Automated Data Analysis Of Clinical Mass Spectrometry Results

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Mass Spec Terms To Know

- Analyte compound or drug to be identified and/or quantitated by Mass spectrometry
- IS Internal Standard
 - Chemically similar to analyte of interest. Used to help quantitate amount of analyte in a particular sample.
- Peak Liquid chromatographic mass spectrometric set of data points used In part, to define a particular analyte of a specific mass
 - Transitions are a set different mass spectrometric peaks, when combined, define the same analyte of interest
- Retention Time the time it takes for a sample to enter the liquid chromatogram and exit into the mass spectrometer.
- AMR Analytical Measurement Range
 - Undiluted linear range of the assay for a given analyte.

Why Have An Automated Data Review Process For LC-MS/MS?

Improve Efficiency (time)

Reduce Errors

Standardize Processes

Why Have An Automated Data Review Process For LC-MS/MS?

Improve Efficiency (time)

Reduce Errors

Why is this a problem with mass spec data?

Standardize Processes

Why Have An Automated Data Review Process For LC-MS/MS?

Improve Efficiency (time)

Reduce Errors

Standardize Processes

Because there are so many data elements to manually review!





40 Samples Per Batch



40 Samples Per Batch 10 Analytes Per Sample





BATCH = 10,800 Data Elements To Manually Review!!!

We Want To Filter The Jumble Of Data



To Focus On Only The Bad Data!





We Want To Bypass This



But Capture This





Where Can A Rules Engine Live?



This Is Our Current Workflow



This Is Where The Rules Engine Placement Made Sense To Us



Where We Started With DI

Built rules based on static parameters

Different for each assay

Different for each analyte

Can not change over time

But...It Gets Complicated...

LC-MS/MS assays are dynamic processes

Data elements change and trend over time

Rules with static values may/will eventually fail

Requires constant monitoring and maintenance

Example Of This Dynamic Process Is Retention Time

For Morphine

A static rule is written

If the morphine Internal Standard Retention Time is greater or less than 0.05 minutes from 3.08 minutes, then flag the result as an outlier

Morphine Internal Standard Peak At Time Of Rule Build



3 months later...Column Is Replaced



3 months later...Column Is Replaced



All samples containing Morphine IS now fail that rule

What Could Be Used To Generate Dynamic Rules?

Calibrators! Because they calibrate more than just the value!



Therefore the calibrators are intrinsically dynamic!

What Could Be Used To Generate Dynamic Rules?

Calibrators! Because they calibrate more than just the value!



Therefore the calibrators are intrinsically dynamic!

We can capitalize on that! By averaging calibrator data elements!!

The Simple Workflow The End-User Sees



What The "Behind the Scenes" Workflow Actually Looks Like!



These Are The 3 Components We Worked On



Our To-Do List

Create a Report Template to send data elements to DI

Create a DI driver which can average data elements from calibrators

Have DI Driver place each calibrator data element average under each patient sample

Write and apply rules to patient samples
What Is A Report Template??

<Analyte

PeakName="Analyte Peak Name PeakName]" PeakArea="Analyte Peak Area PeakArea]" PeakHeight="Analyte Peak Height PeakHeight]" Concentration="Analyte Concentration Concentration]" Calculated Concentration="Calculated Concentration Calculated Concentration]" MRMAreaRatio="CUSTOM MRM Area Ratio MRMAreaRatio]" RetentionTime="Analyte Retention Time (RT)" OutlierReasons="CUSTOM Outlier Reasons OutlierReasons]" SignalToNoise="Analyte Signal To Noise (SignalToNoise]" RelativeRetentionTime="Calculated Relative Retention Time (RelativeRetentionTime]" ExpectedMRMAreaRatio="CUSTOM Expected Ratio (Expected MRMAreaRatio]" RecordModified="Run Script RecordModified]" > </Analyte>

Our To-Do List

Create a Report Template to send data elements to DI

Create a DI driver which can average data elements from calibrators

Have DI Driver list each calibrator data element average under each patient sample

Write and apply rules to patient samples

What Exactly Is A Driver?

- Part of DI Middleware
- Receives Data Elements
- Organizes Data Elements
- Applies Rules to Data Elements
- Flags Outlier Data Elements

- ► OP CAL 1
 - ► Morphine
 - ▶ Value 5 ng/mL
 - ► IS Retention Time 3.08
- ► OP CAL 3
 - ► Morphine
 - ▶ Value 50 ng/mL
 - ▶ IS Retention Time 3.06

- ► OP CAL 2
 - Morphine
 - Value 10 ng/mL
 - ▶ IS Retention Time 3.07
- OP CAL 4
 - ► Morphine
 - Value 100 ng/mL
 - ► IS Retention Time 3.07

- ► OP CAL 1
 - Morphine
 - ▶ Value 5 ng/mL
 - ► IS Retention Time 3.08
- OP CAL 3
 - ► Morphine



► IS Retention Time 3.06

- OP CAL 2
 - Morphine

▶ Value 10 ng/mL

- IS Retention Time 3.07
- OP CAL 4
 - ► Morphine

Value 100 ng/mL

► IS Retention Time 3.07

- ► OP CAL 1
 - ► Morphine
 - ▶ Value 5 ng/mL

IS Retention Time 3.08

- ► OP CAL 3
 - ► Morphine
 - ▶ Value 50 ng/mL
 - IS Retention Time 3.06

- OP CAL 2
 - Morphine
 - ► Value 10 ng/mL
 - IS Retention Time 3.07
- OP CAL 4
 - ► Morphine
 - Value 100 ng/mL
 - IS Retention Time 3.07

Patient 1

► Morphine

- ▶ Value 56 ng/mL
- IS Retention Time 3.15
- Average Calibrator IS Retention time 3.07
- Patient 2

Morphine

- Value 582 ng/mL
- IS Retention Time 3.07
- Average Calibrator IS Retention time 3.07

Patient 1

► Morphine

- ▶ Value 56 ng/mL
- ▶ IS Retention Time 3.15
- Average Calibrator IS Retention time 3.07
- Patient 2
 - ► Morphine
 - Value 582 ng/mL
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Patient 1

► Morphine

▶ Value 56 ng/mL

► IS Retention Time 3.15

Average Calibrator IS Retention time 3.07

- Patient 2
 - ► Morphine
 - Value 582 ng/mL

► IS Retention Time 3.07

Average Calibrator IS Retention time 3.07

Our To-Do List

Create a Report Template to send data elements to DI

Create a DI driver which can average data elements from calibrators

Have DI Driver place each calibrator data element average under each patient sample

Write and apply rules to patient samples

An Example Dynamic Rule We Wrote

Internal Standard Retention Time for Morphine:

If the morphine Internal Standard Retention Time is greater or less than 0.05 minutes of the average of the calibrators for morphine, then flag the result as an outlier

30 rules in total...and growing!













Mass Spec (Sciex)

Middleware (Data Innovations)

> Samples can be rejected by the tech











Middleware (Data Innovations)

> Sample can be accepted if OK by the reviewing tech







How Does A Bench Tech See A Result Held For Review?

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How Does A Bench Tech See A Result Held For Review?

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How Does A Bench Tech See A Result Held For Review?

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System Configuration Diagnostics Security Specimen Management SSR DC SR MM MA Laboratory Intelligence Reports Window Help

Specimen Management Work... × Status Display

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Specimen Worksheet

4 × Test Worksheet

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	P24	24	Not calculat	5/18/2018 6:22:12 AM					
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How Does Visual Peak Review Translate Into DI Rule Flags?



Example 1: How Do Very High Drug Samples Behave?

- ▶ 67 y/o female
- Prescribed Oxycontin (oxycodone 10 mg/12hr) for pain
- Patient was positive for oxycodone and noroxycodone



Example 1: This Is What Flags Were Observed

System Configuration Diagnostics Security Specimen Management SSR DC SR MM MA Laboratory Intelligence Reports Window Help

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		10614325A	P13	13	Not calculat	5/18/2018 8:25:4	4
		10603041A	P14	14	Not calculat	5/18/2018 8:25:	5
		10614260A	P15	15	Not calculat	5/18/2018 8:25:	5
		10607833A	P16	16	Not calculat	5/18/2018 8:25:	5
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		10606777A	P23	23	Not calculat	5/18/2018 8:26:	2
		10611194A	P24	24	Not calculat	5/18/2018 8:26:	2
		10614066A	P25	25	Not calculat	5/18/2018 8:26:	3
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		10613710A	P27	27	Not calculat	5/18/2018 8:26:	3

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	OP Noroxycodone 1	4743.08	SAT, DIL, PW High						
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	OP Oxycodone 1	7534.99	SAT, DIL, IS PA Low, IS PH Low						
Γ	OP Oxycodone 2	7779.68	SAT						

Example 1: What A Normal Noroxycodone 1 Peak Looks Like



Example 1: What This Patient's Noroxycodone 1 Peak Looked Like



Example 1: These Are The Flags



Example 1: Need To Use Dilution Values

We co-extracted a 20-fold dilution

We rejected the "over the AMR" values

The 20-fold diluted noroxycodone values had no errors and were already in the LIS waiting for reporting

Example 2: How Much Hydromorphone do we really have?

- 42 y/o male
- Prescribed MS Contin (Morphine) at 30 mg daily for pain
- Patient had a positive confirmation (>500 ng/mL) for morphine
- Patient also had a questionable hydromorphone around 500 ng/mL

Example 2: This Is A Problem!

- Hydromorphone can be seen as a minor metabolite in morphine use
- ► A result of 500 ng/mL however, suggests co-use of hydromorphone
- The amount of hydromorphone can mean the difference between drug compliance and non-compliance

Example 2: What A Normal Hydromorphone 1 Peak At 500 ng/mL Looks Like



Example 2: This Is What The Patient's Hydromorphone 1 Peak Looked Like



Example 2: This Is What The Patient's Hydromorphone 1 Peak Looked Like



Example 2: These Are What Flags Were Observed

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Example 2: These Are What Flags Were Observed

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	10613019A	P19	19	Not calculat	5/18/2018 8:26:09									
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Example 2: This Is What A Normal Hydromorphone IS Looks Like



Example 2: This Is What This Patient's Hydromorphone IS Looked Like



Example 2: These Are The Flags



Example 2: After Re-integration of IS

- All flags disappeared
- Re-calculated sample value went from 500 ng/mL to 7 ng/mL
- That is less than our cutoff of 10 ng/mL
- Results align with patient's medication list

Example 3: Is There Noroxycodone?

32 y/o male

Prescribed Norco (hydrocodone 10 mg/day) for pain

- Hydrocodone was confirmed positive
- There was also a questionable noroxycodone quantitation of around 70 ng/mL

Is there a compliance issue??

Example 3: These Are What Flags Were Observed

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	10710704A	P31	31	Not calculat	5/18/2018 8:26:5					
	10709472A	P32	32	Not calculat	5/18/2018 8:26:5					
	10707159A	P33	33	Not calculat	5/18/2018 8:26:5					
	10704455A	F04	04	Not calculat	5/10/2010 0.27.0					
	10706451A	P35	35	Not calculat	5/18/2018 8:27:0					
	10014000A	P37	37	inot calculat	J10/2010 0.27.1					
	10606334A	P38	38	Not calculat	5/18/2018 8:27:1					
	10612401A	P10 X20	40	Not calculat	5/18/2018 8:27:1					

Example 3: This Is What A Normal Noroxycodone 2 Peak Looks Like



Example 3: This Is What This Patient's Noroxycodone 2 Peak Looked Like



Example 3: These Are The Flags



Example 3: Not Noroxycodone

Sample was confirmed negative for noroxycodone

Results align with patient's medication list



Example 4: The Subtle Art Of Peak Review

- ▶ 58 y/o male
- Prescribed Percocet(oxycodone 10 mg/day)
- Positive confirmed oxycodone and noroxycodone
- Also had a questionably positive codeine at around 25 ng/mL
- Is there codeine in this sample??

Example 4: Here Is A Set Of Patient Samples With Potential Codeine Peaks



Example 4: Can You Figure Out Which Sample Has A Problem?



Example 4: This Patient Sample Has a Relative Retention Time (RRT) Error



Example 4: Here Are The Flags In DI

System Configuration Diagnostics Security Specimen Management SSR DC SR MM MA Laboratory Intelligence Reports Window Help

🔣 Specimen Management Work... 🗙

Workspace Edit View Format Action Help

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🔥 Click here to see a list of warnings 🗸 🖉		

Specimen Worksheet

₽ × Test Worksheet

រដ្ឋ		-					-
Po	Γ	Specimen ID	Patient ID	Position	Rack	First Result to IM C ^	
		10615172A	P12	12	Not calculat	5/18/2018 8:25:4	Þ
		10614325A	P13	13	Not calculat	5/18/2018 8:25:4	
		10603041A	P14	14	Not calculat	5/18/2018 8:25:5	
		10614260A	P15	15	Not calculat	5/18/2018 8:25:5	
		10607833A	P16	16	Not calculat	5/10/2010 0:25:5	
	Þ	10607388A	P18	18	Not calculat	5/18/2018 8:26:0	
	Ľ	TUDISUISA	PIS	19	ivot calculat	5/16/2018 8:20:0	
		10503740A	P21	21	Not calculat	5/18/2018 8:26:1	
		10610034A	P22	22	Not calculat	5/18/2018 8:26:2	
		10606777A	P23	23	Not calculat	5/18/2018 8:26:2	
		10611194A	P24	24	Not calculat	5/18/2018 8:26:2	
		1061/0664	D25	25	Not calculat	5/19/2019 9:26:3	

	est worksheet			
F	Test Code /	Recult	Error Code(s)	
P	OP Codeine 1	23.02	, RRT	
	OP Codeine 2	27.70	, RRT	
	OP Noroxycodone 1	5418.10	SAT, DIL, PW H	igh
Γ	OP Noroxycodone 2	5488.27	SAT, PW High	

Example 4: These Are The Flags



Example 4: Not Codeine

- The only give away is the Relative Retention Time Flag
- Techs in my lab are trained to visually see that subtle difference in RRT for codeine
 - Now they do not have to
- Codeine was confirmed negative.

How Are We Validating?

Made all rules fire at least once

Not an easy task!

Tried combinations of rule firing

Analyzed multiple production patient batches both manually and by DI

Compared results and time



The Data

Typical batches take about 2.5 hours to manually review

- A Real Opiate Batch with 37 patients was analyzed on 1/15/2018
- Batch Reviewed both:
 - ► Manually
 - Auto Data Review



- Both manual and auto data review found the exact same 49 "bad" peaks
- Estimated time to review cut by 50 %
 - Anticipated time to review will be only 20% of manual review.

Questions? Caveats?

Is this solution in production in your lab?

Is this a "plug and play" solution?

What is next?

More To Come! | Promise!

Alec Saitman, PhD DABCC (CC, TC) Director, Toxicology and Special Chemistry Providence Regional Laboratories alec.saitman@providence.org

Supplementary Slides

The driver initializes data collection by identifying an **Initializing Sample Name** or **ISN**

We use the blank sample at the start of the batch called "Blank"

													N	
	Index	Sample Name	Sample ID	Sample Type	Acquisition Date & Time	Dilution Factor	Component Name	Outlier Reasons	Actual Concentration	Area	IS Area	Height	Retention Time	IS Retention Time
	4	Blank		Double Blank	12/31/2017 3:52:26 PM	1.00	OP Morphine 1		N/A	N/A	6.102e0	N/A	N/A	1.95
	32	DIATIK + IS		Blank	12/31/2017 3:59:53 PM	1.00	OP Morphine 1		N/A	N/A	1.061e6	N/A	N/A	1.95
	60	OP Cal 1		Standard	12/31/2017 4:06:03 PM	1.00	OP Morphine 1		5.00	5.147e4	4.411e5	2.106e4	1.98	1.95
	88	OP Cal 2		Standard	12/31/2017 4:12:10 PM	1.00	OP Morphine 1		20.00	2.184e5	4.378e5	8.672e4	1.97	1.94
	116	OP Cal 3		Standard	12/31/2017 4:18:21 PM	1.00	OP Morphine 1		100.00	1.167e6	4.685e5	4.768e5	1.98	1.95
	144	OP Cal 4		Standard	12/31/2017 4:24:31 PM	1.00	OP Morphine 1		500.00	5.434e6	4.606e5	2.168e6	1.97	1.95
	172	Blank + IS		Blank	12/31/2017 4:30:40 PM	1.00	OP Morphine 1		N/A	N/A	1.084e6	N/A	N/A	1.94
	200	9709	QC 1 (10 ng/mL)	Quality Control	12/31/2017 4:43:02 PM	1.00	OP Morphine 1		10.00	1.212e5	5.145e5	4.862e4	1.97	1.94
	228	9710	QC 2 (200 ng/mL)	Quality Control	12/31/2017 4:49:12 PM	1.00	OP Morphine 1		199.00	2.354e6	5.006e5	9.375e5	1.97	1.95
	256	Blank + IS		Blank	12/31/2017 4:55:21 PM	1.00	OP Morphine 1		N/A	N/A	1.124e6	N/A	N/A	1.95
	284	36403129A	P10	Unknown	12/31/2017 5:01:32 PM	1.00	OP Morphine 1		N/A	N/A	1.868e5	N/A	N/A	1.98
	312	36403130A	P11	Unknown	12/31/2017 5:07:42 PM	1.00	OP Morphine 1		N/A	N/A	1.840e5	N/A	N/A	1.98
	340	36306028A	P12	Unknown	12/31/2017 5:13:52 PM	1.00	OP Morphine 1		N/A	N/A	2.964e5	N/A	N/A	1.94
-								/						

The driver organizes the different analyte components by the **Test Prefix** or **TP**

The example for the morphine test name is "OP Morphine"

All test names with the prefix "**OP Morphine**" are organized under that test name

Ind	lex	Sample Name	Sample ID	Sample Type	Acquisition Date & Time	Dilution Factor	Component Name	Outlier Reasons	Actual Concentration	Area	IS Area	Height	Retention Time	IS Retention Time
4		Blank		Double Blank	12/31/2017 3:52:26 PM	1.00	OP Morphine 1		N/A	N/A	6.102e0	N/A	N/A	1.95
3	2	Blank + IS		Blank	12/31/2017 3:59:53 PM	1.00	OP Morphine 1		N/A	N/A	1.061e6	N/A	N/A	1.95
6	0	OP Cal 1		Standard	12/31/2017 4:06:03 PM	1.00	OP Morphine 1		5.00	5.147e4	4.411e5	2.106e4	1.98	1.95
8	8	OP Cal 2		Standard	12/31/2017 4:12:10 PM	1.00	OP Morphine 1		20.00	2.184e5	4.378e5	8.672e4	1.97	1.94
1	16	OP Cal 3		Standard	12/31/2017 4:18:21 PM	1.00	OP Morphine 1		100.00	1.167e6	4.685e5	4.768e5	1.98	1.95
1	44	OP Cal 4		Standard	12/31/2017 4:24:31 PM	1.00	OP Morphine 1		500.00	5.434e6	4.606e5	2.168e6	1.97	1.95
1	72	Blank + IS		Blank	12/31/2017 4:30:40 PM	1.00	OP Morphine 1		N/A	N/A	1.084e6	N/A	N/A	1.94
2	00	9709	QC 1 (10 ng/mL)	Quality Control	12/31/2017 4:43:02 PM	1.00	OP Morphine 1		10.00	1.212e5	5.145e5	4.862e4	1.97	1.94
2	28	9710	QC 2 (200 ng/mL)	Quality Control	12/31/2017 4:49:12 PM	1.00	OP Morphine 1		199.00	2.354e6	5.006e5	9.375e5	1.97	1.95
2	56	Blank + IS		Blank	12/31/2017 4:55:21 PM	1.00	OP Morphine 1		N/A	N/A	1.124e6	N/A	N/A	1.95
2	84	36403129A	P10	Unknown	12/31/2017 5:01:32 PM	1.00	OP Morphine 1		N/A	N/A	1.868e5	N/A	N/A	1.98
3	12	36403130A	P11	Unknown	12/31/2017 5:07:42 PM	1.00	OP Morphine 1		N/A	N/A	1.840e5	N/A	N/A	1.98
3	40	36306028A	P12	Unknown	12/31/2017 5:13:52 PM	1.00	OP Morphine 1		N/A	N/A	2.964e5	N/A	N/A	1.94

*OP Morphine 1 is a different test component than OP Morphine 2

The driver then looks for all calibrators which are specified by the calibrator type prefix or CTP

This example would be for opiates "OP CAL"

All sample names with the prefix "**OP CAL**" are identified as calibrators

Index	Sample Name	Sample ID	Sample Type	Acquisition Date & Time	Dilution Factor	Component Name	Outlier Reasons	Actual Concentration	Area	IS Area	Height	Retention Time	IS Retention Time
4	Blank		Double Blank	12/31/2017 3:52:26 PM	1.00	OP Morphine 1		N/A	N/A	6.102e0	N/A	N/A	1.95
32	Plank - IS		Blank	12/31/2017 3:59:53 PM	1.00	OP Morphine 1		N/A	N/A	1.061e6	N/A	N/A	1.95
60	OP Cal 1		Standard	12/31/2017 4:06:03 PM	1.00	OP Morphine 1		5.00	5.147e4	4.411e5	2.106e4	1.98	1.95
88	OP Cal 2		Standard	12/31/2017 4:12:10 PM	1.00	OP Morphine 1		20.00	2.184e5	4.378e5	8.672e4	1.97	1.94
116	OP Cal 3		Standard	12/31/2017 4:18:21 PM	1.00	OP Morphine 1		100.00	1.167e6	4.685e5	4.768e5	1.98	1.95
144	OP Cal 4		Standard	12/31/2017 4:24:31 PM	1.00	OP Morphine 1		500.00	5.434e6	4.606e5	2.168e6	1.97	1.95
172	Blank + IS		Blank	12/31/2017 4:30:40 PM	1.00	OP Morphine 1		N/A	N/A	1.084e6	N/A	N/A	1.94
200	9709	QC 1 (10 ng/mL)	Quality Control	12/31/2017 4:43:02 PM	1.00	OP Morphine 1		10.00	1.212e5	5.145e5	4.862e4	1.97	1.94
228	9710	QC 2 (200 ng/mL)	Quality Control	12/31/2017 4:49:12 PM	1.00	OP Morphine 1		199.00	2.354e6	5.006e5	9.375e5	1.97	1.95
256	Blank + IS		Blank	12/31/2017 4:55:21 PM	1.00	OP Morphine 1		N/A	N/A	1.124e6	N/A	N/A	1.95
284	36403129A	P10	Unknown	12/31/2017 5:01:32 PM	1.00	OP Morphine 1		N/A	N/A	1.868e5	N/A	N/A	1.98
312	36403130A	P11	Unknown	12/31/2017 5:07:42 PM	1.00	OP Morphine 1		N/A	N/A	1.840e5	N/A	N/A	1.98
340	36306028A	P12	Unknown	12/31/2017 5:13:52 PM	1.00	OP Morphine 1		N/A	N/A	2.964e5	N/A	N/A	1.94

Test elements which are delivered to the driver by the report template can be:

Selected for further calculations

	Index	Sample Name	Sample ID	Sample Type	Acquisition Date & Time	Dilution Factor	Component Name	Outlier Reasons	Actual Concentration	Area	IS Area	Height	Retention Time	IS Retention Time
	4	Blank		Double Blank	12/31/2017 3:52:26 PM	1.00	OP Morphine 1		N/A	N/A	6.102e0	N/A	N/A	1.95
	32	Blank + IS		Blank	12/31/2017 3:59:53 PM	1.00	OP Morphine 1		N/A	N/A	1.061e6	N/A	N/A	1.95
	60	OP Cal 1		Standard	12/31/2017 4:06:03 PM	1.00	OP Morphine 1		5.00	5.147e4	4.411e5	2.106e4	1.98	1.95
	88	OP Cal 2		Standard	12/31/2017 4:12:10 PM	1.00	OP Morphine 1		20.00	2.184e5	4.378e5	8.672e4	1.97	1.94
	116	OP Cal 3		Standard	12/31/2017 4:18:21 PM	1.00	OP Morphine 1		100.00	1.167e6	4.685e5	4.768e5	1.98	1.95
	144	OP Cal 4		Standard	12/31/2017 4:24:31 PM	1.00	OP Morphine 1		500.00	5.434e6	4.606e5	2.168e6	1.97	1.95
	172	Blank + IS		Blank	12/31/2017 4:30:40 PM	1.00	OP Morphine 1		N/A	N/A	1.084e6	N/A	N/A	1.94
	200	9709	QC 1 (10 ng/mL)	Quality Control	12/31/2017 4:43:02 PM	1.00	OP Morphine 1		10.00	1.212e5	5.145e5	4.862e4	1.97	1.94
	228	9710	QC 2 (200 ng/mL)	Quality Control	12/31/2017 4:49:12 PM	1.00	OP Morphine 1		199.00	2.354e6	5.006e5	9.375e5	1.97	1.95
	256	Blank + IS		Blank	12/31/2017 4:55:21 PM	1.00	OP Morphine 1		N/A	N/A	1.124e6	N/A	N/A	1.95
	284	36403129A	P10	Unknown	12/31/2017 5:01:32 PM	1.00	OP Morphine 1		N/A	N/A	1.868e5	N/A	N/A	1.98
	312	36403130A	P11	Unknown	12/31/2017 5:07:42 PM	1.00	OP Morphine 1		N/A	N/A	1.840e5	N/A	N/A	1.98
	340	36306028A	P12	Unknown	12/31/2017 5:13:52 PM	1.00	OP Morphine 1		N/A	N/A	2.964e5	N/A	N/A	1.94
-														

Test elements which are delivered to the driver by the report template can be:

Ignored.

Index	Sample Name	Sample ID	Sample Type	Acquisition Date & Time	Dilution Factor	Component Name	Outlier Reasons	Actual Concentration	Area	IS Area	Height	Retention Time	IS Retention Time
4	Blank		Double Blank	12/31/2017 3:52:26 PM	1.00	OP Morphine 1		N/A	N/A	6.102e0	N/A	N/A	1.95
32	Blank + IS		Blank	12/31/2017 3:59:53 PM	1.00	OP Morphine 1		N/A	N/A	1.061e6	N/A	N/A	1.95
60	OP Cal 1		Standard	12/31/2017 4:06:03 PM	1.00	OP Morphine 1		5.00	5.147e4	4.411e5	2.106e4	1.98	1.95
88	OP Cal 2		Standard	12/31/2017 4:12:10 PM	1.00	OP Morphine 1		20.00	2.184e5	4.378e5	8.672e4	1.97	1.94
116	OP Cal 3		Standard	12/31/2017 4:18:21 PM	1.00	OP Morphine 1		100.00	1.167e6	4.685e5	4.768e5	1.98	1.95
144	OP Cal 4		Standard	12/31/2017 4:24:31 PM	1.00	OP Morphine 1		500.00	5.434e6	4.606e5	2.168e6	1.97	1.95
172	Blank + IS		Blank	12/31/2017 4:30:40 PM	1.00	OP Morphine 1		N/A	N/A	1.084e6	N/A	N/A	1.94
200	9709	QC 1 (10 ng/mL)	Quality Control	12/31/2017 4:43:02 PM	1.00	OP Morphine 1		10.00	1.212e5	5.145e5	4.862e4	1.97	1.94
228	9710	QC 2 (200 ng/mL)	Quality Control	12/31/2017 4:49:12 PM	1.00	OP Morphine 1		199.00	2.354e6	5.006e5	9.375e5	1.97	1.95
256	Blank + IS		Blank	12/31/2017 4:55:21 PM	1.00	OP Morphine 1		N/A	N/A	1.124e6	N/A	N/A	1.95
284	36403129A	P10	Unknown	12/31/2017 5:01:32 PM	1.00	OP Morphine 1		N/A	N/A	1.868e5	N/A	N/A	1.98
312	36403130A	P11	Unknown	12/31/2017 5:07:42 PM	1.00	OP Morphine 1		N/A	N/A	1.840e5	N/A	N/A	1.98
340	36306028A	P12	Unknown	12/31/2017 5:13:52 PM	1.00	OP Morphine 1		N/A	N/A	2.964e5	N/A	N/A	1.94
	:												