392 USA

Tel: (301) 975-3935
Fax: (301) 977-0685
Email: david.duewer@nist.gov

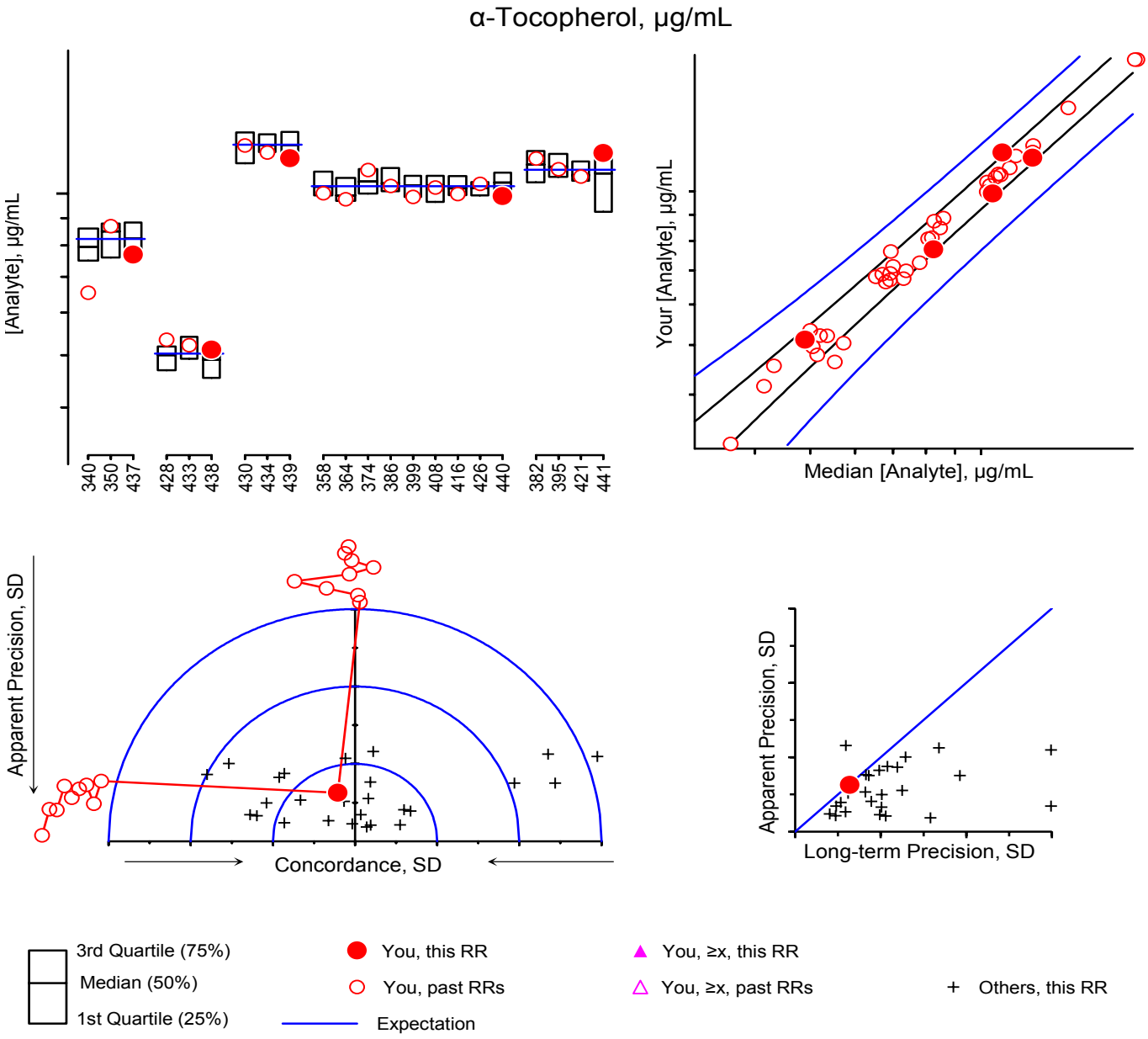
Individualized RR LXXXII Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

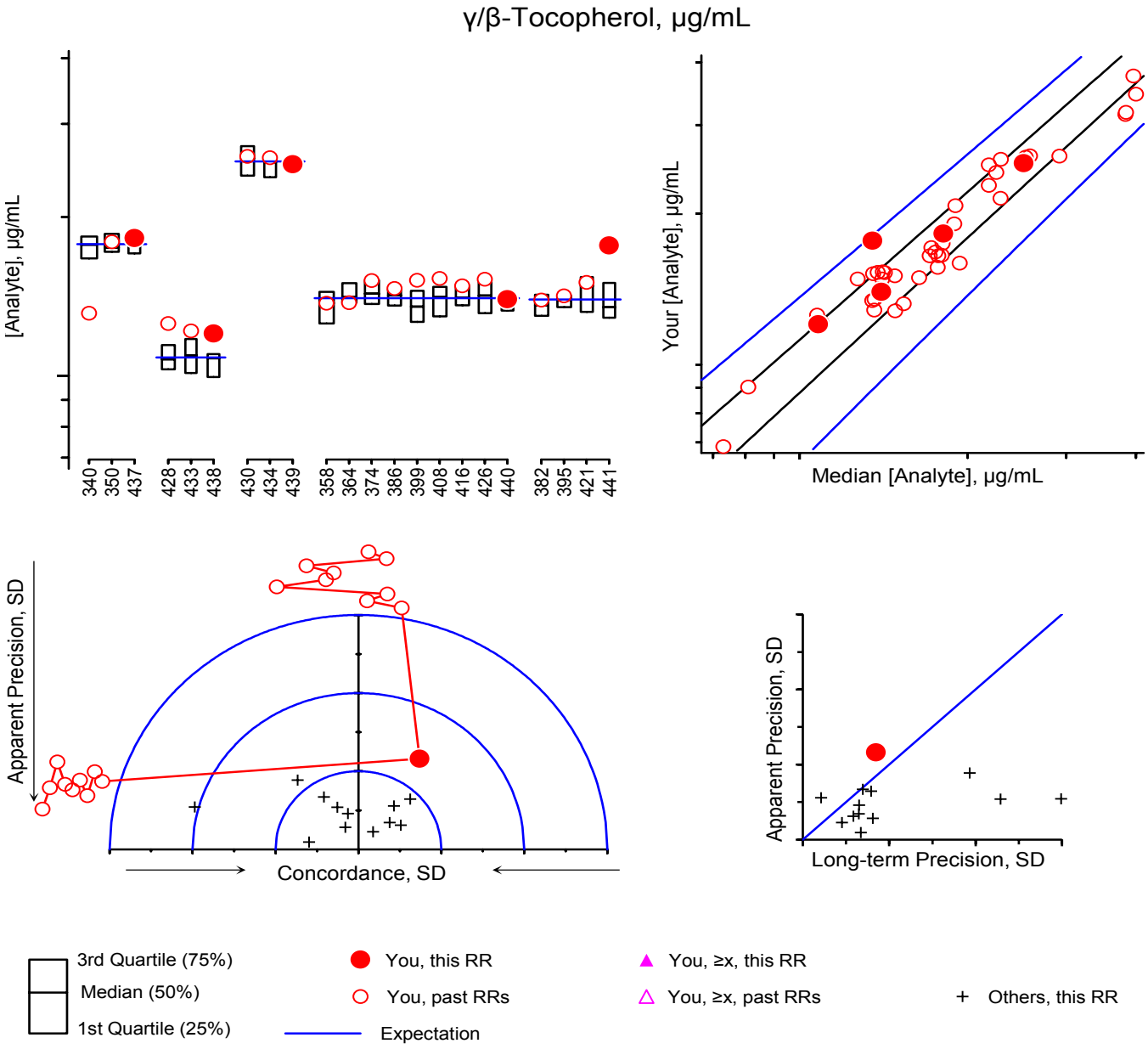
Individualized RR LXXXII Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

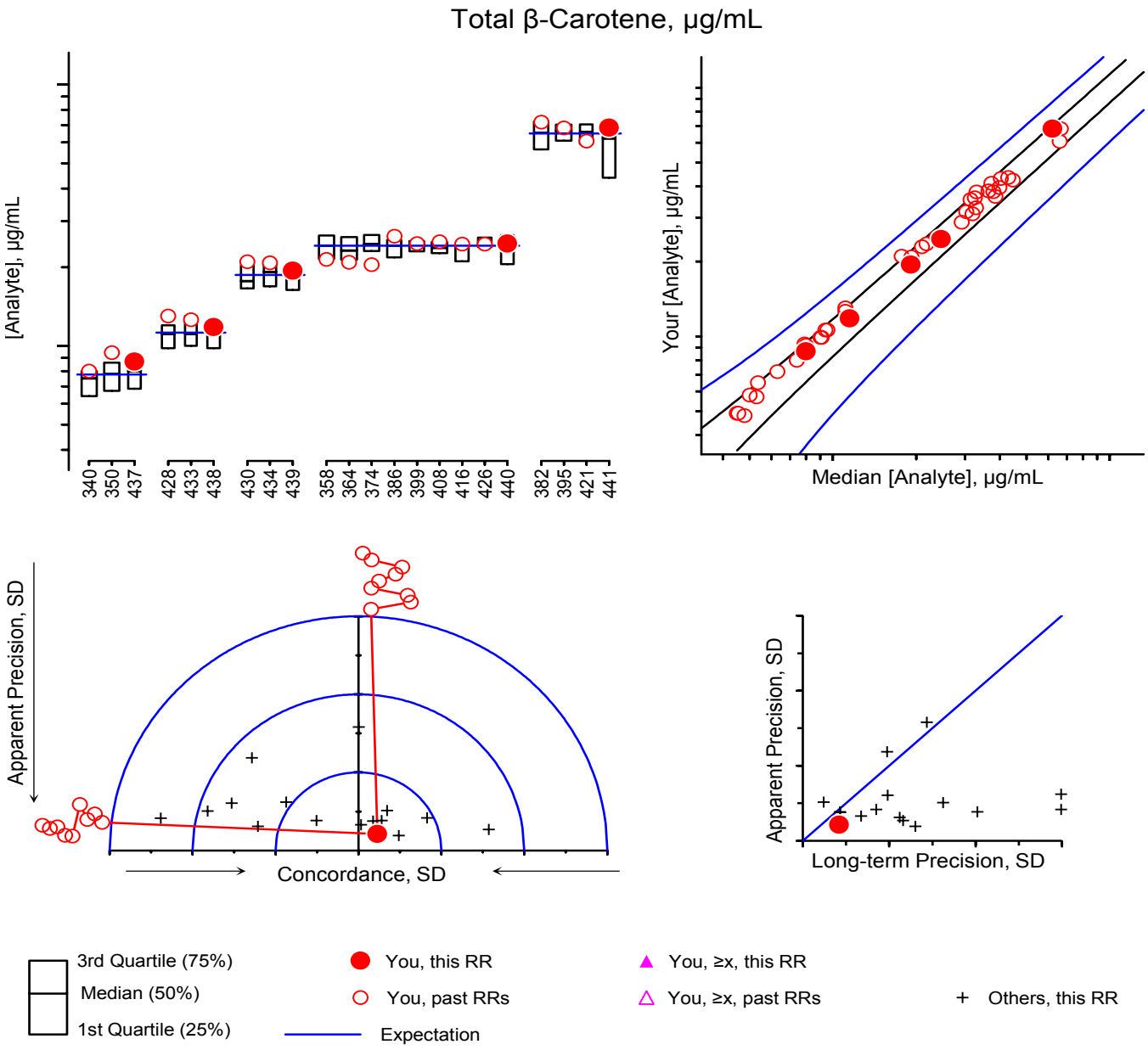
Individualized RR LXXXII Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

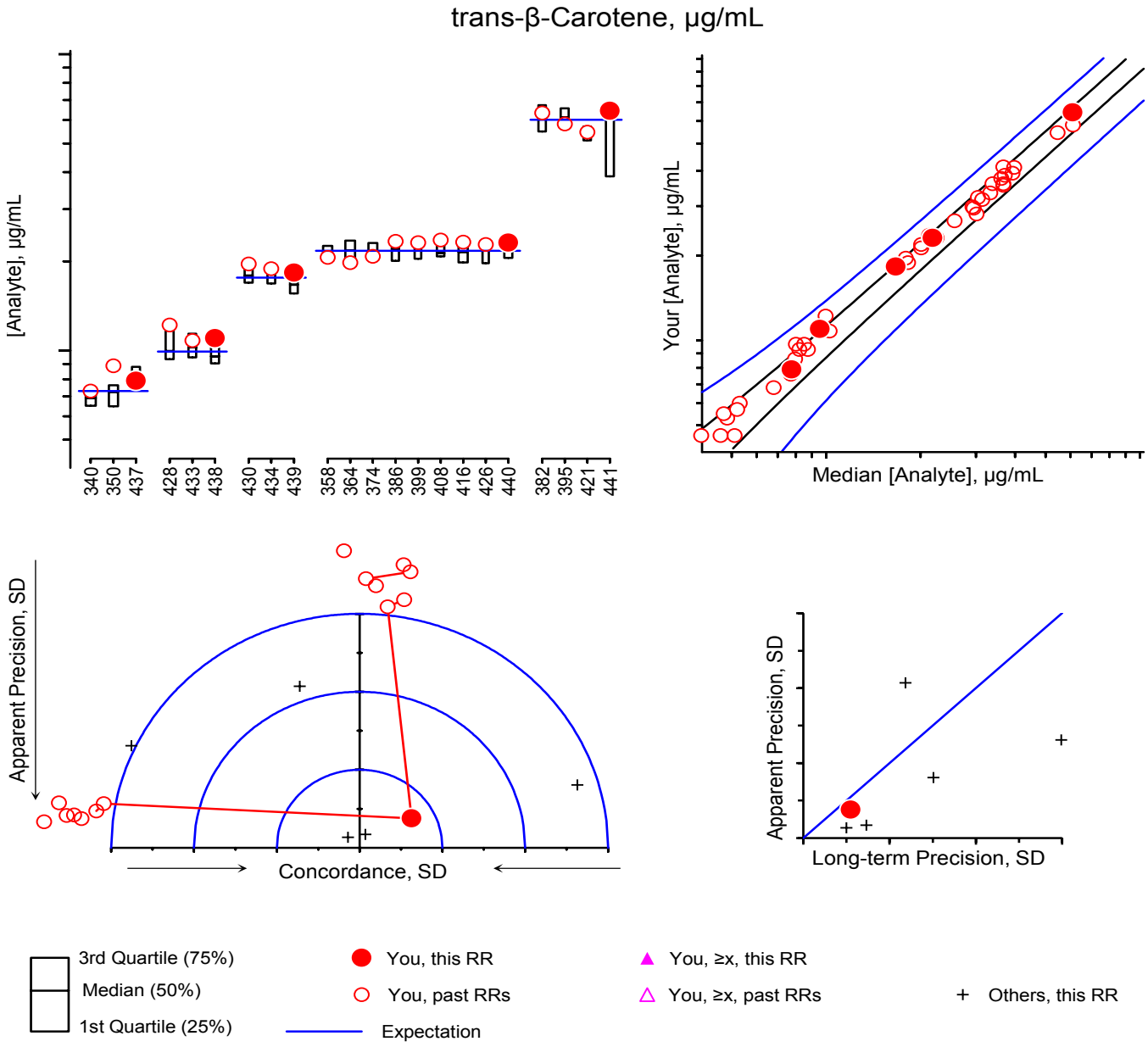
Individualized RR LXXXII Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

Individualized RR LXXXII Report: FSV-BT



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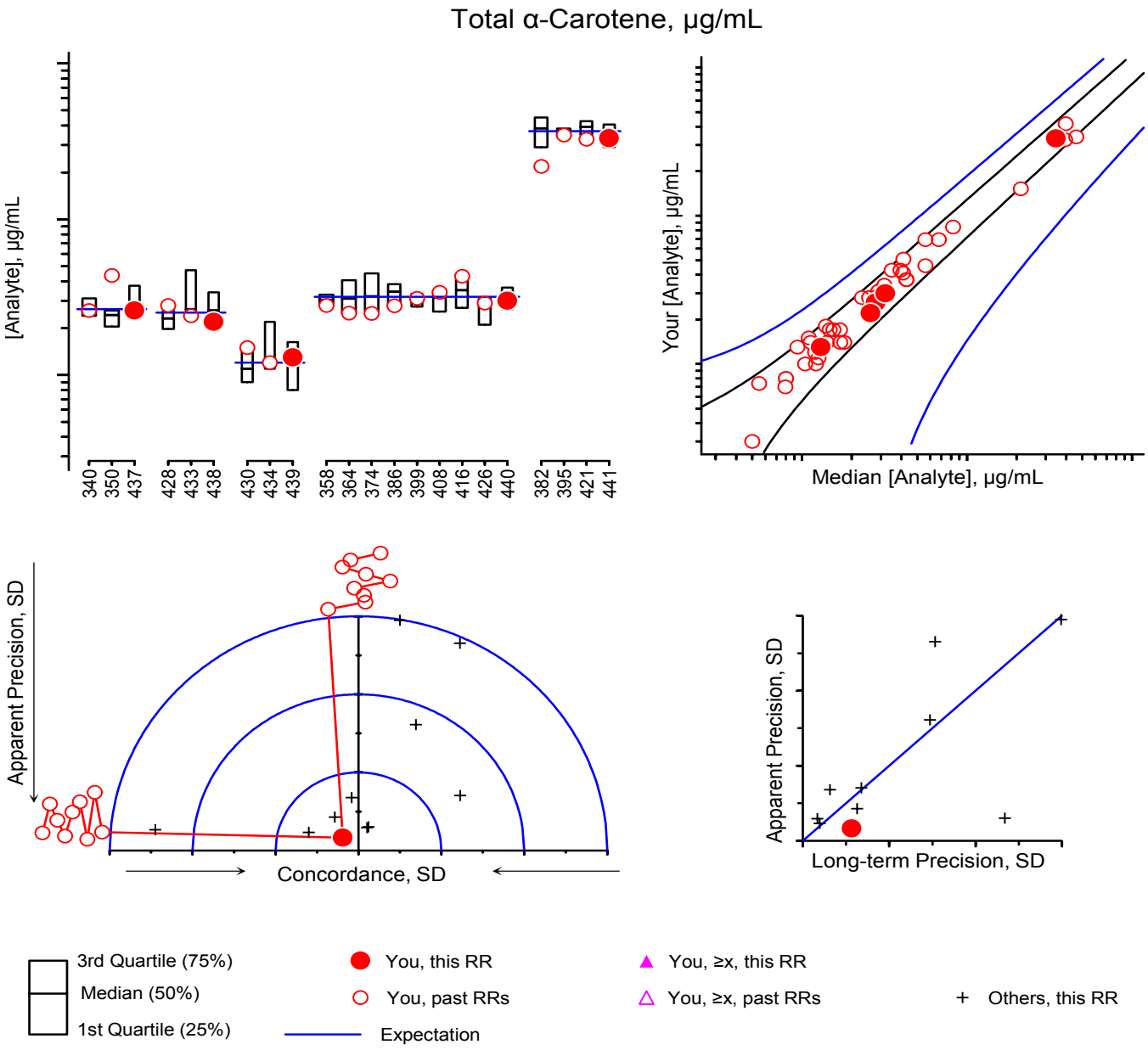
Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

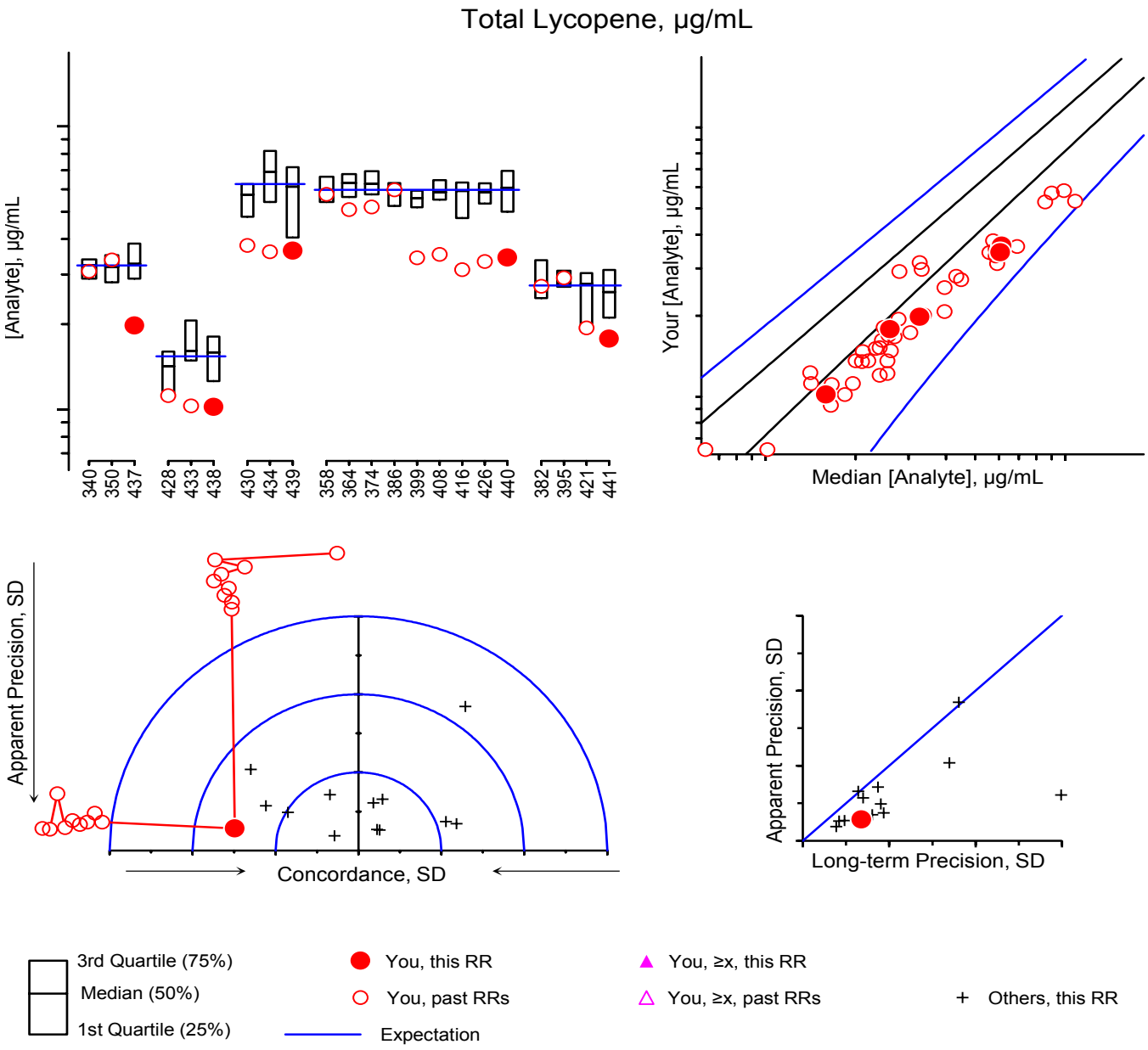
Individualized RR LXXXII Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

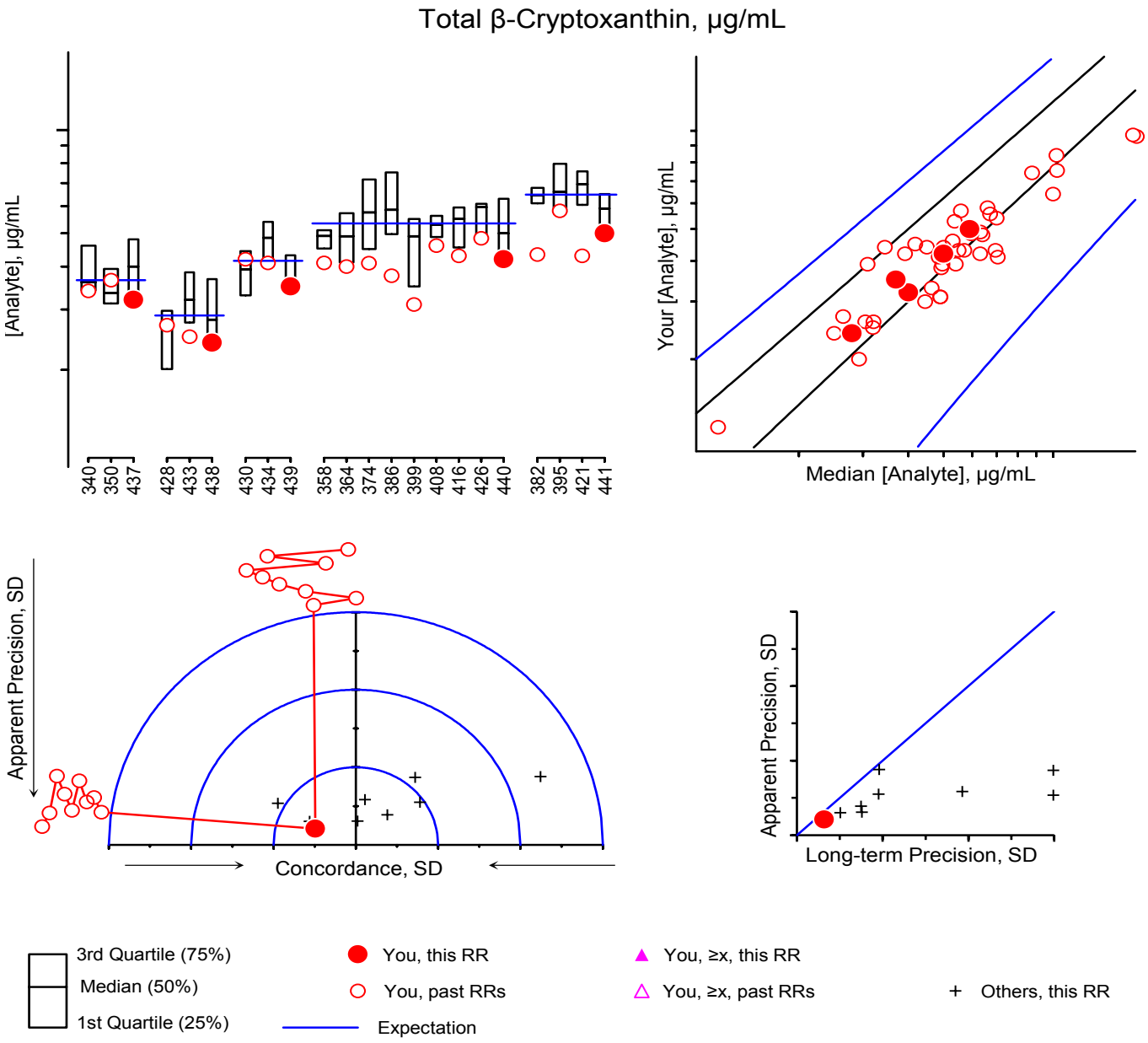
Individualized RR LXXXII Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

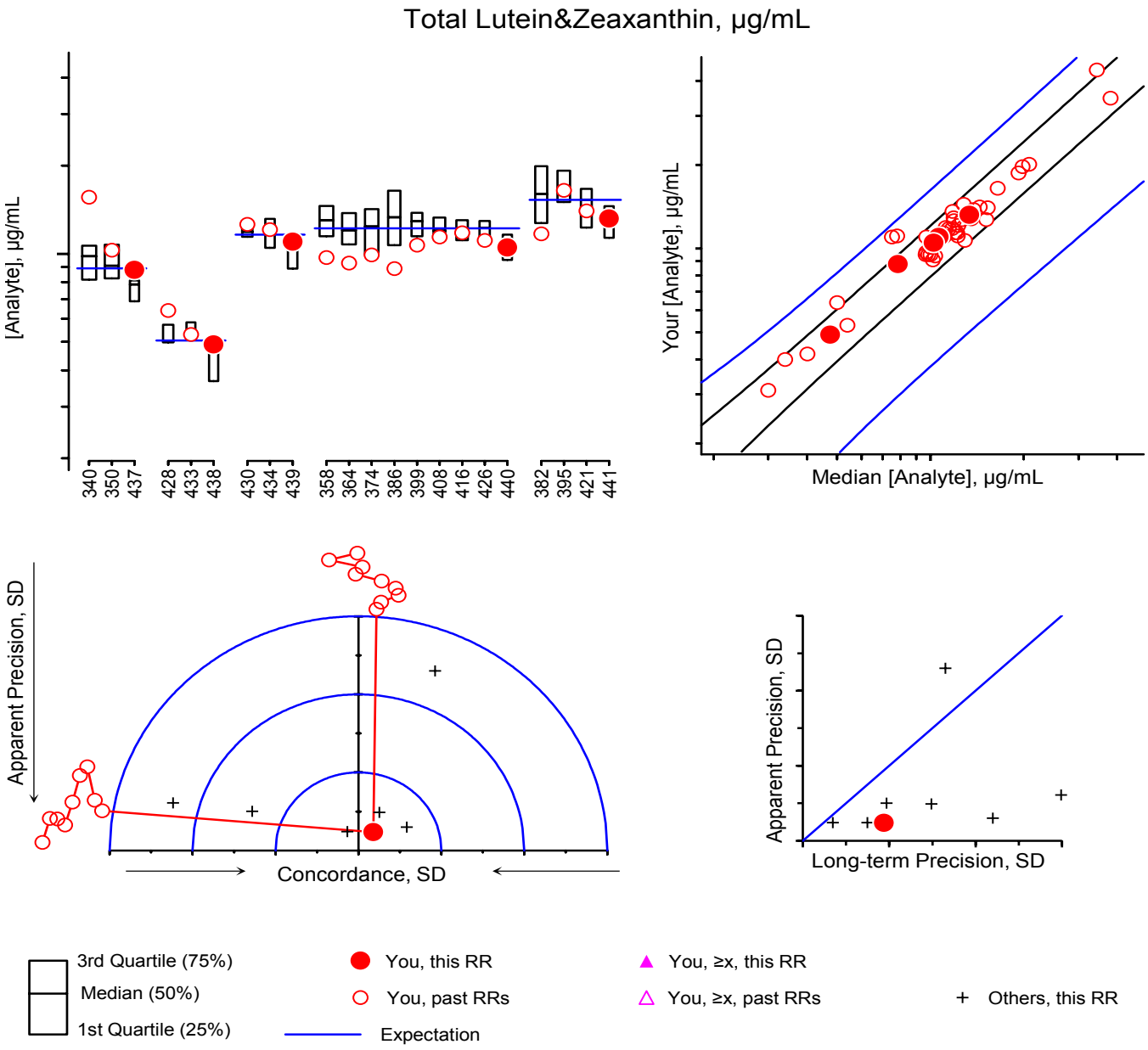
Individualized RR LXXXII Report: FSV-BT



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

Individualized RR LXXXII Report: FSV-BT

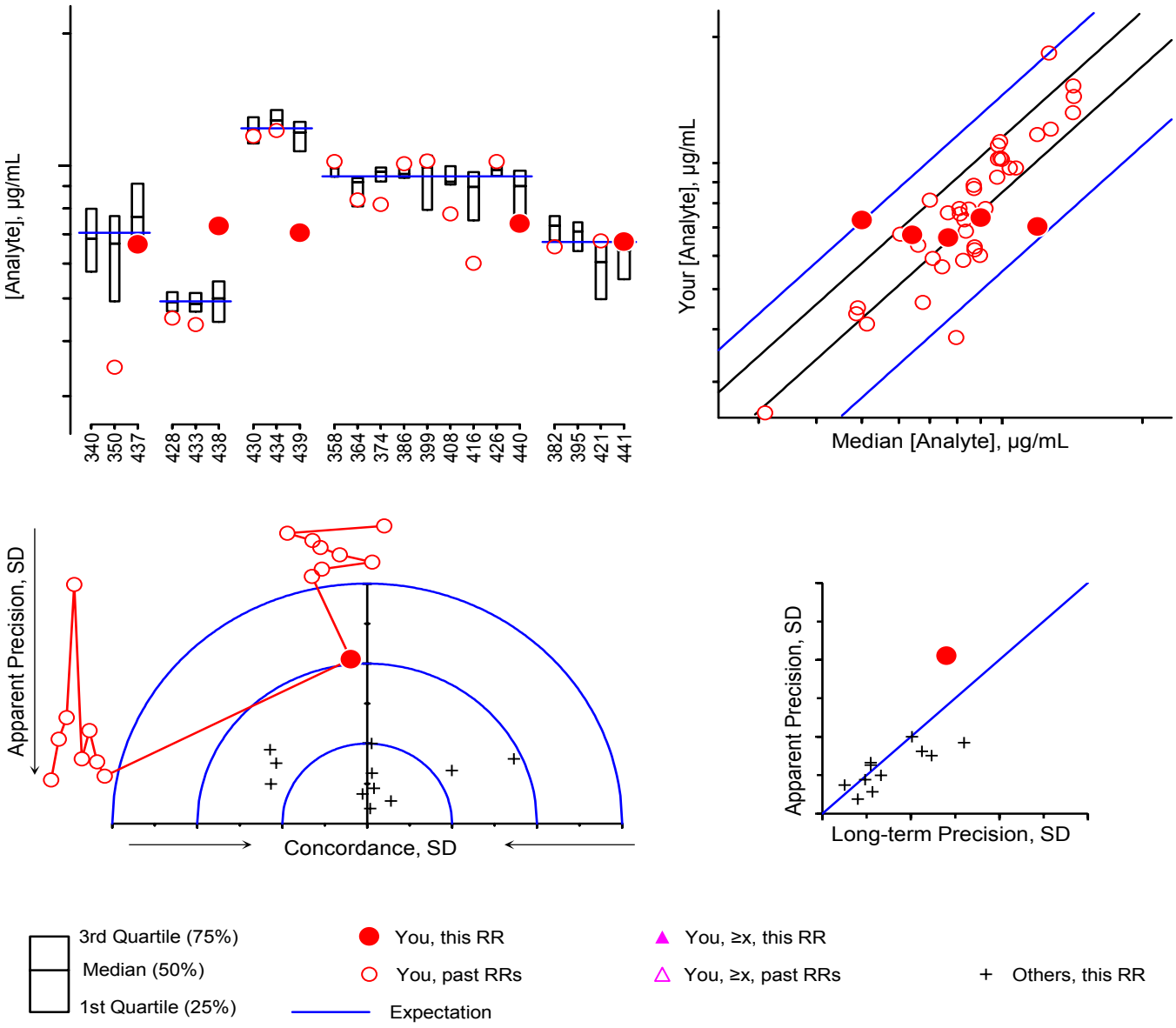


For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

Individualized RR LXXXII Report: FSV-BT

Coenzyme Q10, µg/mL



For details of the construction and interpretation of these plots, see:
Duewer, Kline, Sharpless, Brown Thomas, Gary, Sowell. Anal Chem 1999;71(9):1870-8.

Serum	Comments	History
#437	Plasma, fresh-frozen, native, multi-donor: SRM 1950	RR63#340, RR64#350
#438	Fresh-frozen, native, multi-donor: SRM968f-Lv1	RR80#428, RR81#433
#439	Fresh-frozen, native, multi-donor: SRM968f-Lv2	RR80#430, RR81#434
#440	Fresh-frozen, native, multi-donor: SRM 968e-II	RR66#358, RR67#364, RR69#374, RR71#386, RR74#399, RR76#408, RR77#416, RR79#426
#441	Fresh-frozen, native, multi-donor	RR71#382, RR73#395, RR78#421

Individualized Round Robin LXXXII Report: FSV-BT
Graphical Comparability Summary

G13