Automated Data Analysis Of Clinical Mass Spectrometry Results

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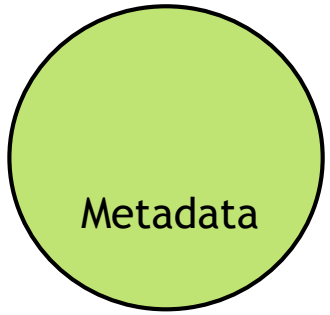
Providence Regional Laboratories

Confusing Language



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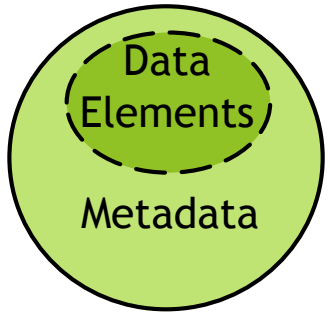

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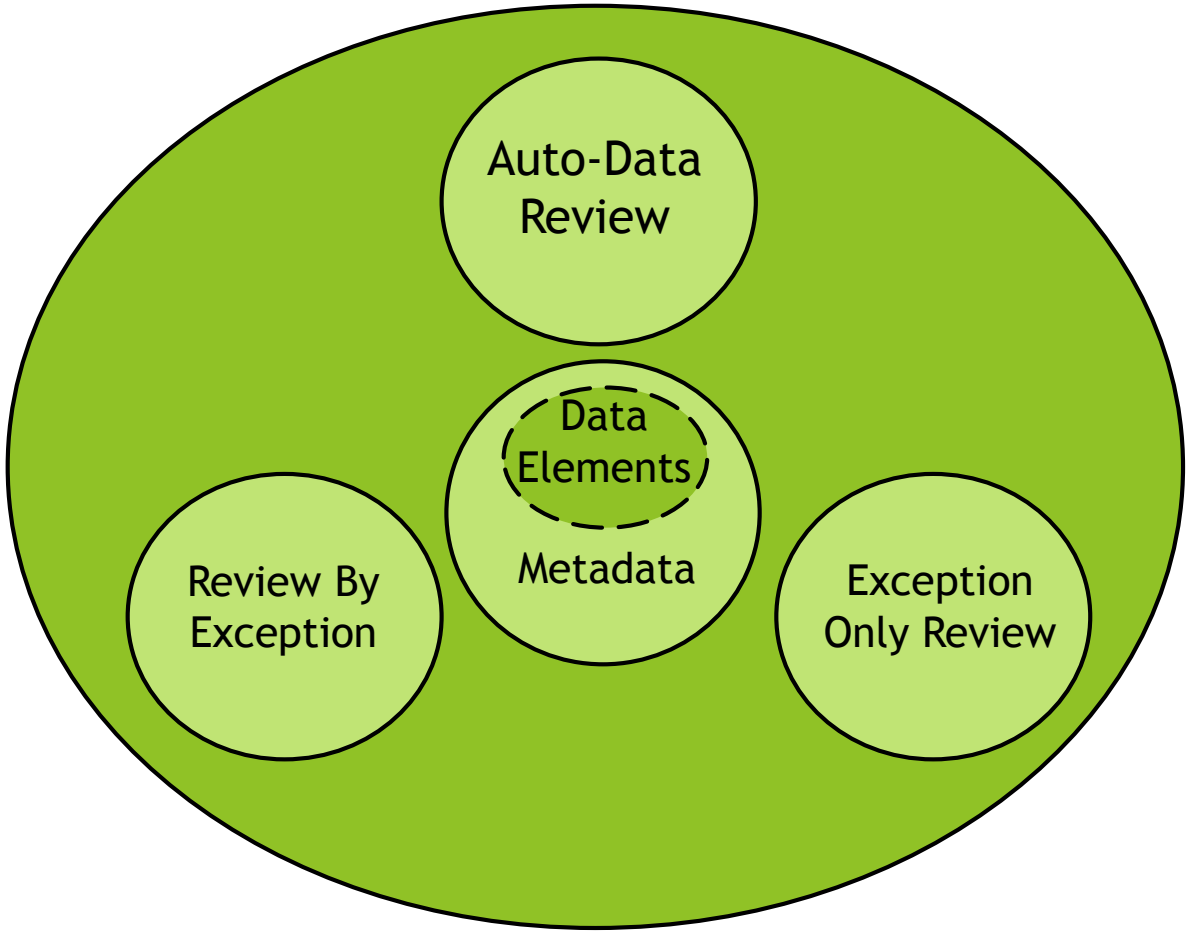

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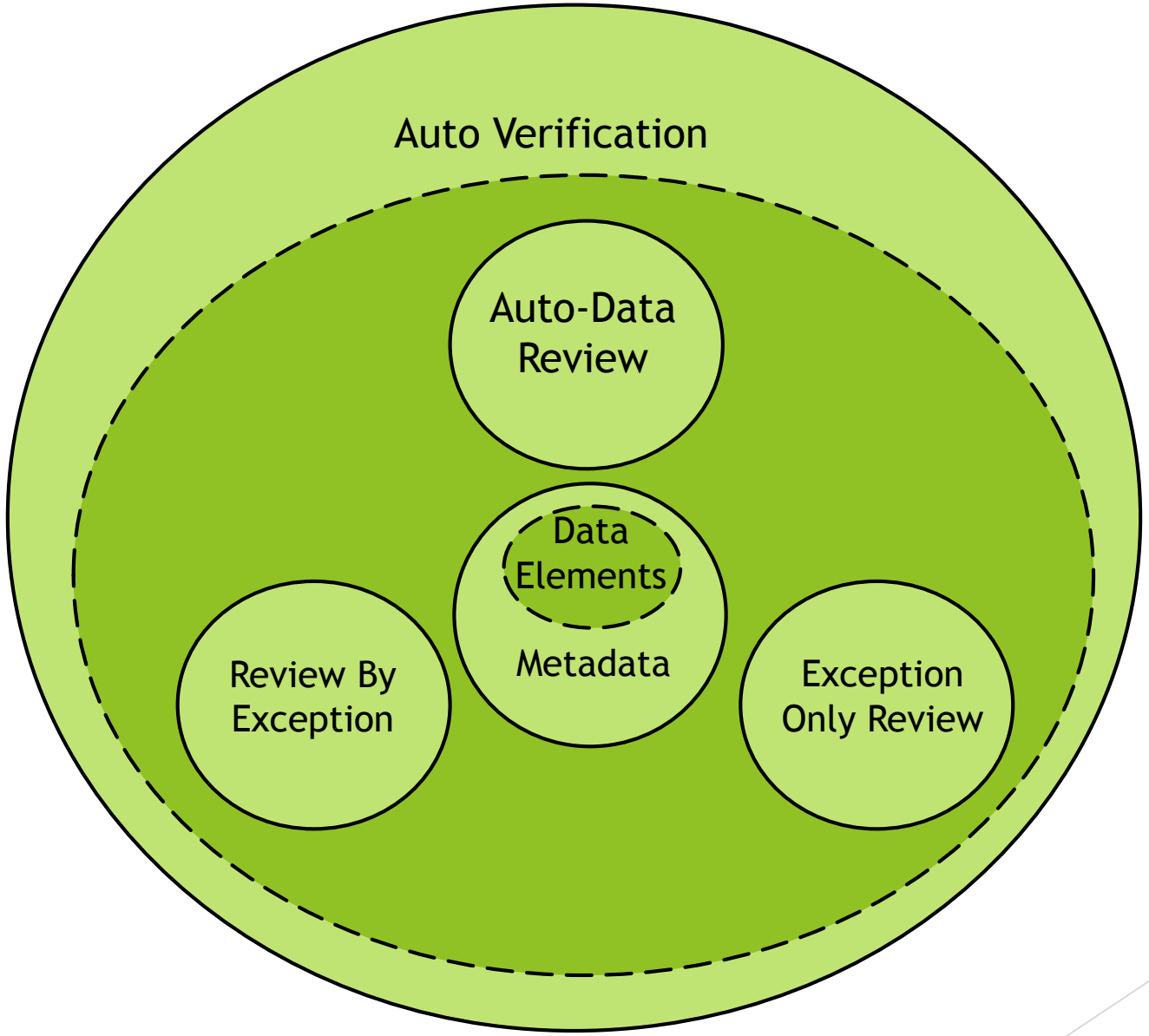

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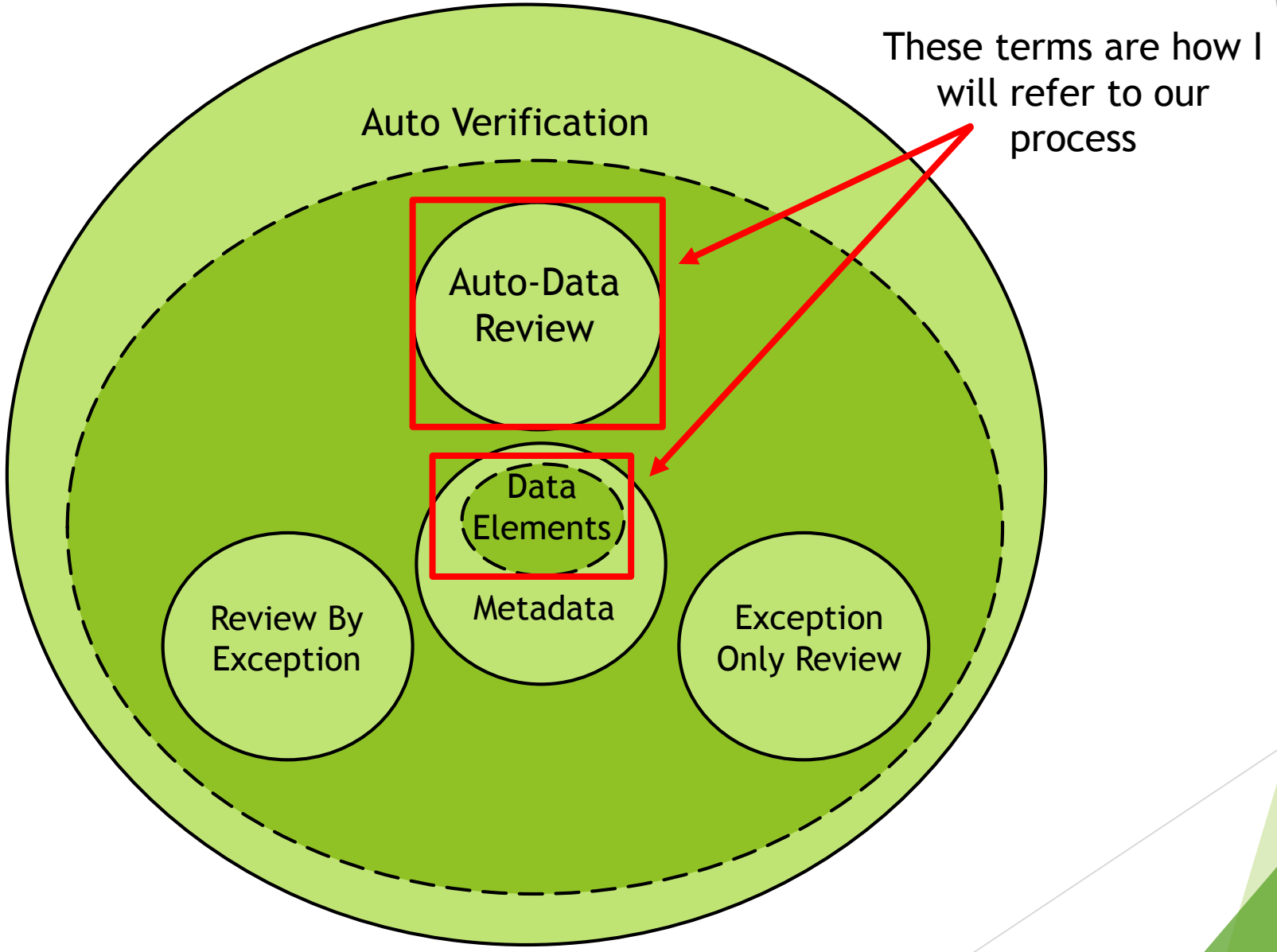

Mass Spec Terms To Know

- **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

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→ Why is this a problem with mass spec data?

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→ Because there are so many data elements to manually review!

How Many Data Elements Need Manual Review In A Typical Mass Spectrometry Assay?

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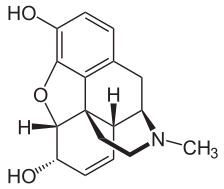
BATCH =

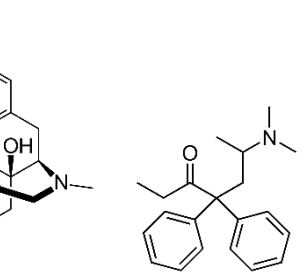
40 Samples
Per Batch

How Many Data Elements Need Manual Review In A Typical Mass Spectrometry Assay?

BATCH =

X





40 Samples
Per Batch

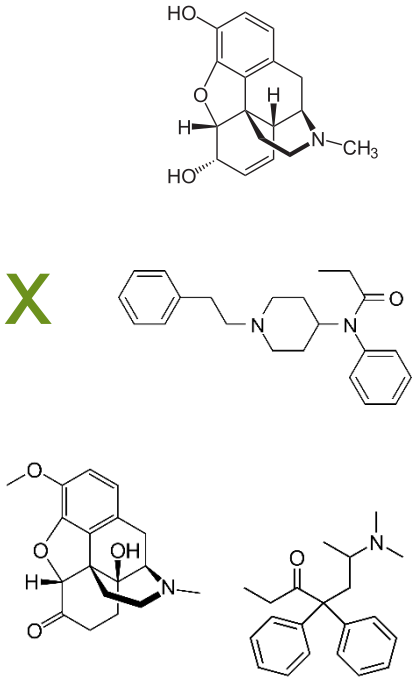
10 Analytes
Per Sample

How Many Data Elements Need Manual Review In A Typical Mass Spectrometry Assay?

BATCH =

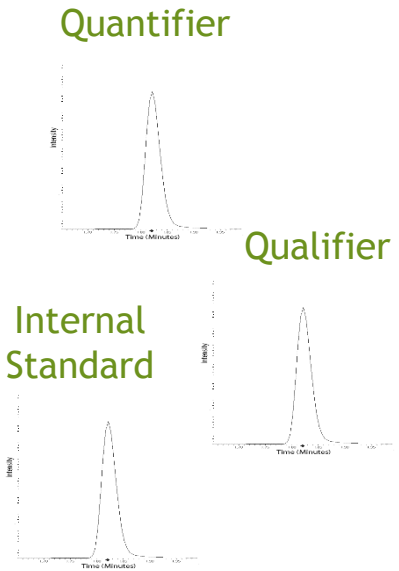
40 Samples Per Batch

x



10 Analytes Per Sample

x



3 Peaks Per Analyte

How Many Data Elements Need Manual Review In A Typical Mass Spectrometry Assay?

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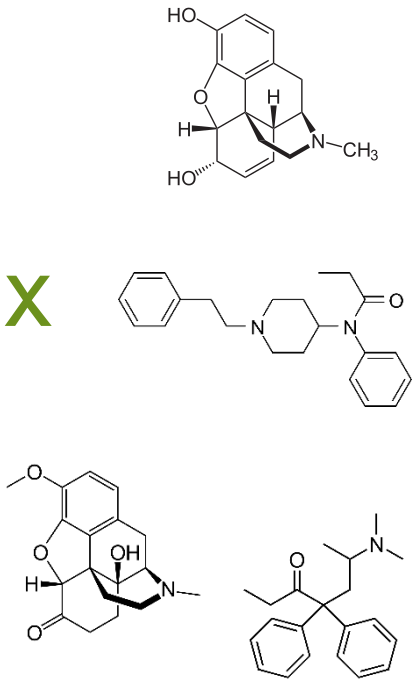
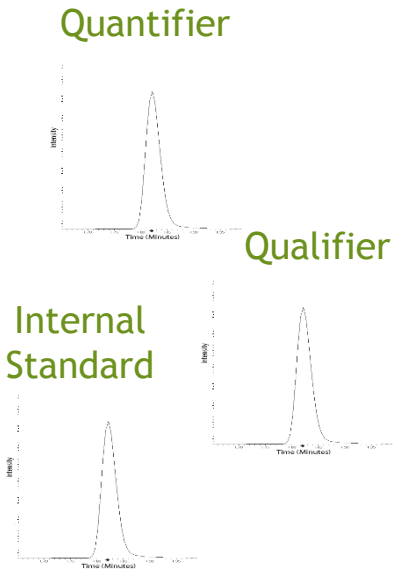
40 Samples Per Batch

x



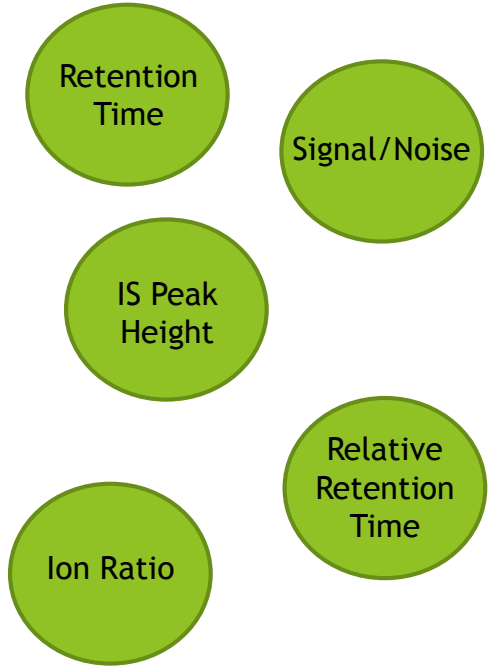
10 Analytes Per Sample

x



3 Peaks Per Analyte

x

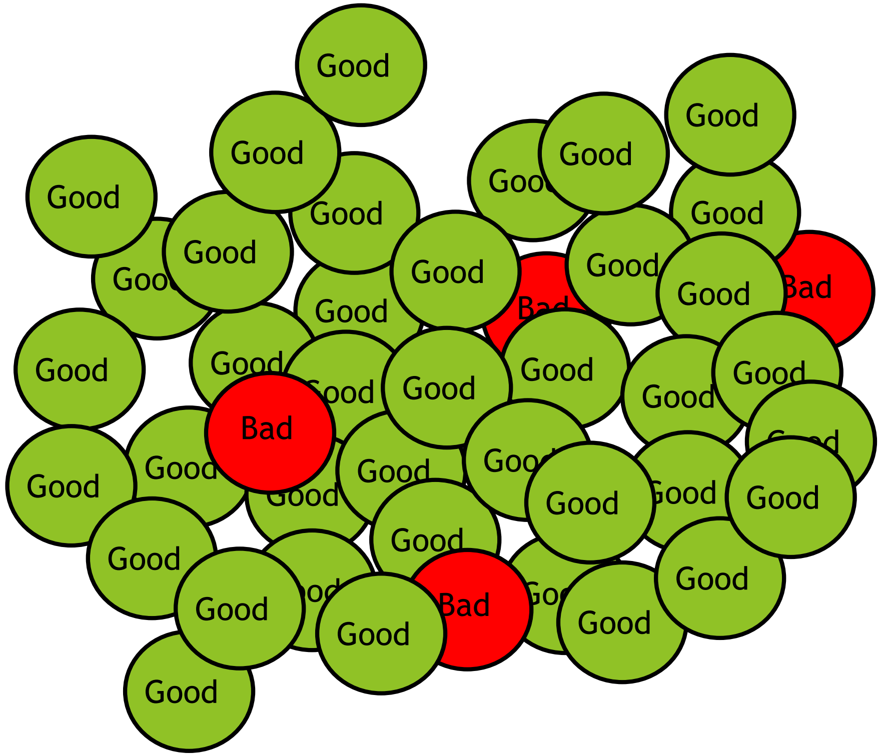


9 Data Elements Per Peak

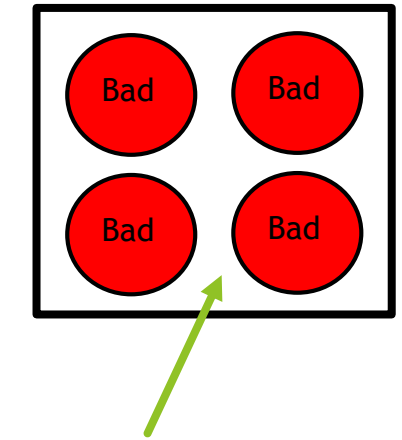
How Many Data Elements Need Manual Review In A Typical Mass Spectrometry Assay?

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

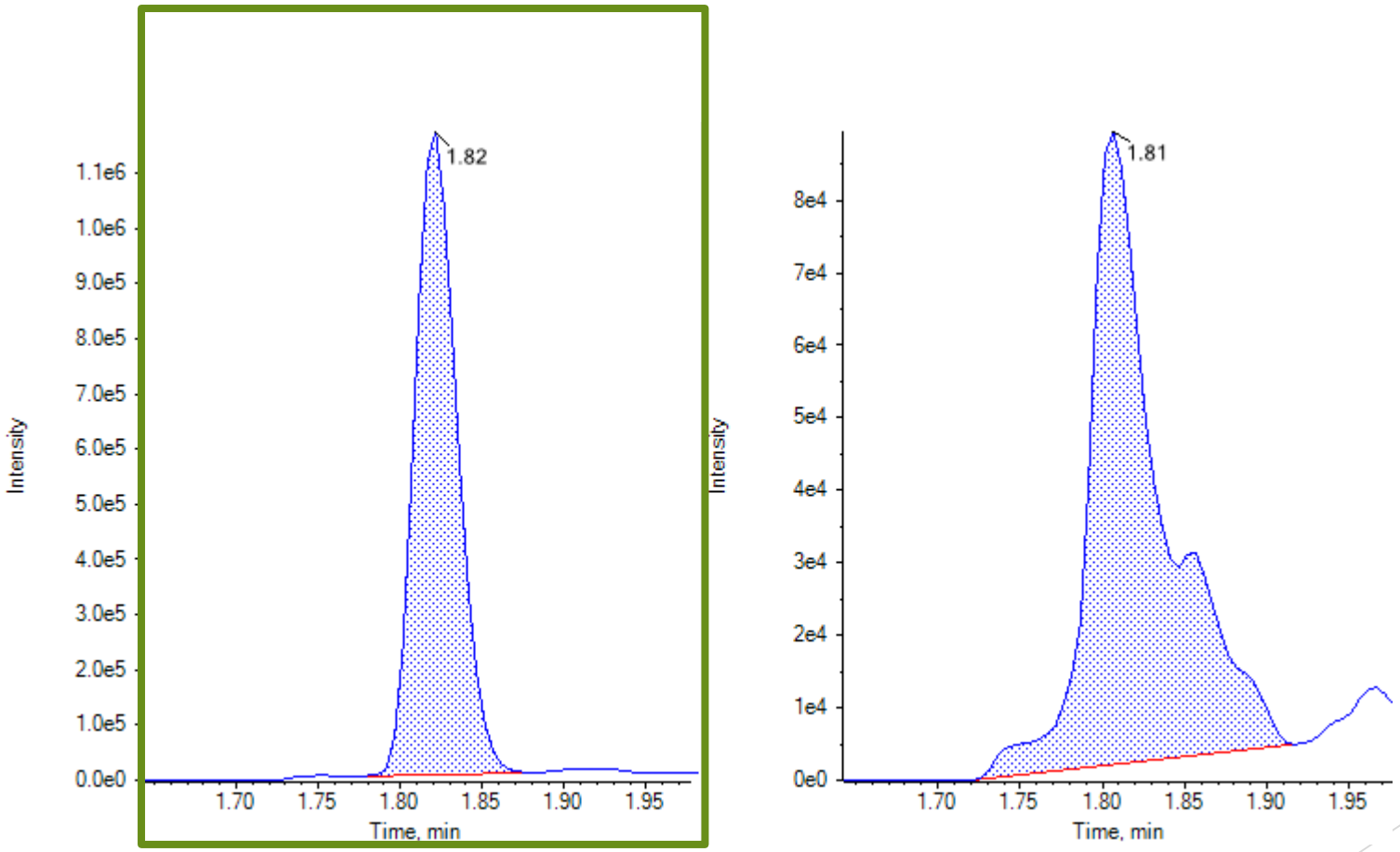
We Want To Filter The Jumble Of Data



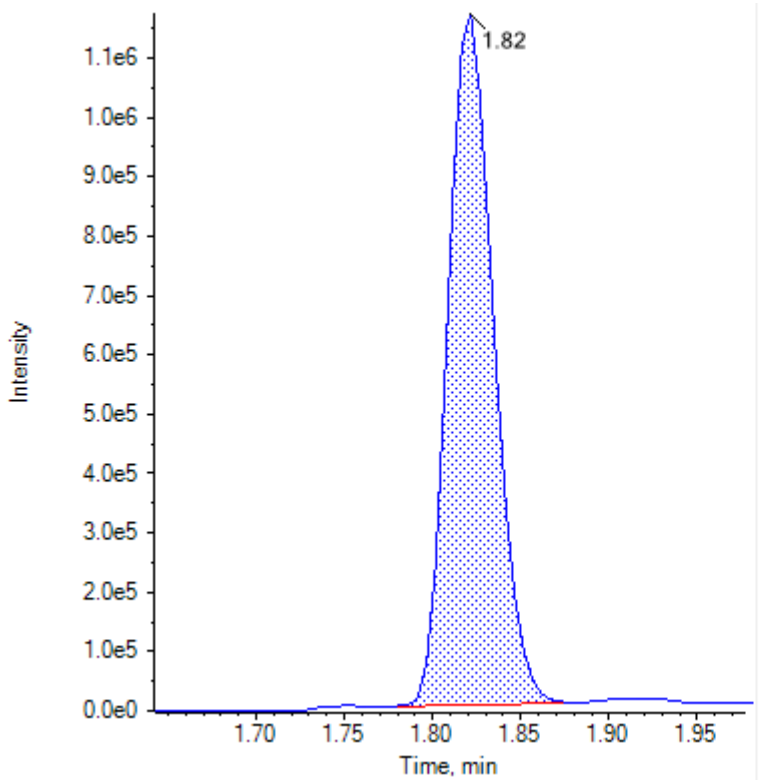
To Focus On Only The Bad Data!

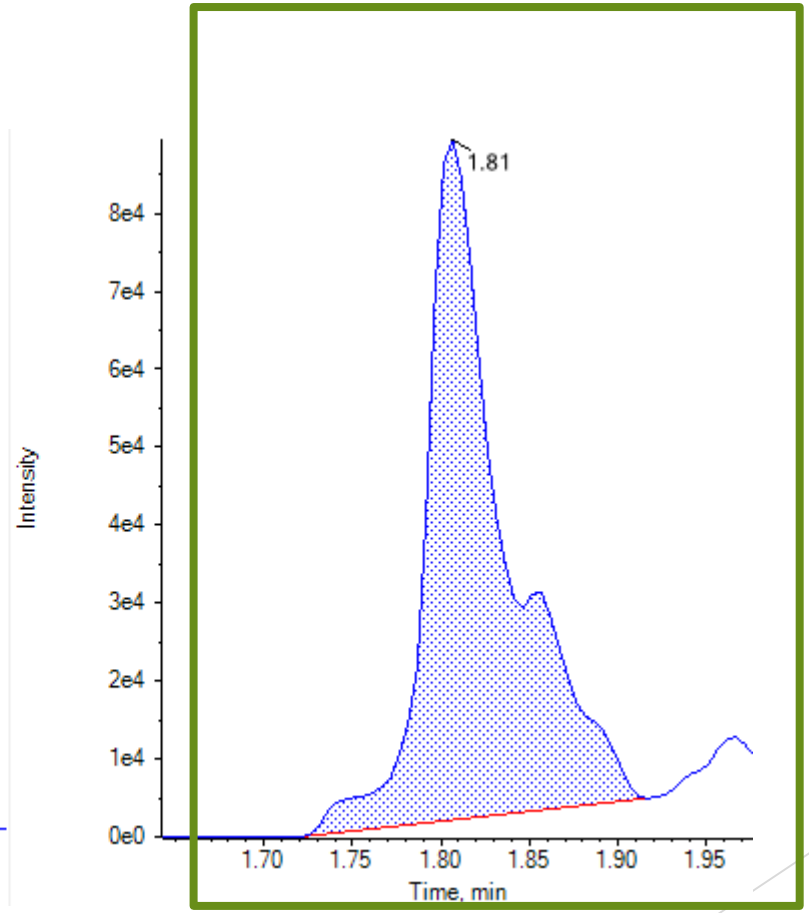


We Want To Bypass This

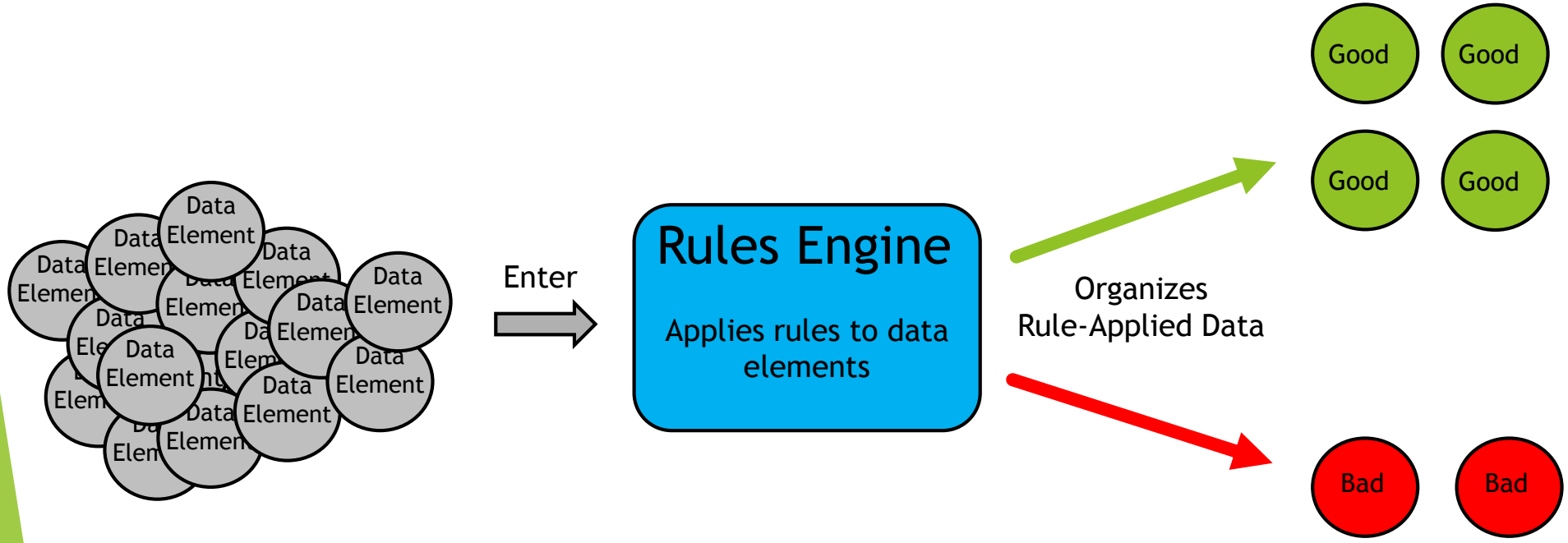


But Capture This

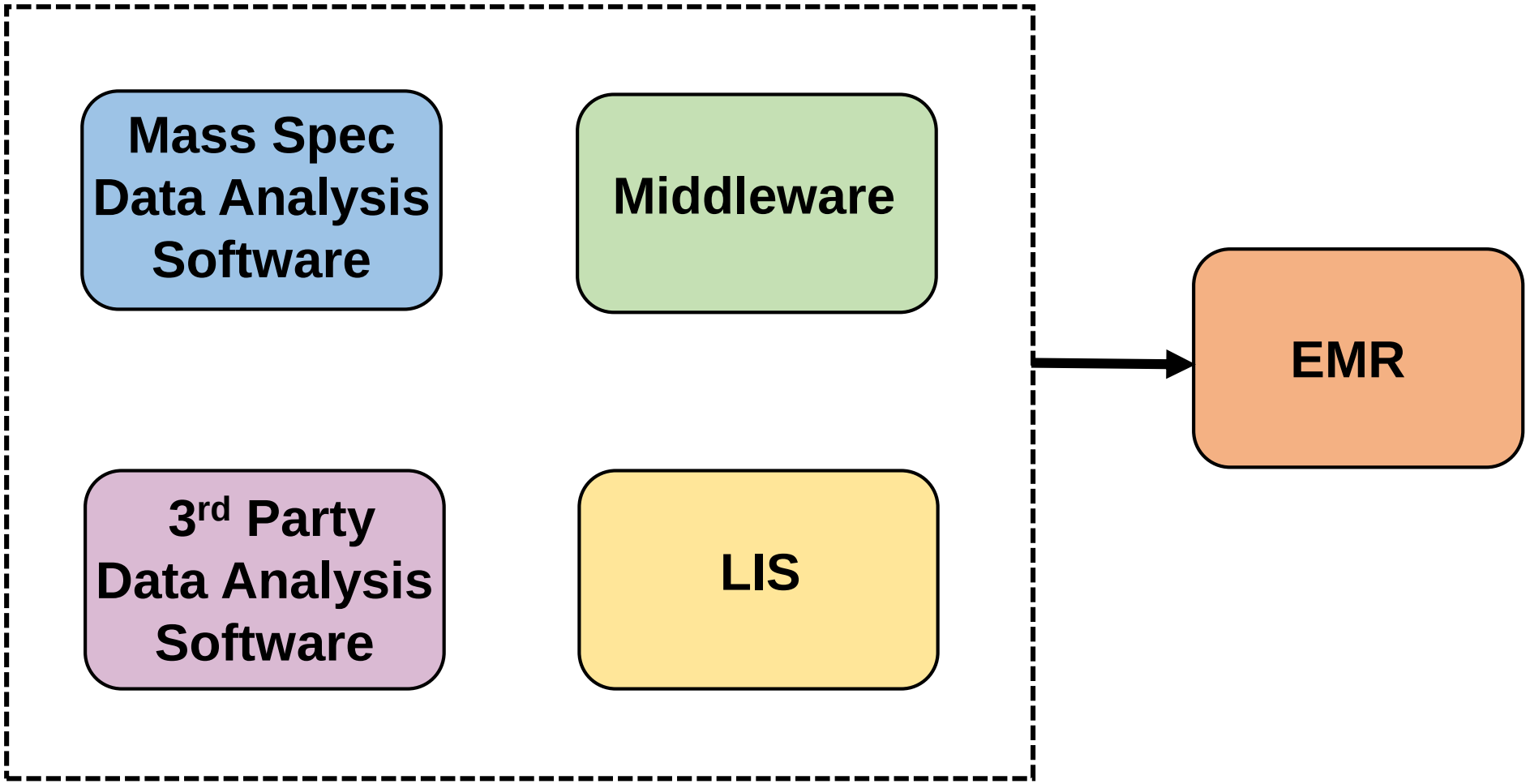




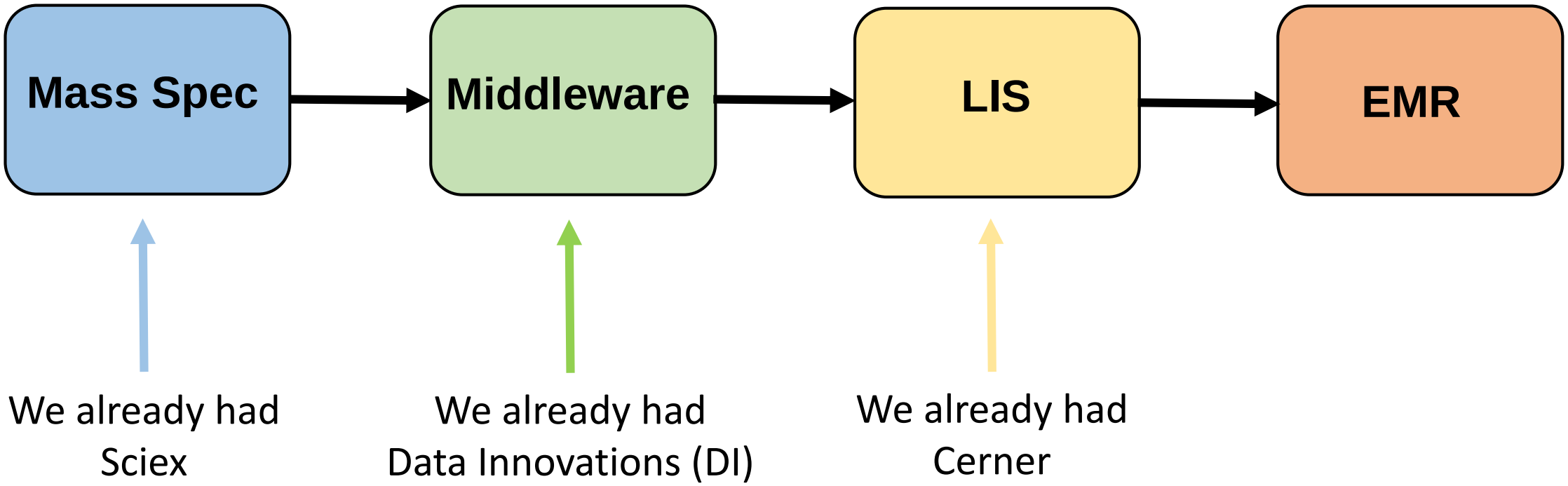
This Is Where A Rules Engine Can Mitigate Manual Data Review



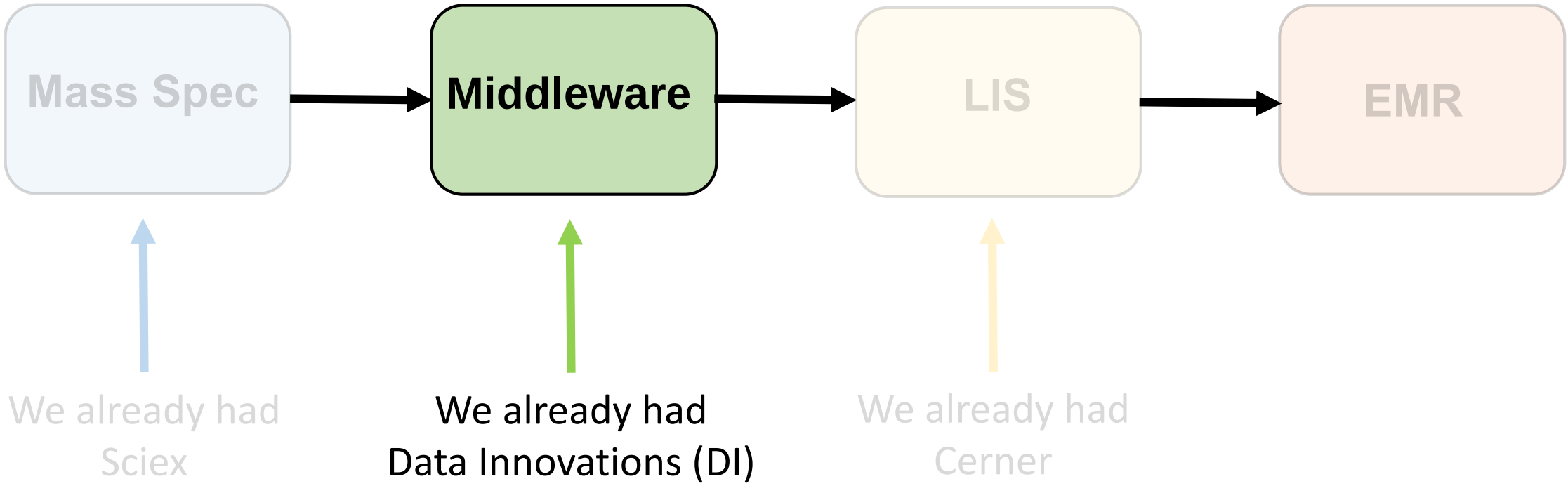
Where Can A Rules Engine Live?



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

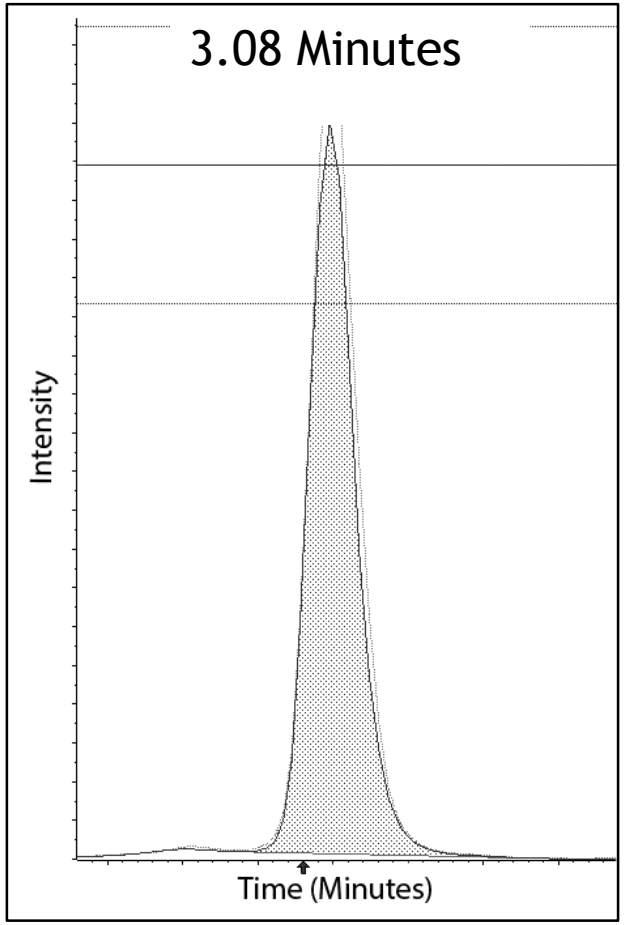
But…It Gets Complicated…

- 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

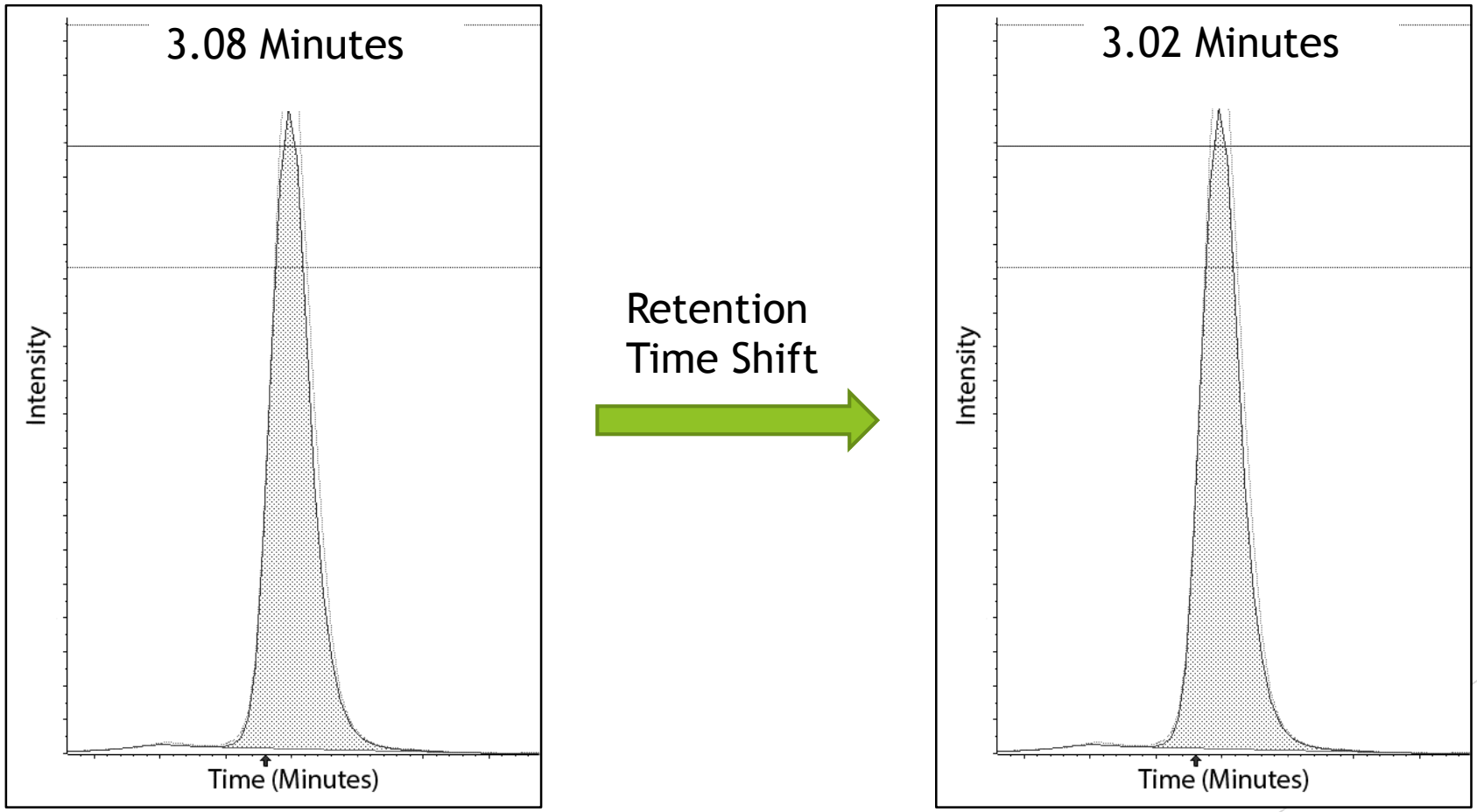
Example Of This Dynamic Process Is Retention Time

- 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

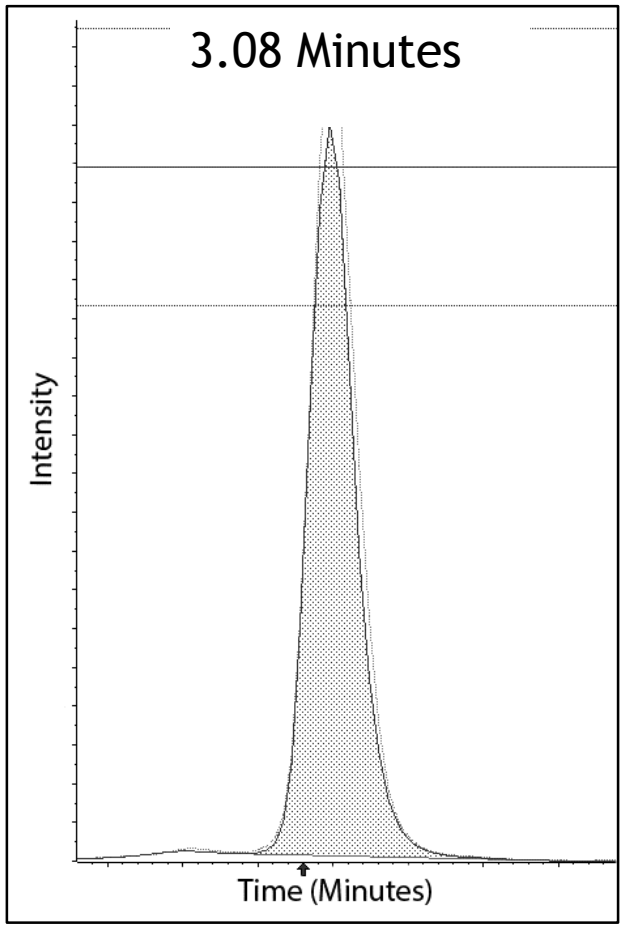


3 months later…Column Is Replaced

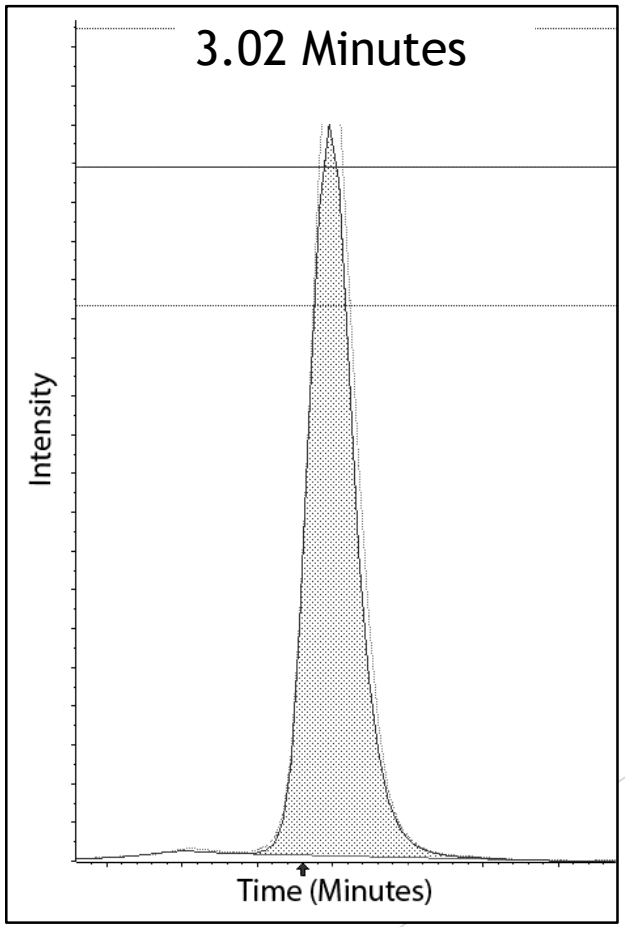


3 months later…Column Is Replaced

All samples containing
Morphine IS now fail that rule

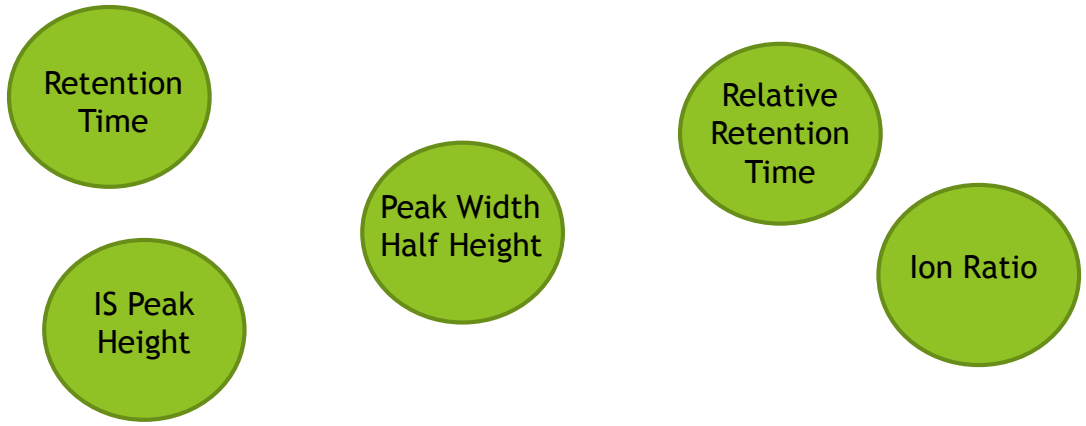


Retention
Time Shift



What Could Be Used To Generate Dynamic Rules?

- Calibrators! Because they calibrate more than just the value!



- Therefore the calibrators are intrinsically dynamic!

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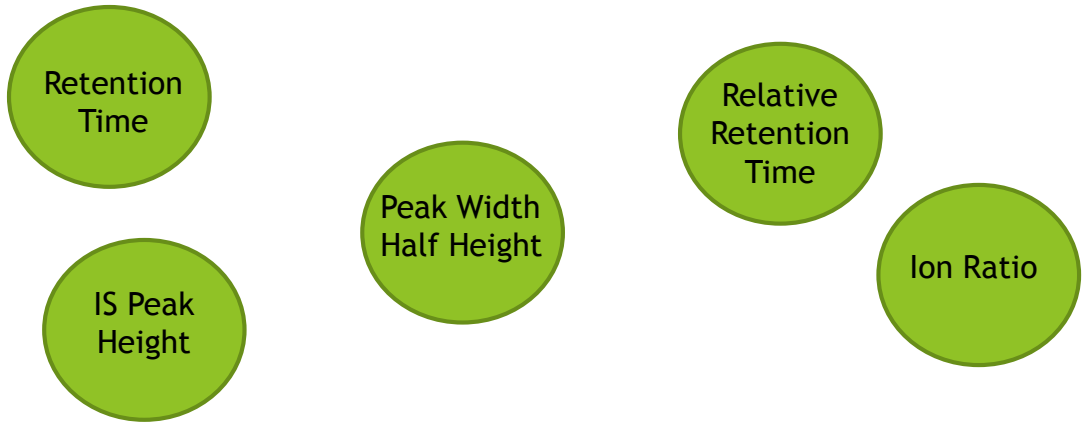
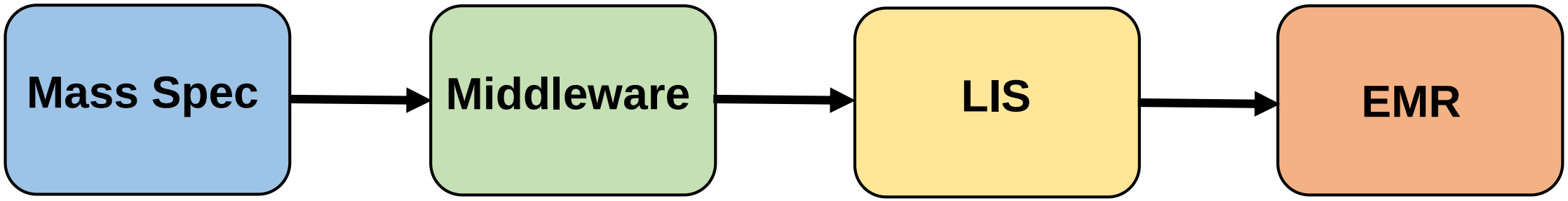


- Therefore the calibrators are intrinsically dynamic!

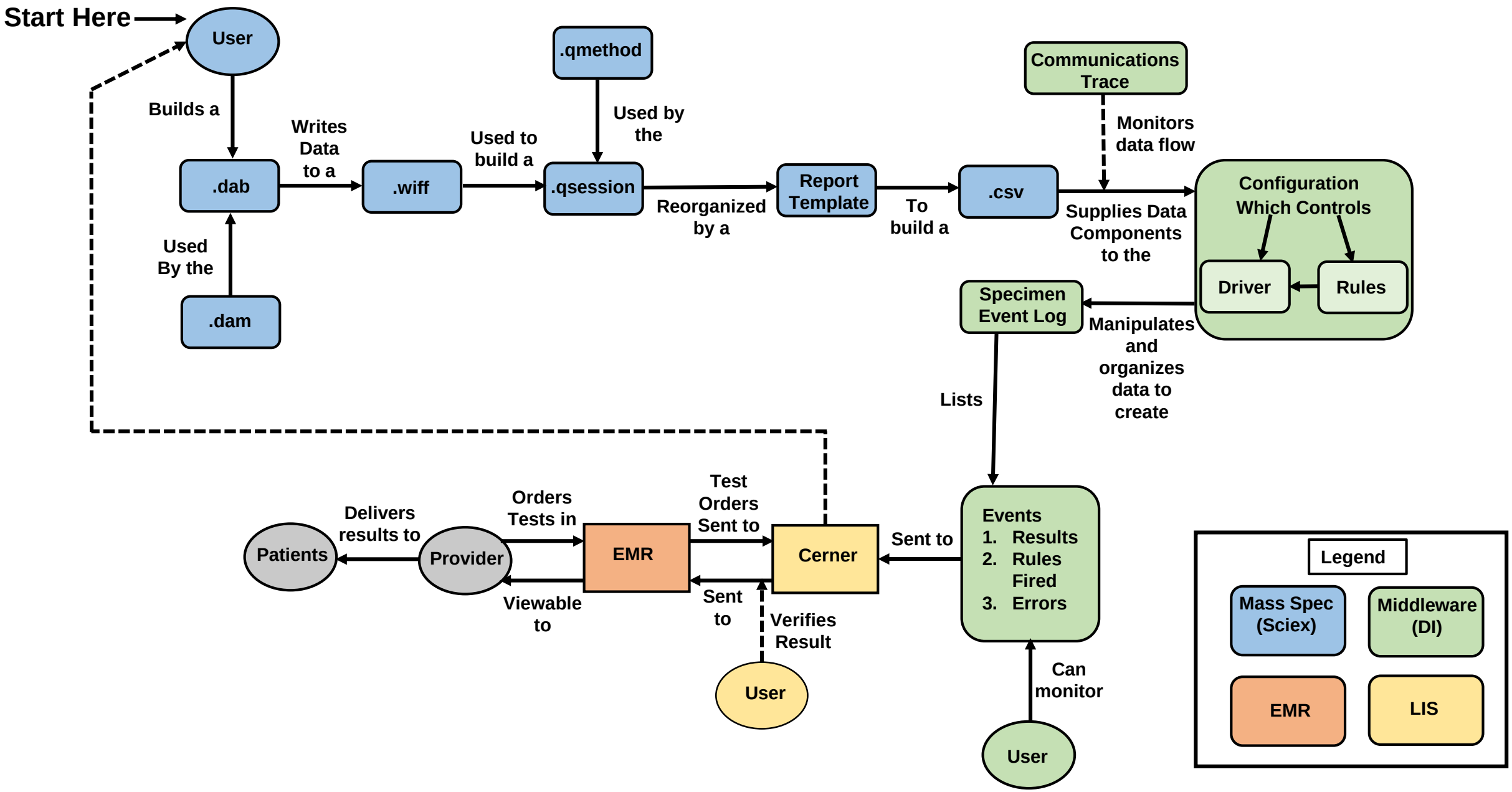
We can capitalize on that!

By averaging calibrator data elements!!

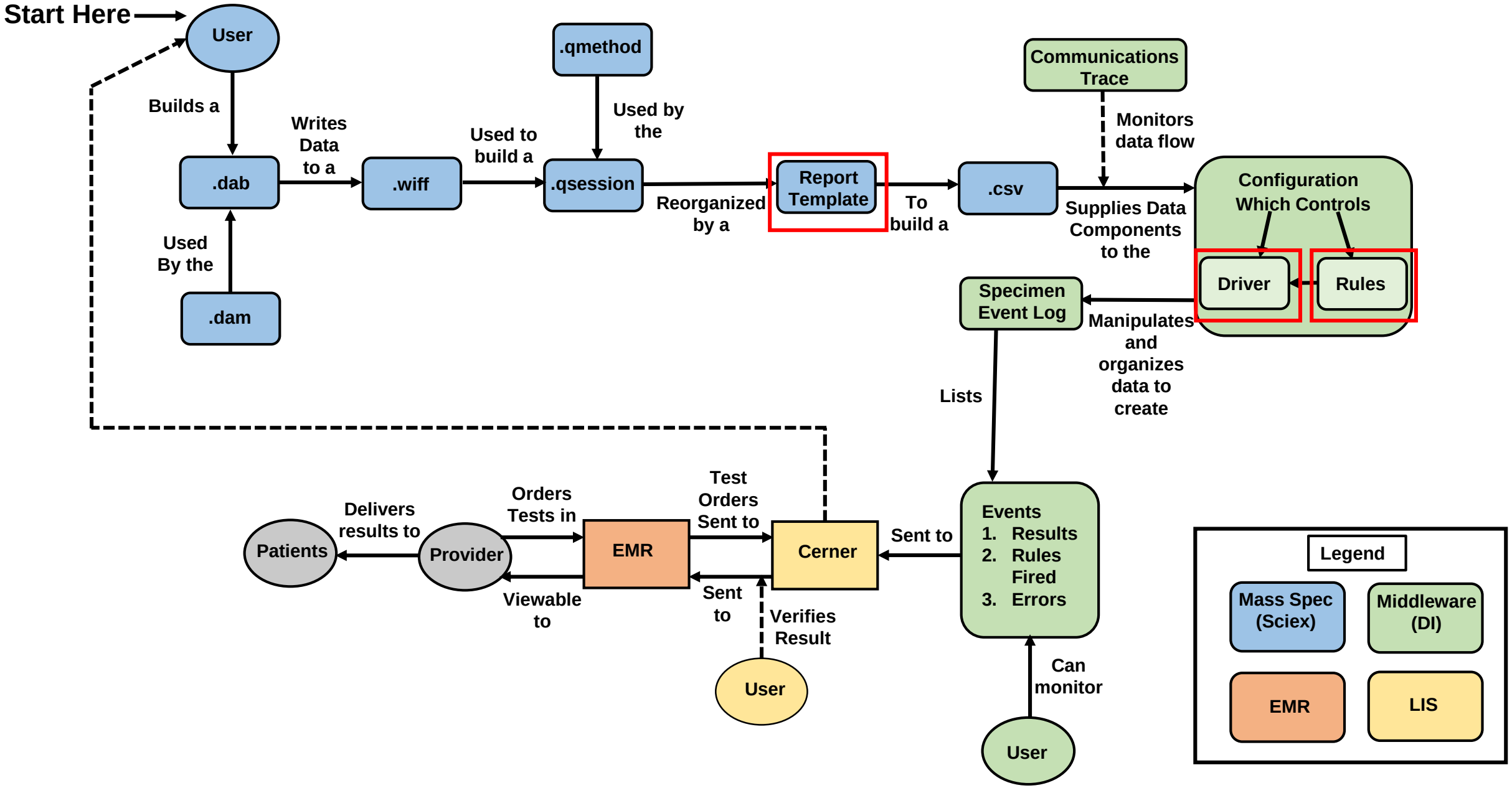
The Simple Workflow The End-User Sees



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}"
CalculatedConcentration="{Calculated Concentration}{CalculatedConcentration}"
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}{ExpectedMRMAreaRatio}"
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

What Makes This Driver Special?

- OP CAL 1
  - Morphine
    - Value 5 ng/mL
    - IS Retention Time 3.08
- OP CAL 2
  - Morphine
    - Value 10 ng/mL
    - IS Retention Time 3.07
- OP CAL 3
  - Morphine
    - Value 50 ng/mL
    - IS Retention Time 3.06
- OP CAL 4
  - Morphine
    - Value 100 ng/mL
    - IS Retention Time 3.07

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What Makes This Driver Special?

- 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

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Create a Report Template to send data elements to DI ✓

Create a DI driver which can average data elements from calibrators ✓

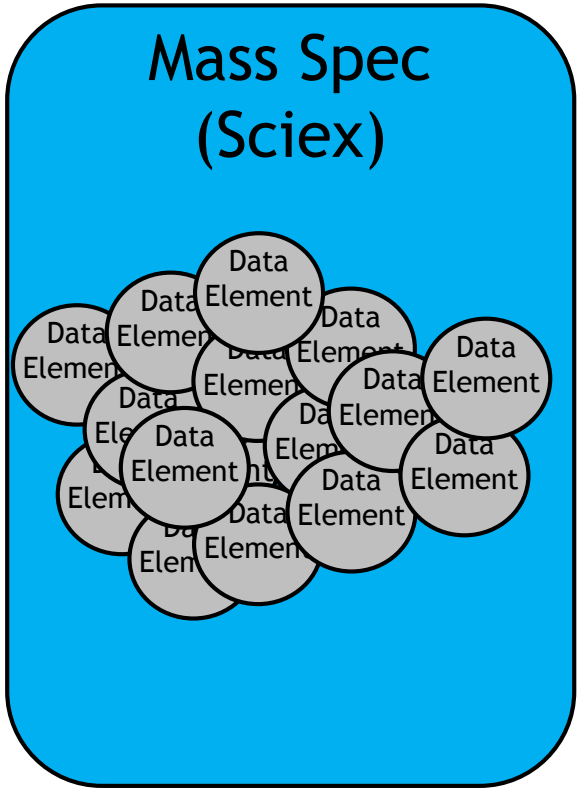
Have DI Driver place each calibrator data element average under each patient sample ✓

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!

What Does This Workflow Now Look Like?



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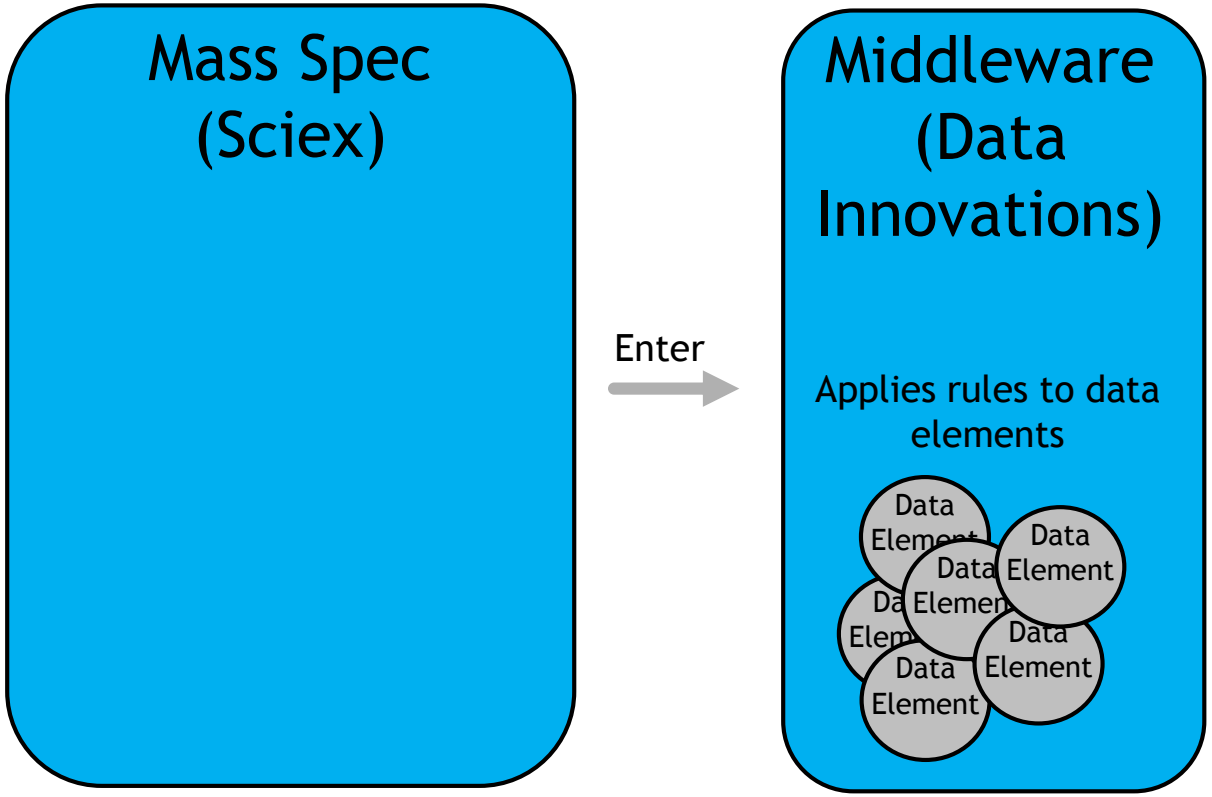

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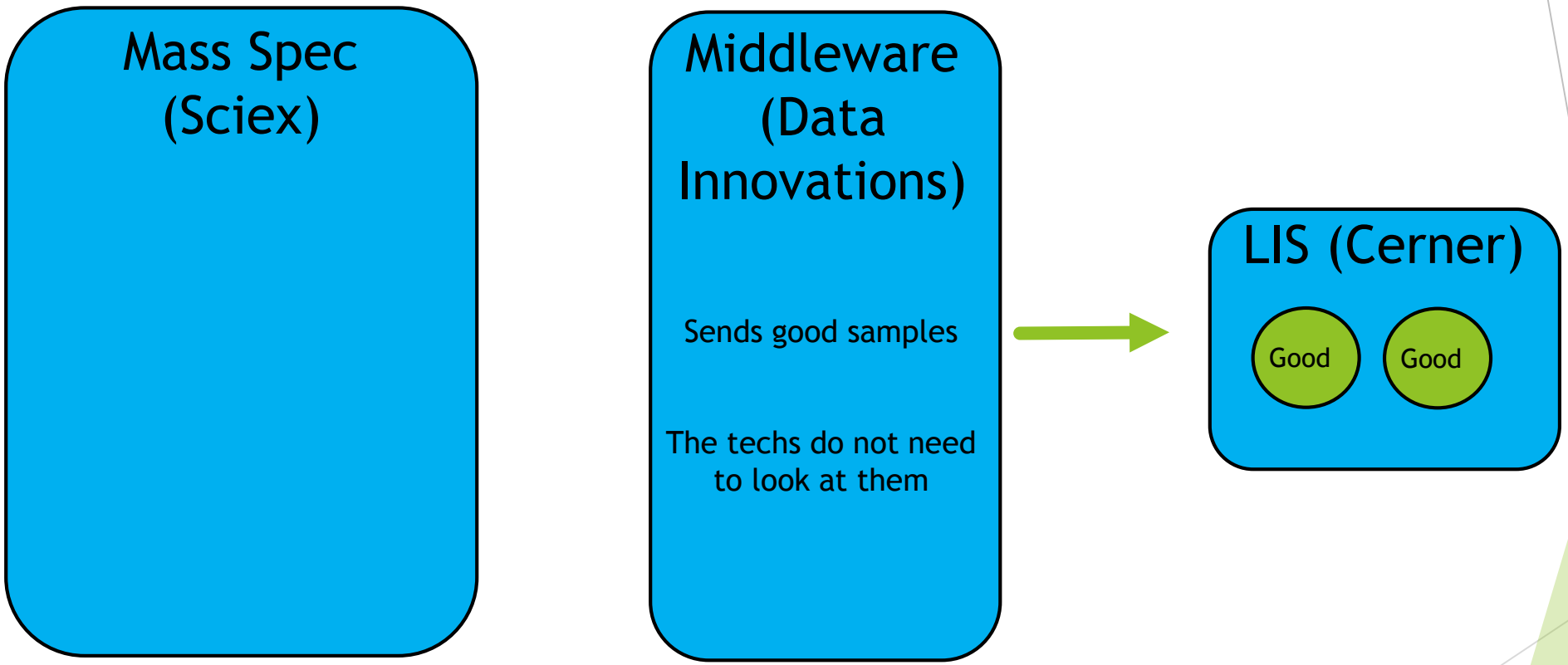

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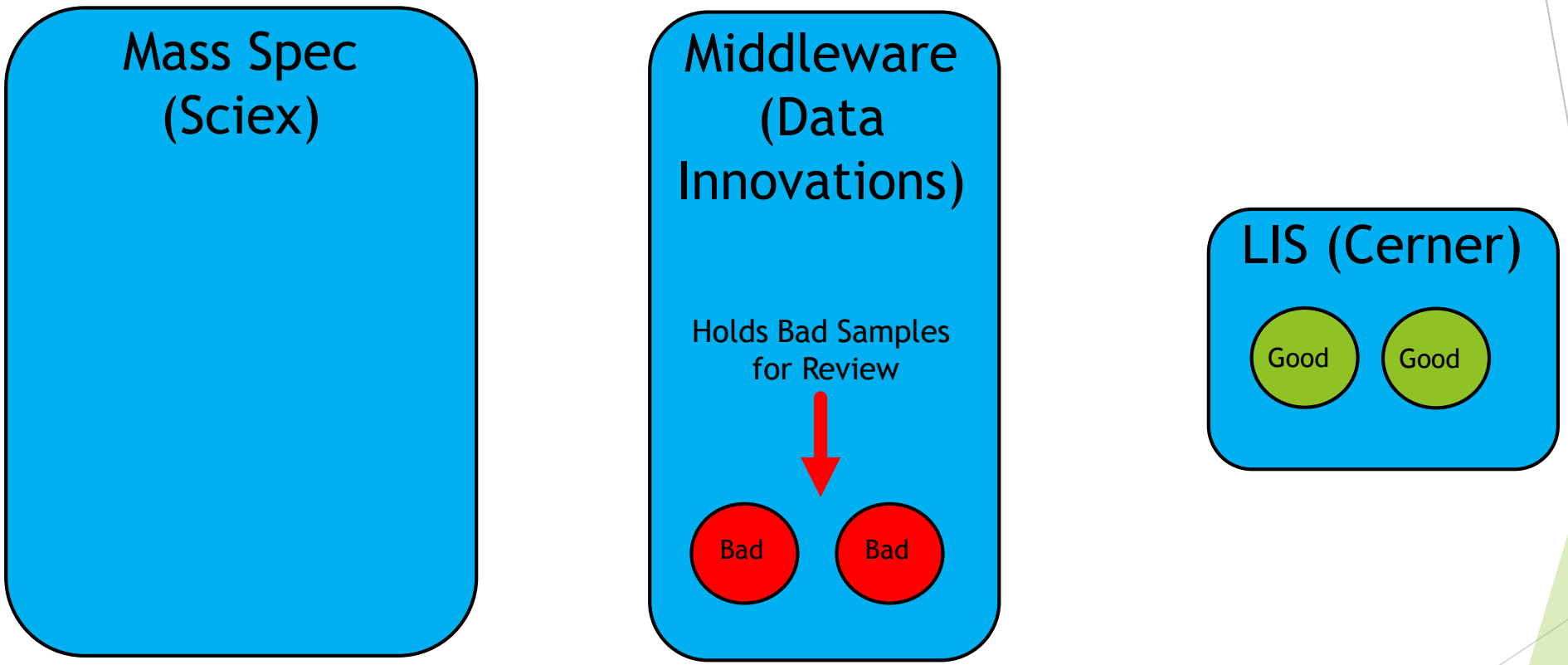

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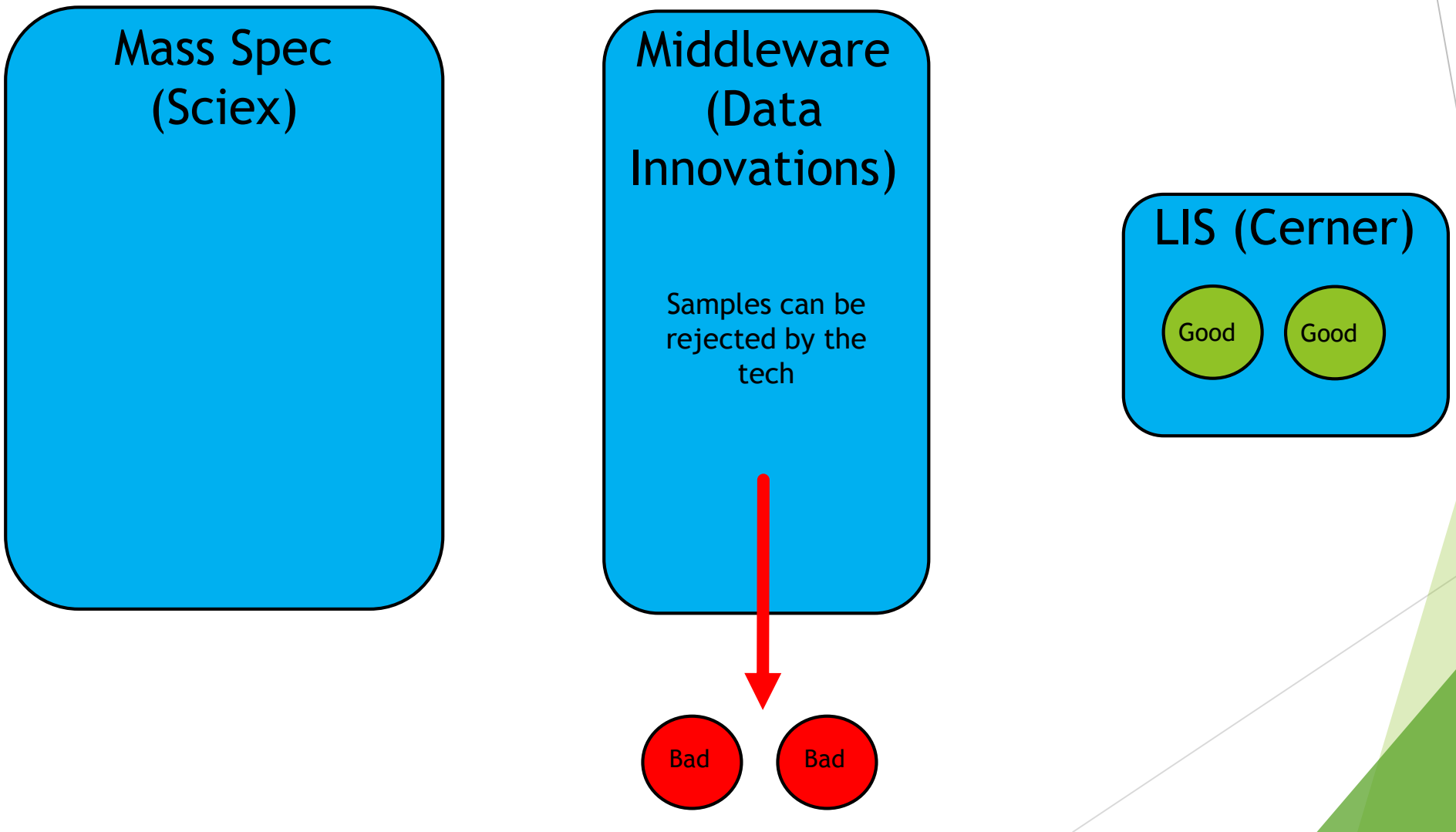

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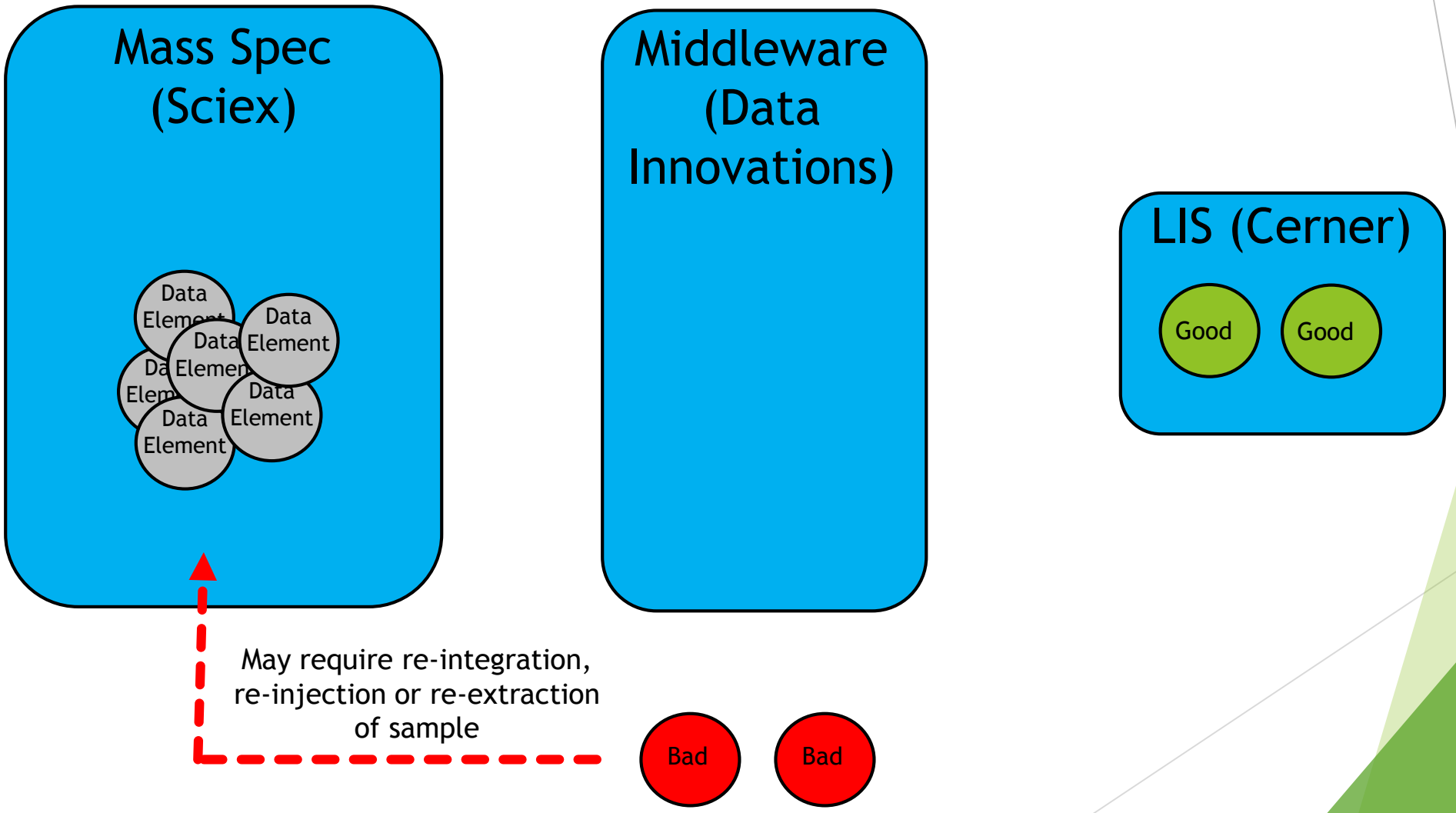

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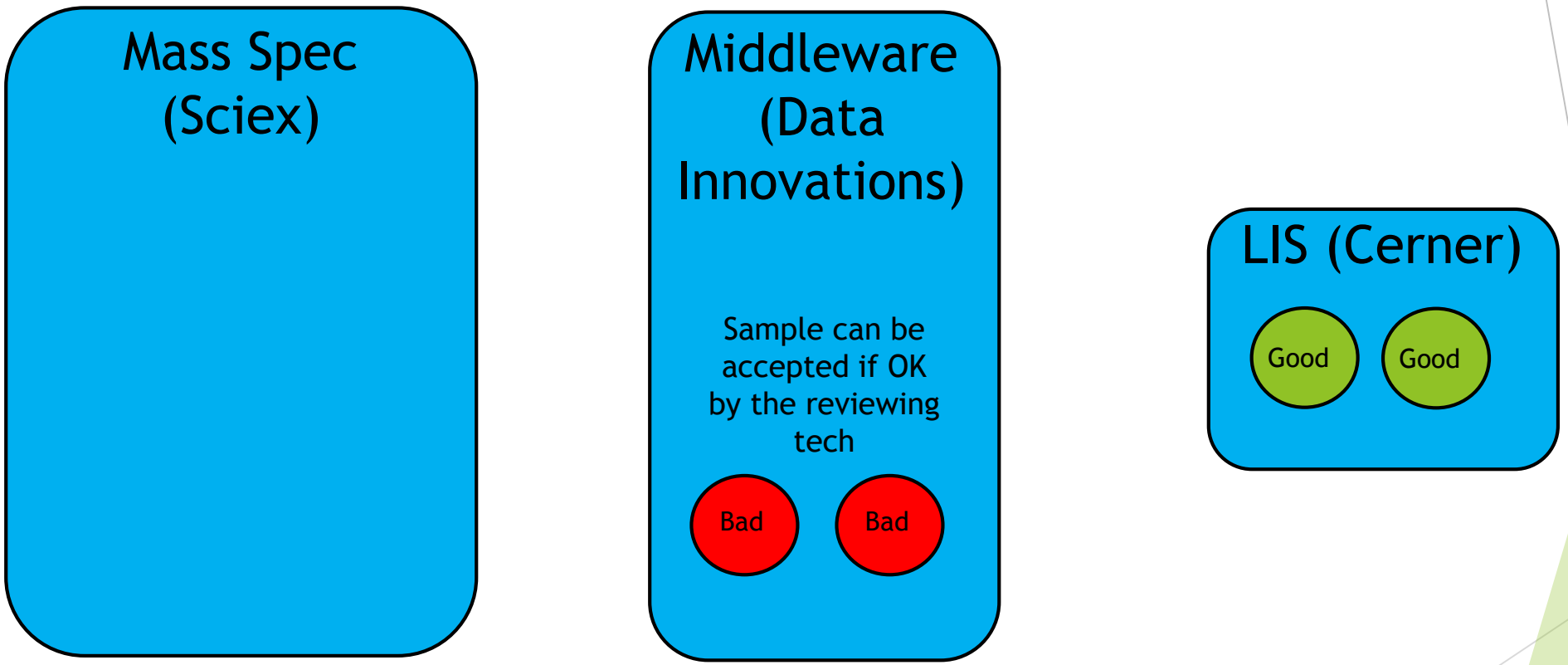

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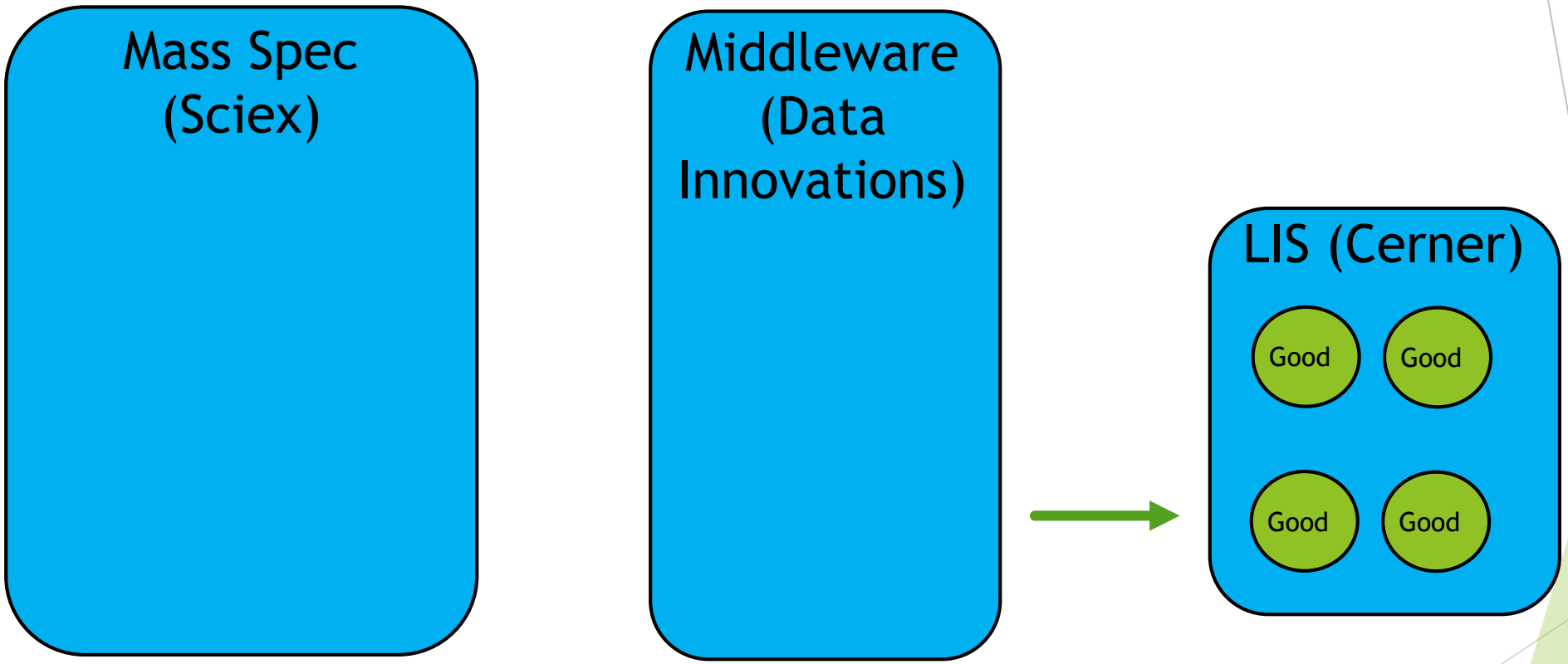
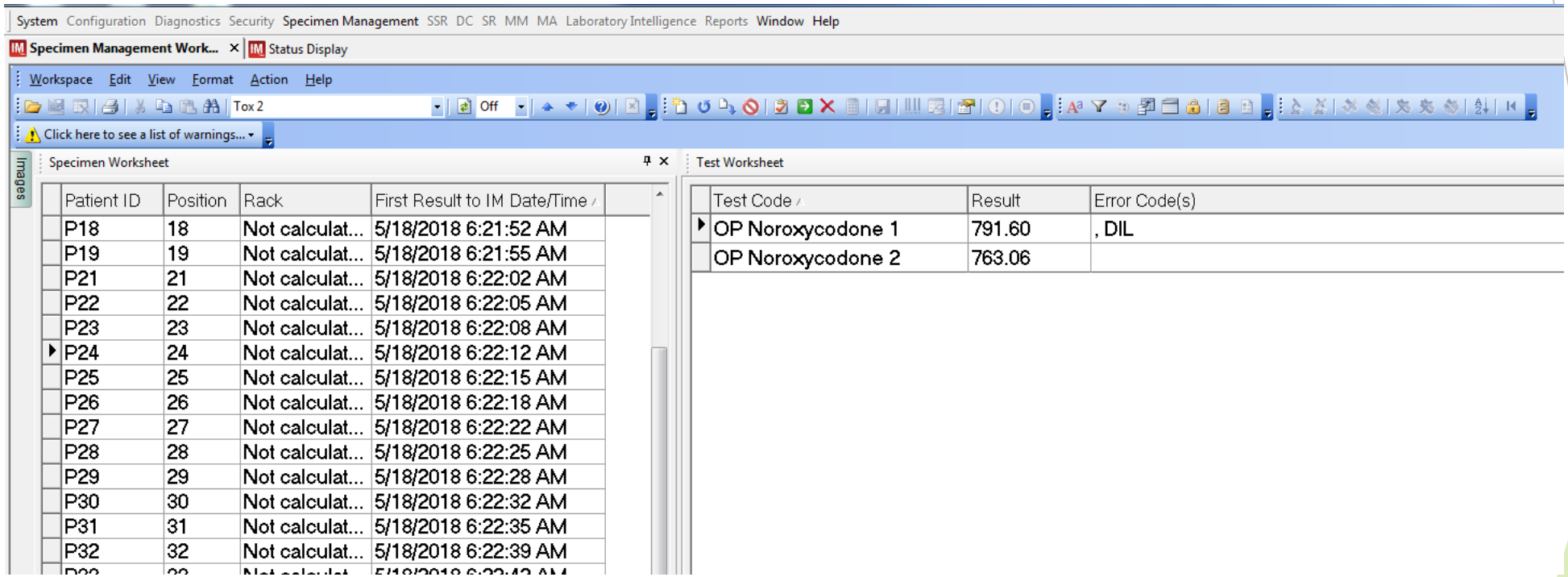


How Does A Bench Tech See A Result Held For Review?



Patient ID	Position	Rack	First Result to IM Date/Time
P18	18	Not calculat...	5/18/2018 6:21:52 AM
P19	19	Not calculat...	5/18/2018 6:21:55 AM
P21	21	Not calculat...	5/18/2018 6:22:02 AM
P22	22	Not calculat...	5/18/2018 6:22:05 AM
P23	23	Not calculat...	5/18/2018 6:22:08 AM
P24	24	Not calculat...	5/18/2018 6:22:12 AM
P25	25	Not calculat...	5/18/2018 6:22:15 AM
P26	26	Not calculat...	5/18/2018 6:22:18 AM
P27	27	Not calculat...	5/18/2018 6:22:22 AM
P28	28	Not calculat...	5/18/2018 6:22:25 AM
P29	29	Not calculat...	5/18/2018 6:22:28 AM
P30	30	Not calculat...	5/18/2018 6:22:32 AM
P31	31	Not calculat...	5/18/2018 6:22:35 AM
P32	32	Not calculat...	5/18/2018 6:22:39 AM

Test Code	Result	Error Code(s)
OP Noroxycodone 1	791.60	, DIL
OP Noroxycodone 2	763.06	

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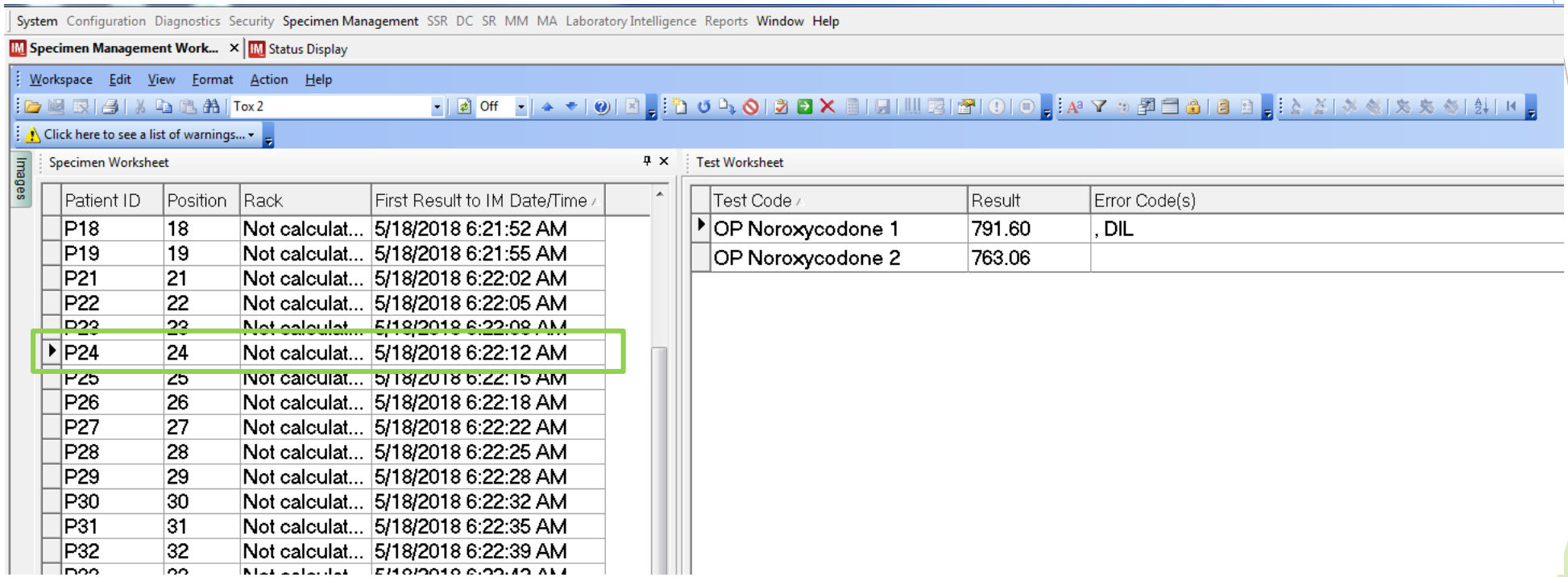

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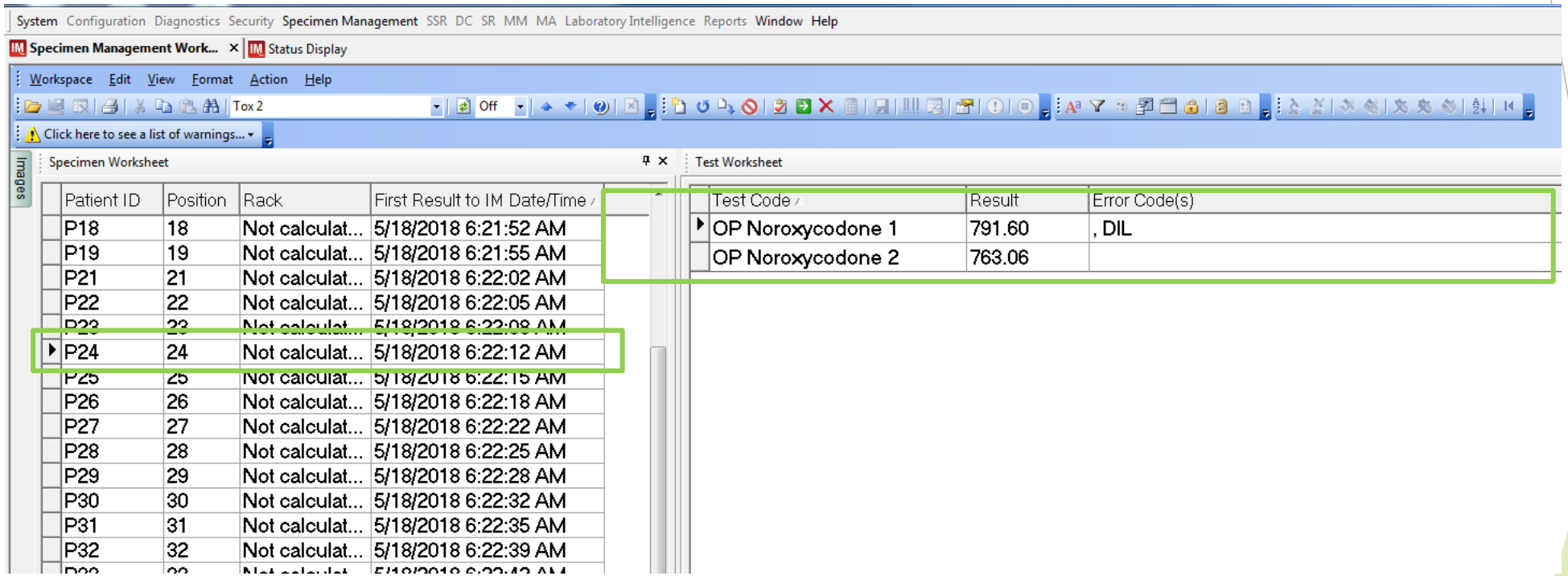
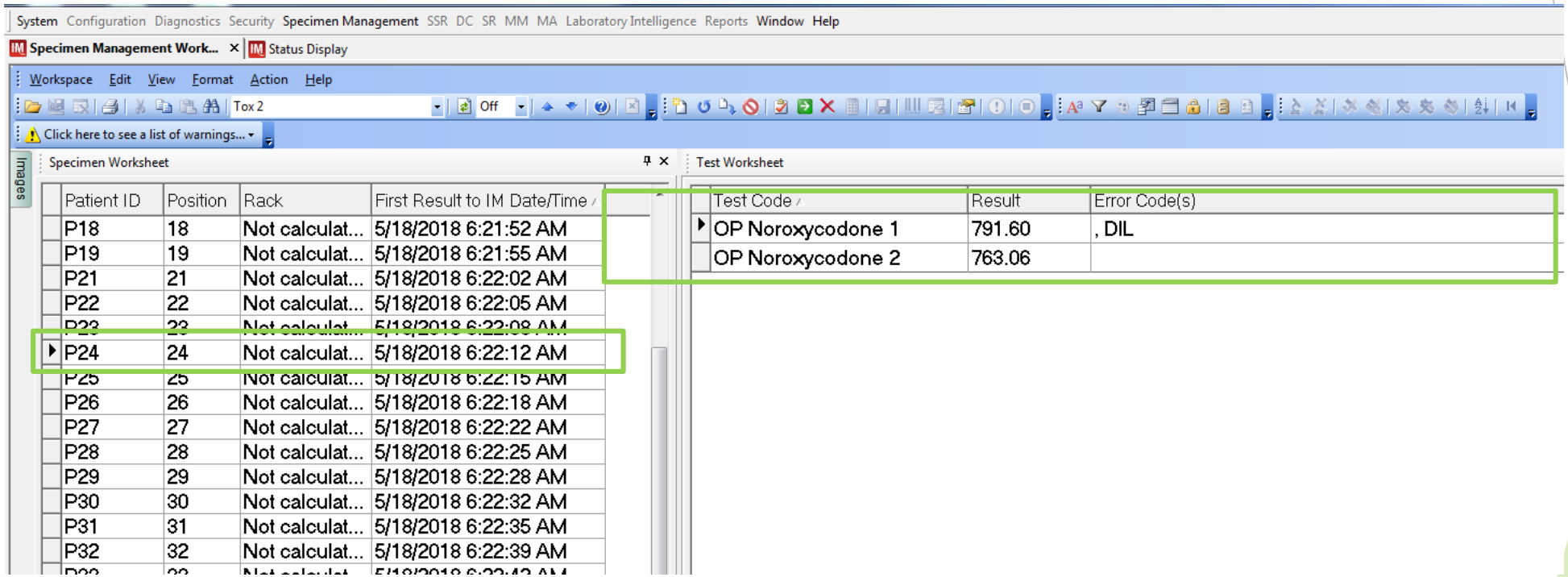


Then What?

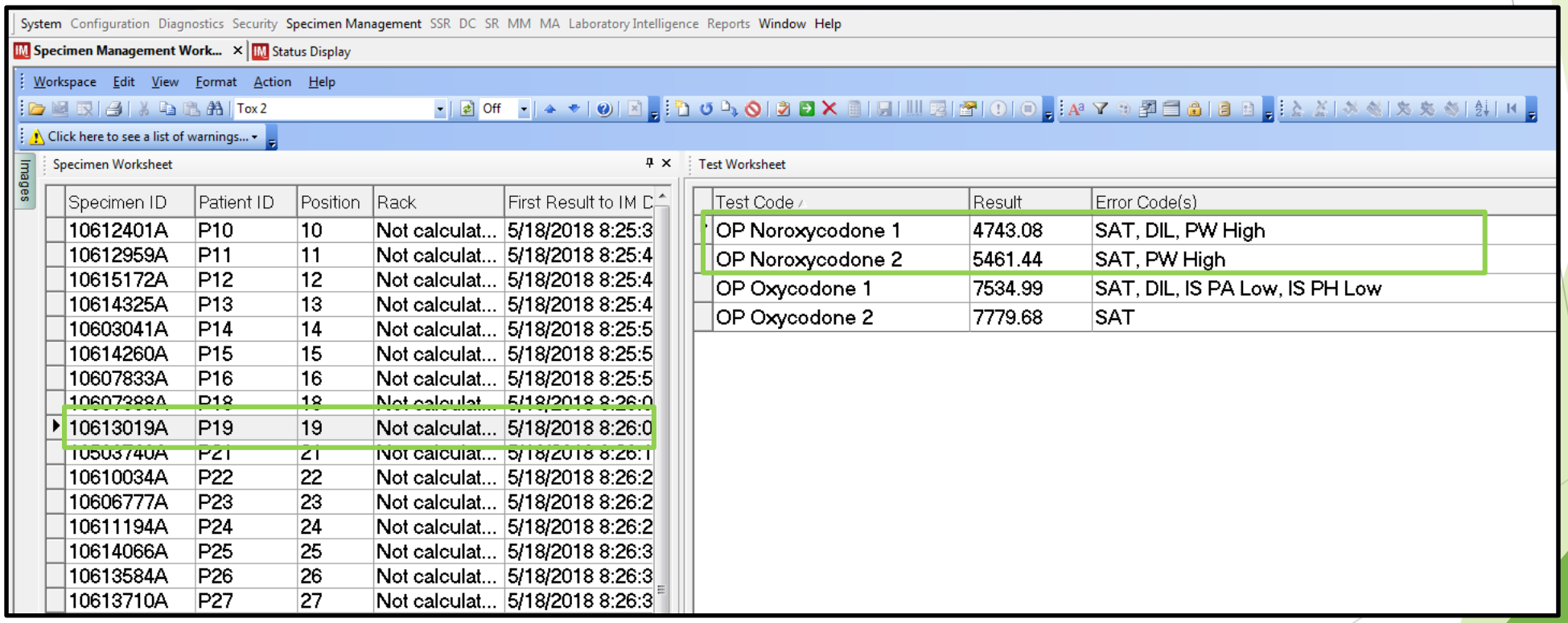

System Configuration Diagnostics Security Specimen Management SSR DC SR MM MA Laboratory Intelligence Reports Window Help
Specimen Management Work...
Status Display
Workspace Edit View Format Action Help
Tox 2
Off
Click here to see a list of warnings...
Images
Specimen Worksheet
Patient ID | Position | Rack | First Result to IM Date/Time
P18 | 18 | Not calculat... | 5/18/2018 6:21:52 AM
P19 | 19 | Not calculat... | 5/18/2018 6:21:55 AM
P21 | 21 | Not calculat... | 5/18/2018 6:22:02 AM
P22 | 22 | Not calculat... | 5/18/2018 6:22:05 AM
P24 | 24 | Not calculat... | 5/18/2018 6:22:12 AM
P26 | 26 | Not calculat... | 5/18/2018 6:22:18 AM
P27 | 27 | Not calculat... | 5/18/2018 6:22:22 AM
P28 | 28 | Not calculat... | 5/18/2018 6:22:25 AM
P29 | 29 | Not calculat... | 5/18/2018 6:22:28 AM
P30 | 30 | Not calculat... | 5/18/2018 6:22:32 AM
P31 | 31 | Not calculat... | 5/18/2018 6:22:35 AM
P32 | 32 | Not calculat... | 5/18/2018 6:22:39 AM
Test Worksheet
Test Code | Result | Error Code(s)
OP Noroxycodone 1 | 791.60 | , DIL
OP Noroxycodone 2 | 763.06 |

How Does Visual Peak Review Translate Into DI Rule Flags?

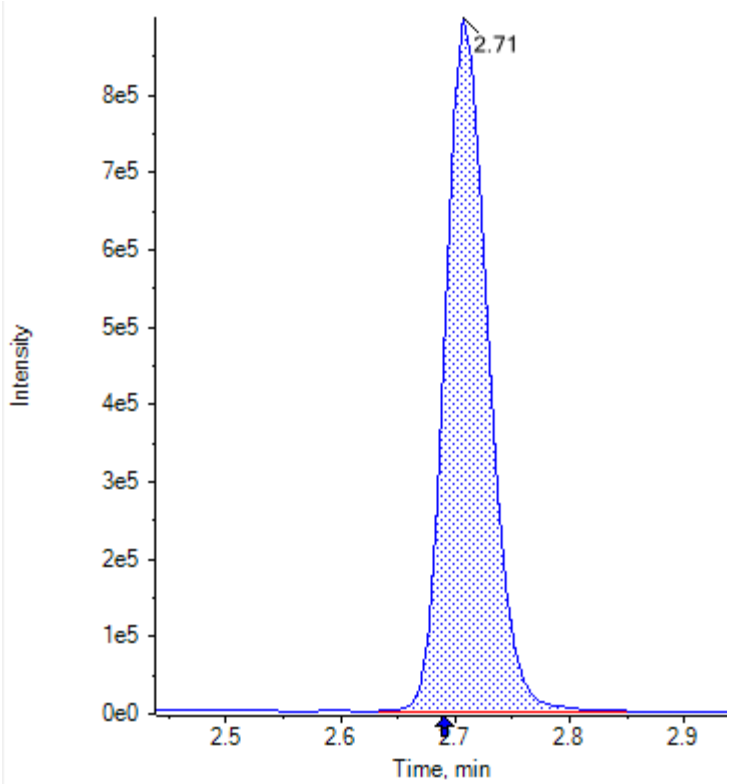
Example 1: How Do Very High Drug Samples Behave?

- 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

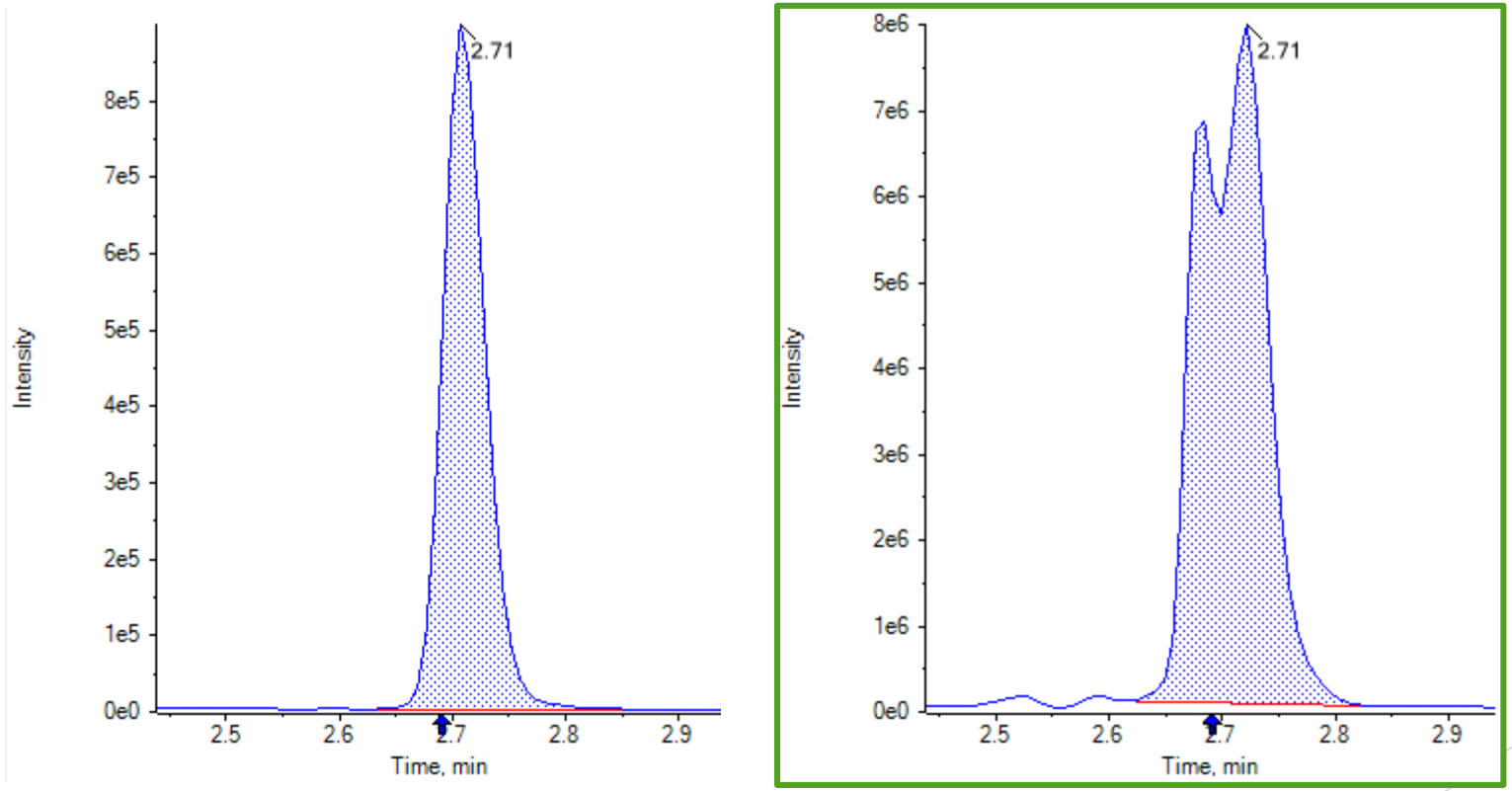


Example 1: What A Normal Noroxycodone 1 Peak Looks Like

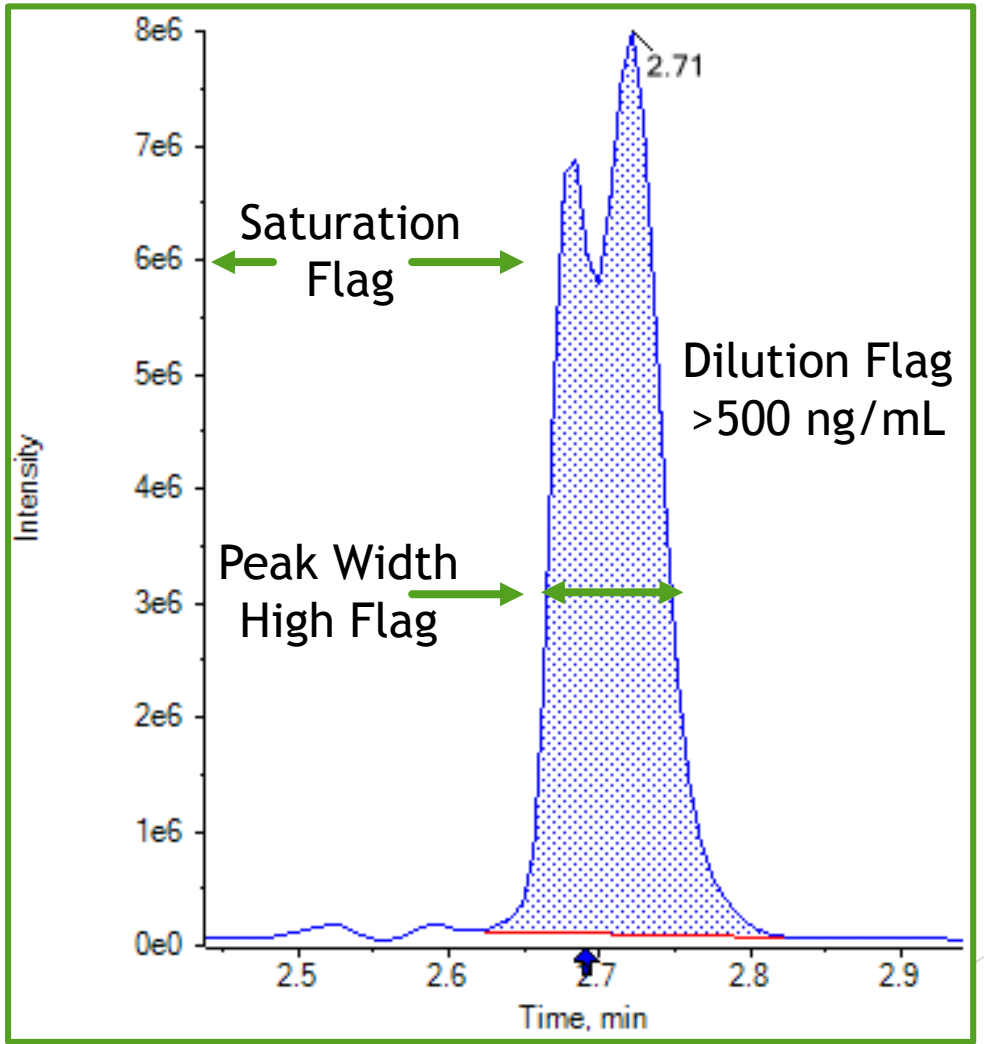


Noroxycodone 1 quantitation at around 450 ng/mL

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

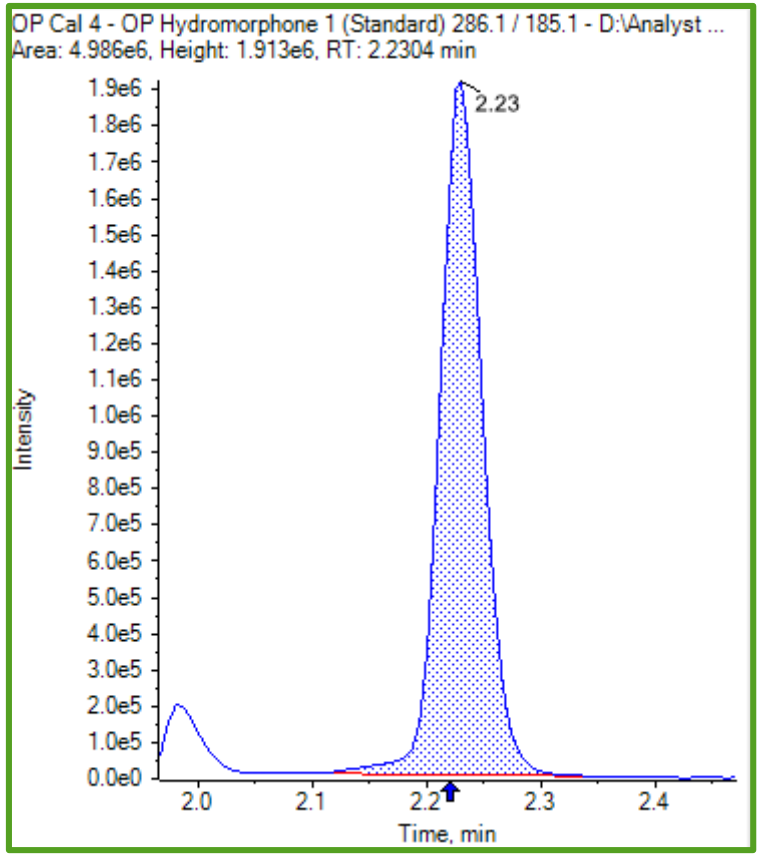
Example 2: How Much Hydromorphone do we really have?

- 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

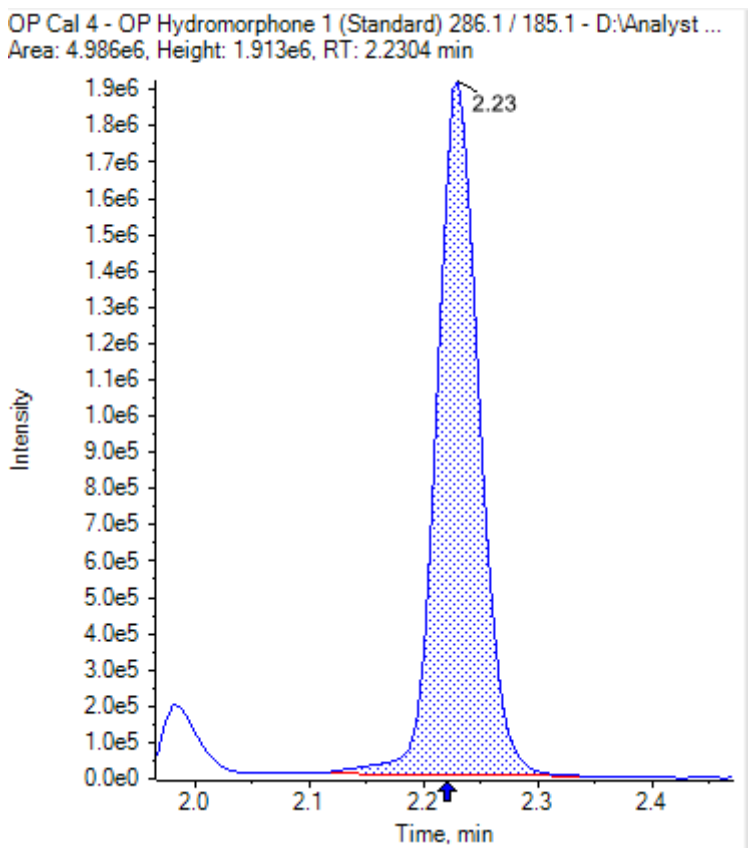
Example 2: This Is A Problem!

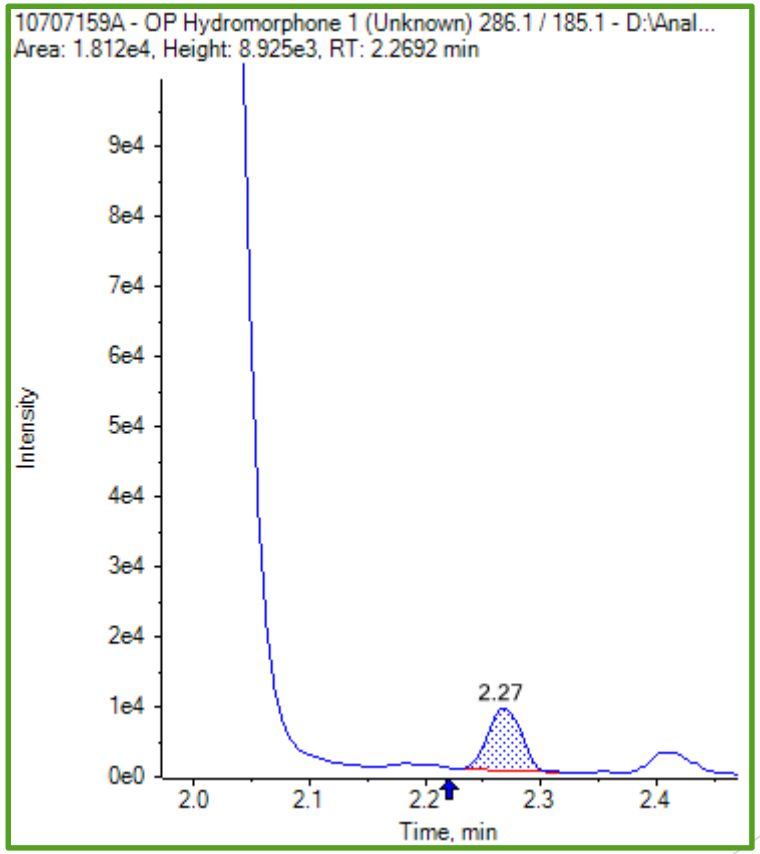
- Hydromorphone can be seen as a minor metabolite in morphine use
- A result of 500 ng/mL however, suggests co-use of hydromorphone
- The amount of hydromorphone can mean the difference between drug compliance and non-compliance

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

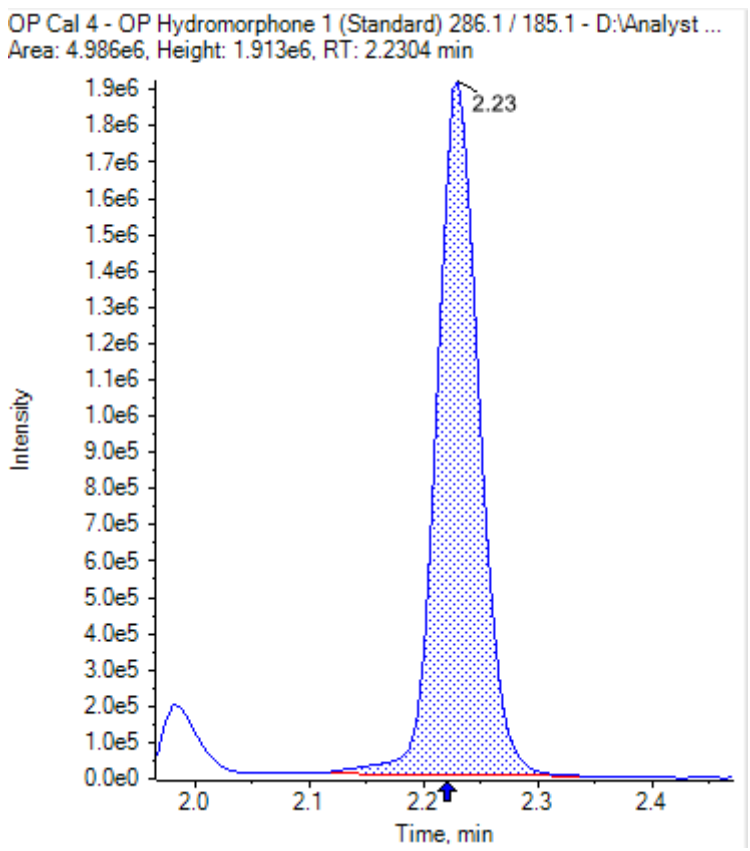


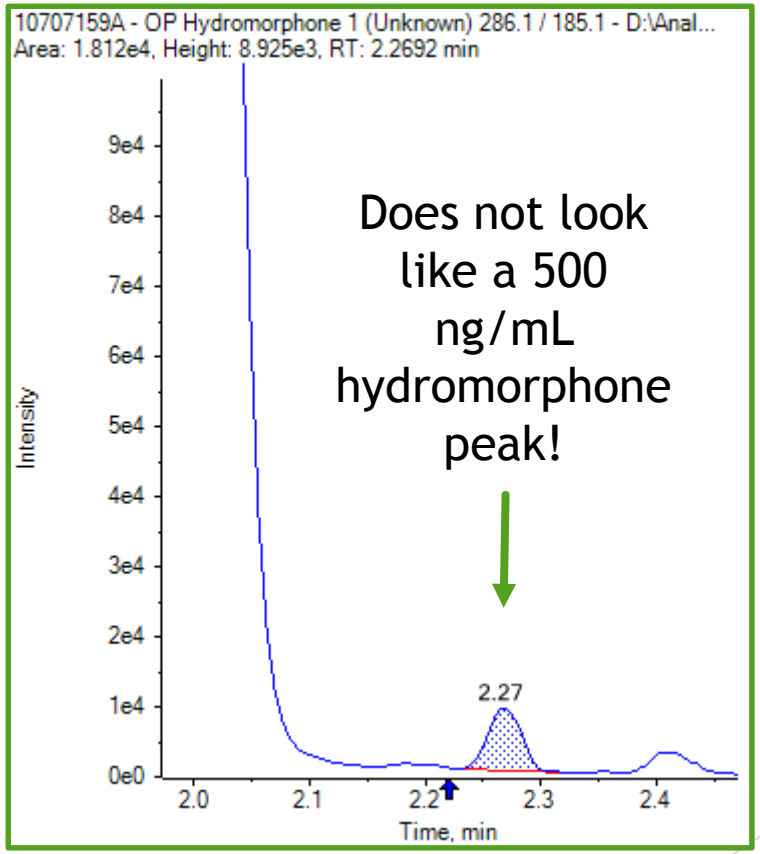
Example 2: This Is What The Patient's Hydromorphone 1 Peak Looked Like



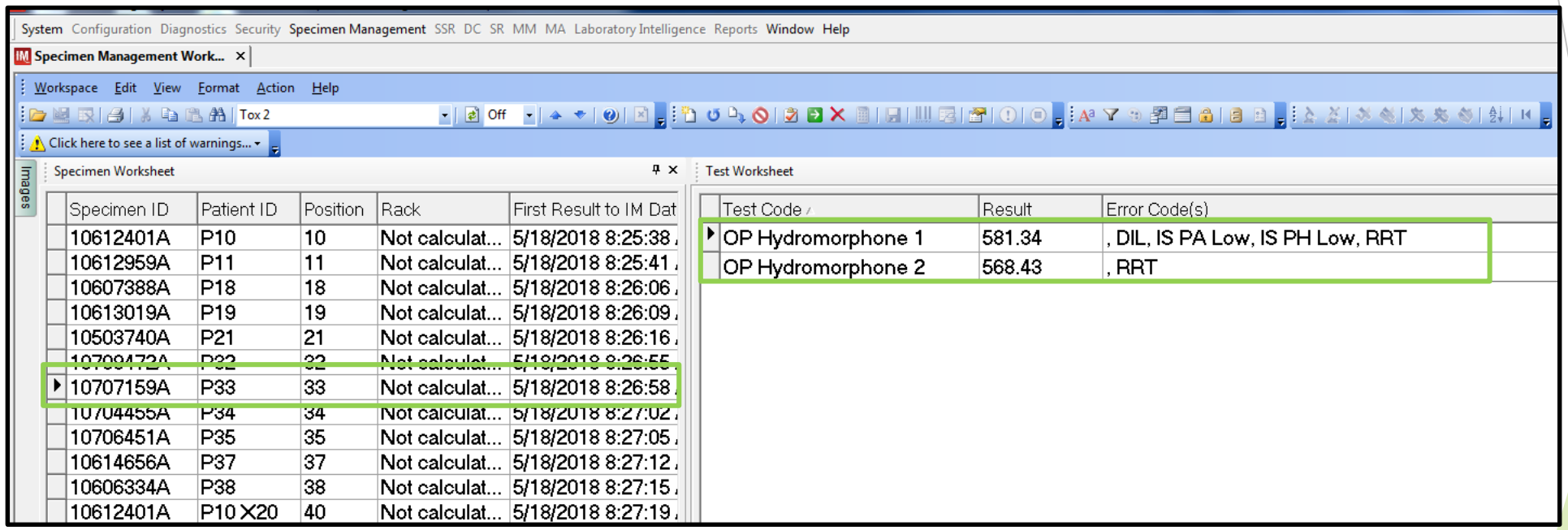


Example 2: This Is What The Patient's Hydromorphone 1 Peak Looked Like

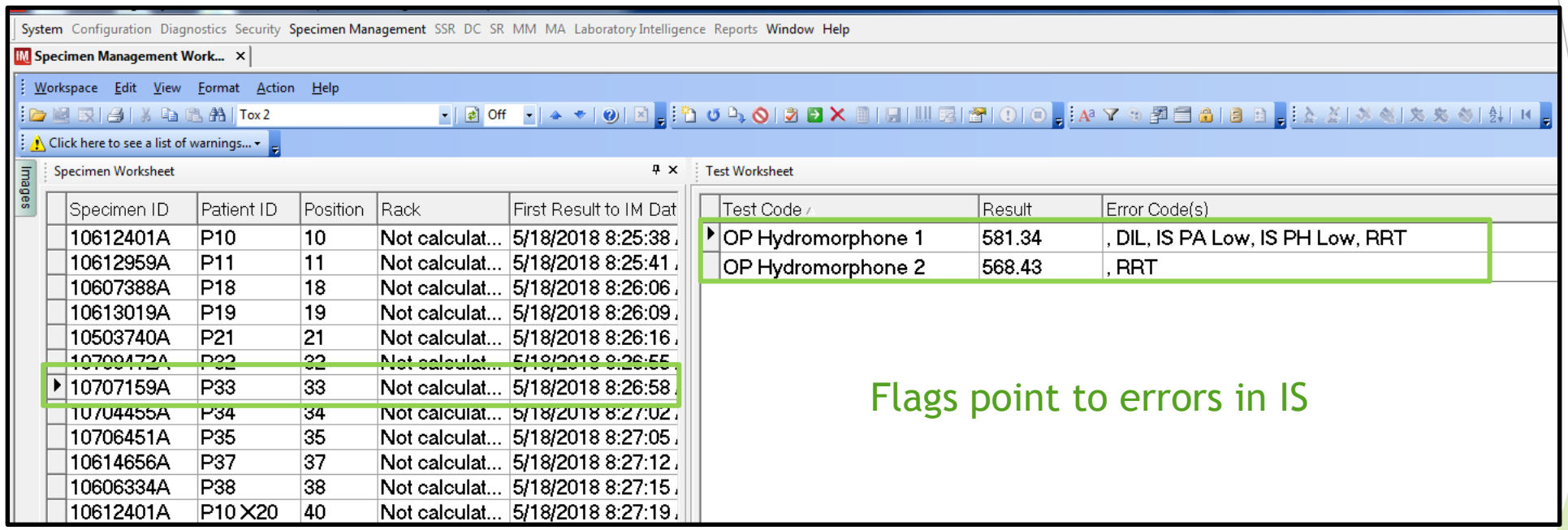




Example 2: These Are What Flags Were Observed

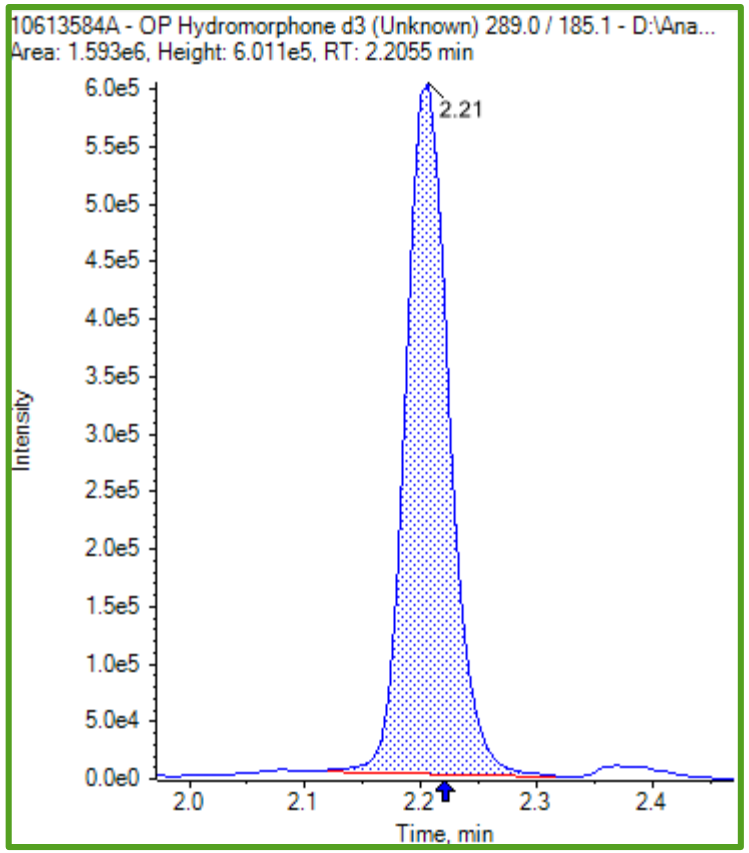


Example 2: These Are What Flags Were Observed

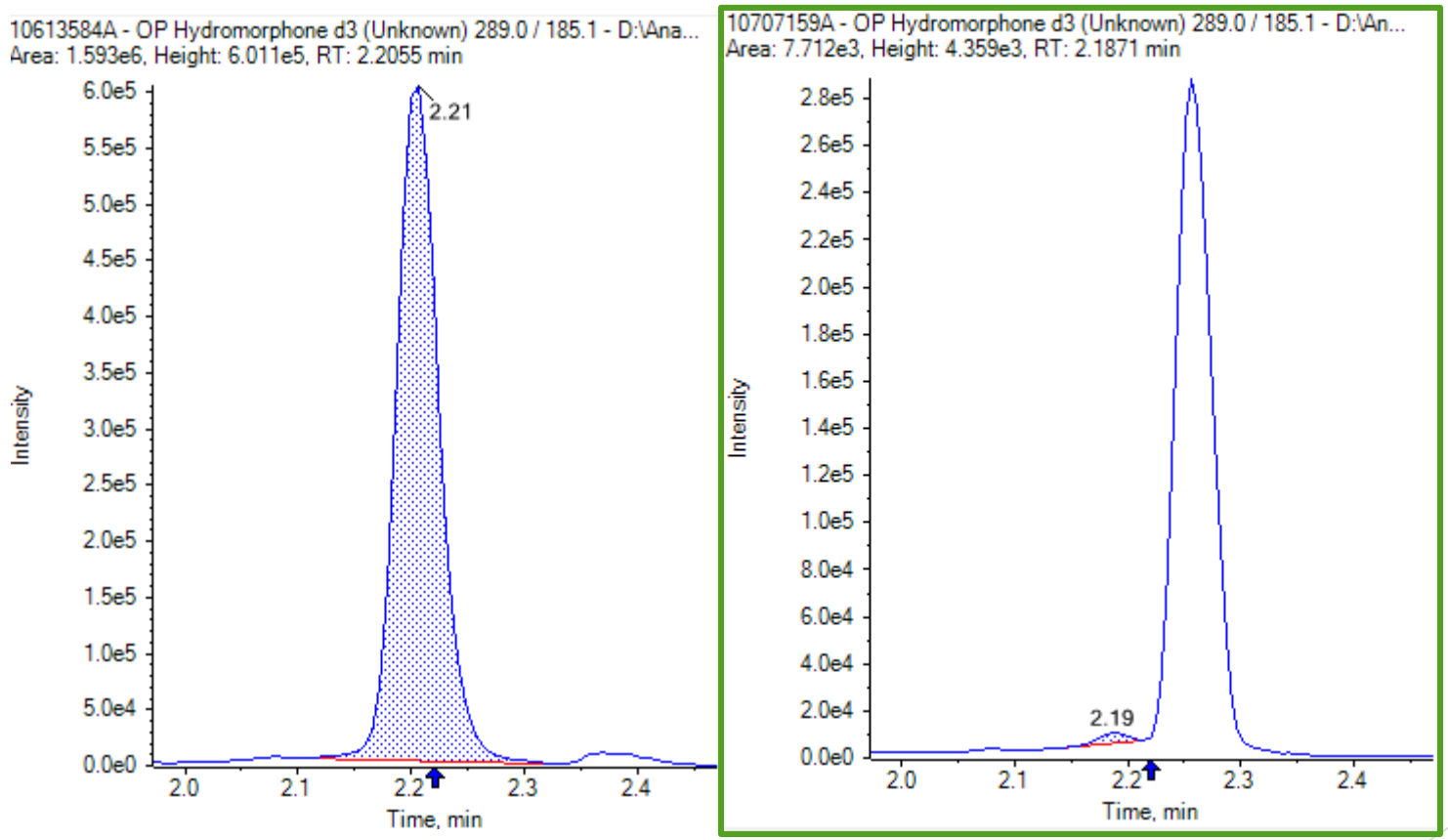


Flags point to errors in IS

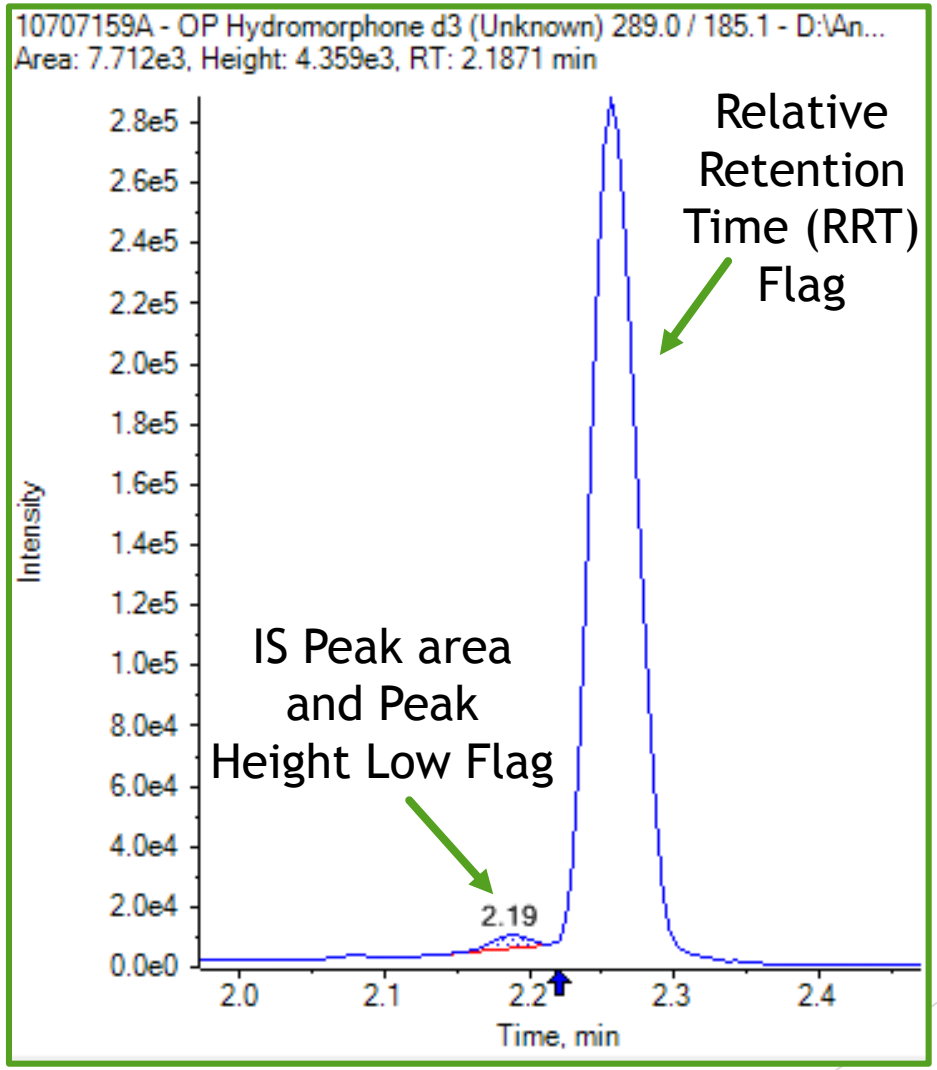
Example 2: This Is What A Normal Hydromorphone IS Looks Like



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



Example 2: These Are The Flags



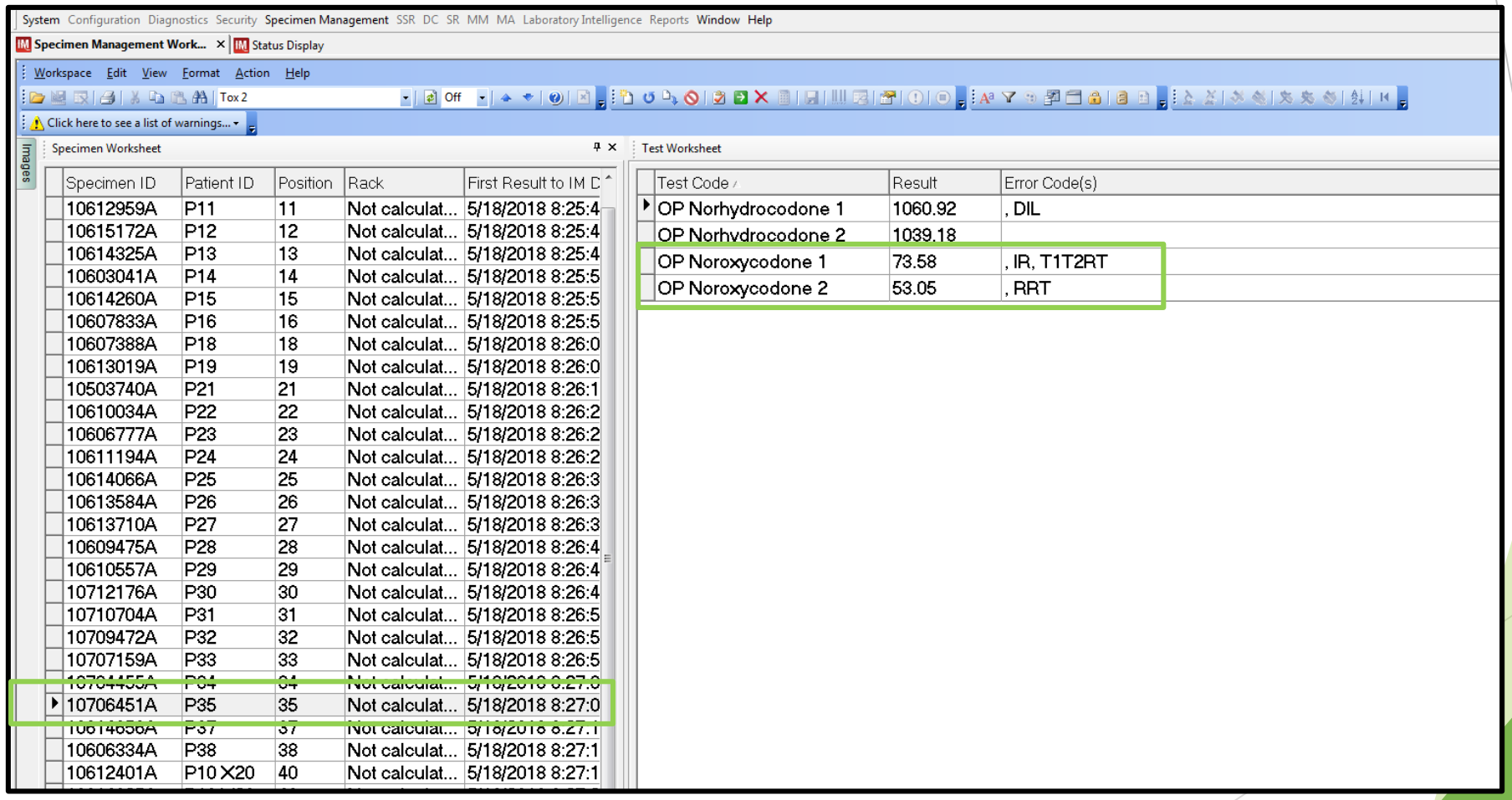
Example 2: After Re-integration of IS

- 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

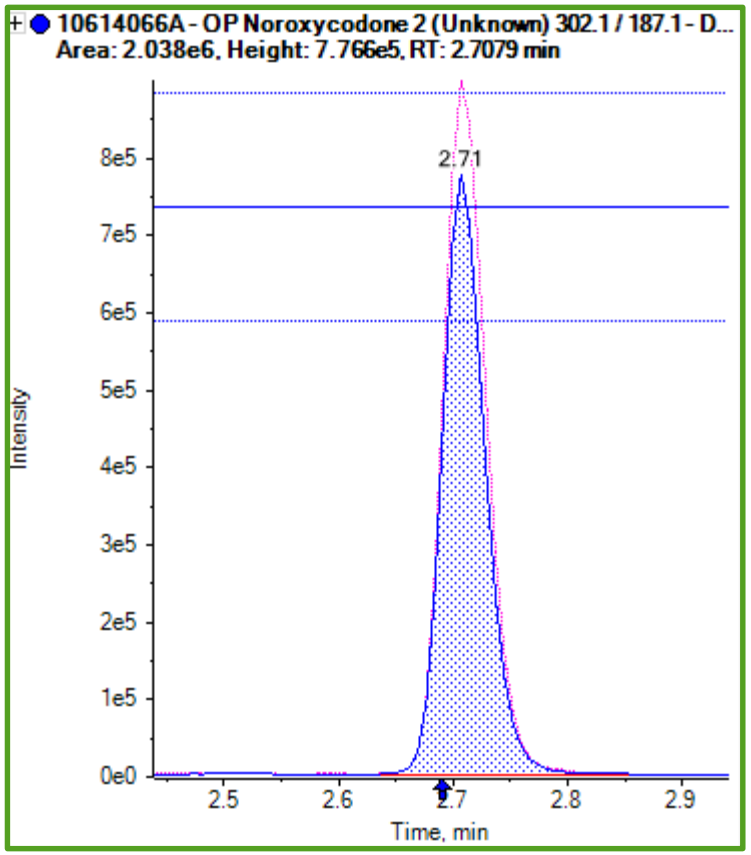
Example 3: Is There Noroxycodone?

- 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??

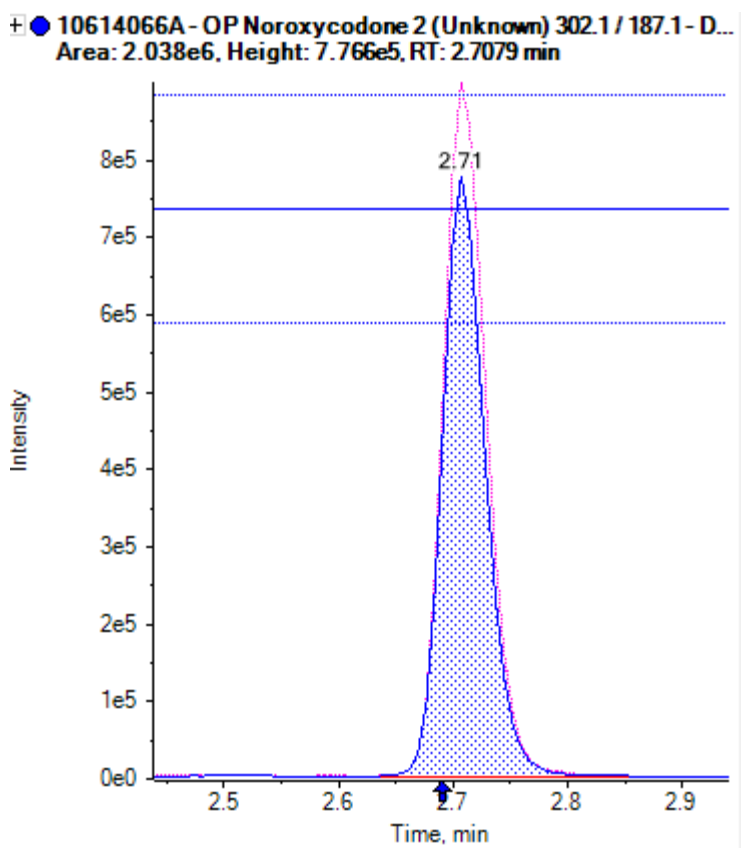
Example 3: These Are What Flags Were Observed

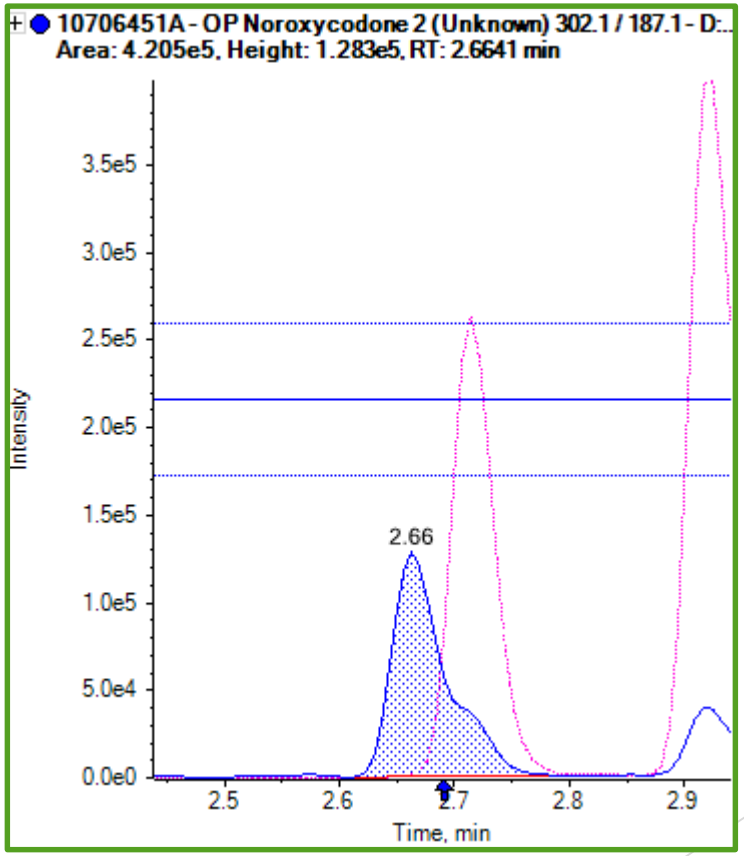


Example 3: This Is What A Normal Noroxycodone 2 Peak Looks Like

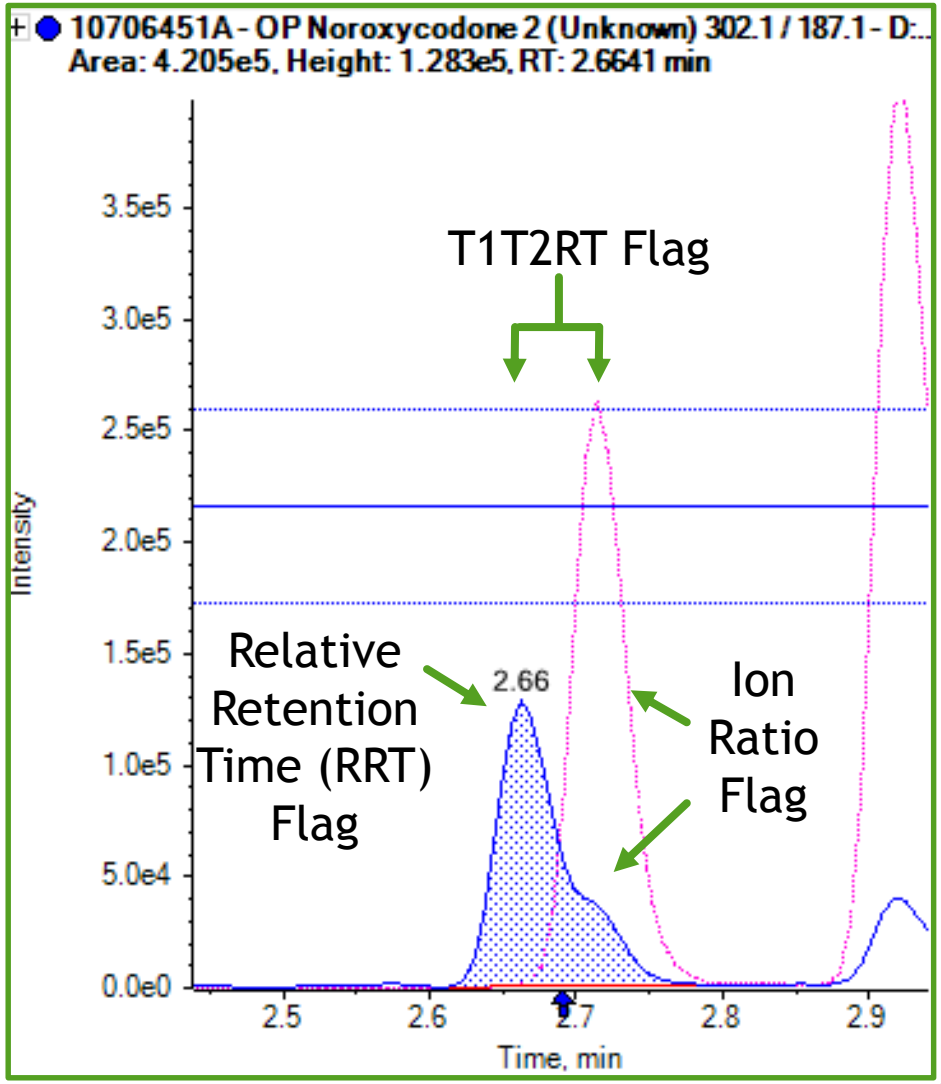


Example 3: This Is What This Patient's Noroxycodone 2 Peak Looked Like





Example 3: These Are The Flags



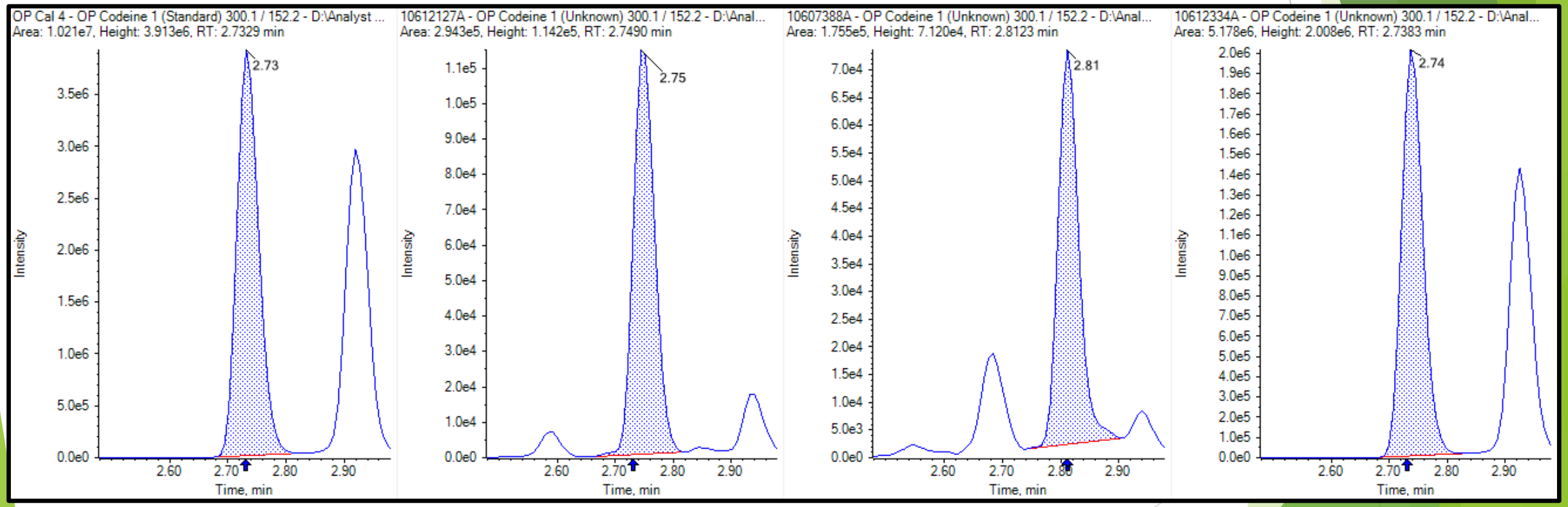
Example 3: Not Noroxycodone

- Sample was confirmed negative for noroxycodone
- Results align with patient's medication list

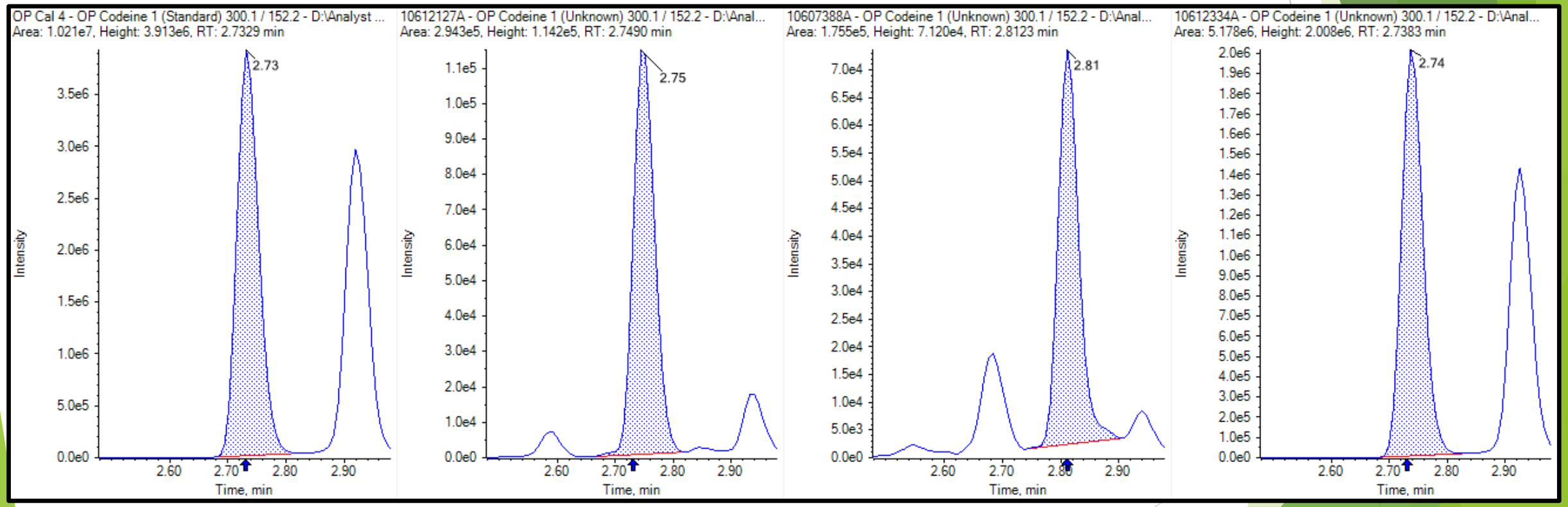
Example 4: The Subtle Art Of Peak Review

- 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??

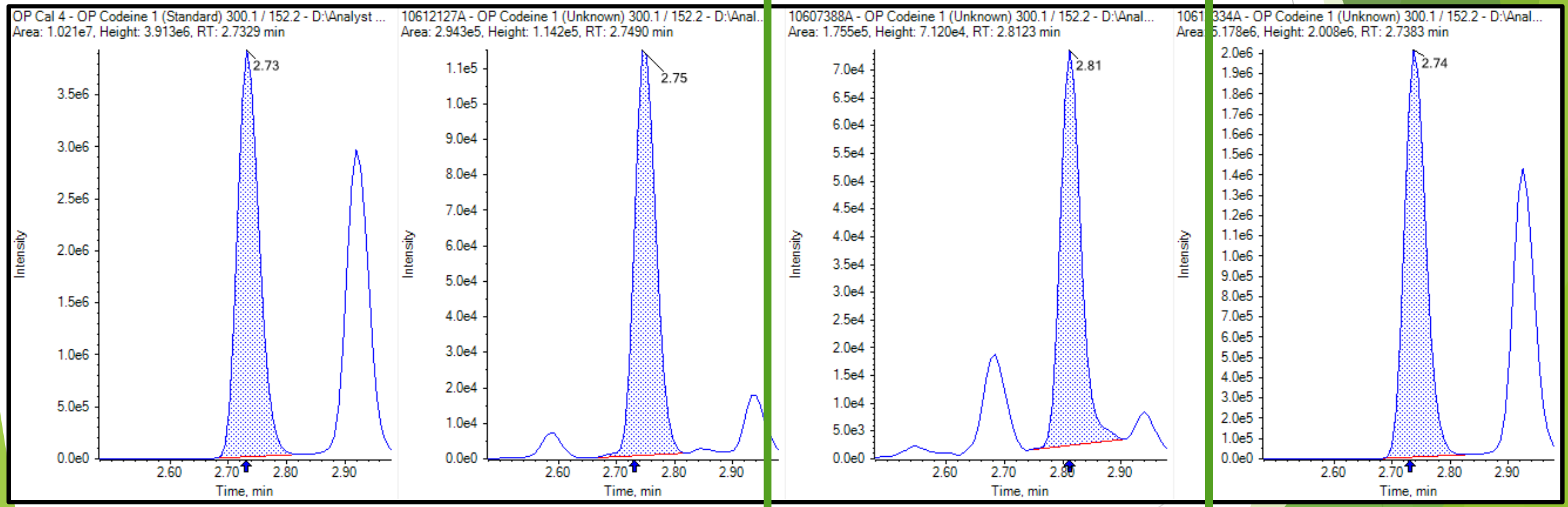
Example 4: Here Is A Set Of Patient Samples With Potential Codeine Peaks



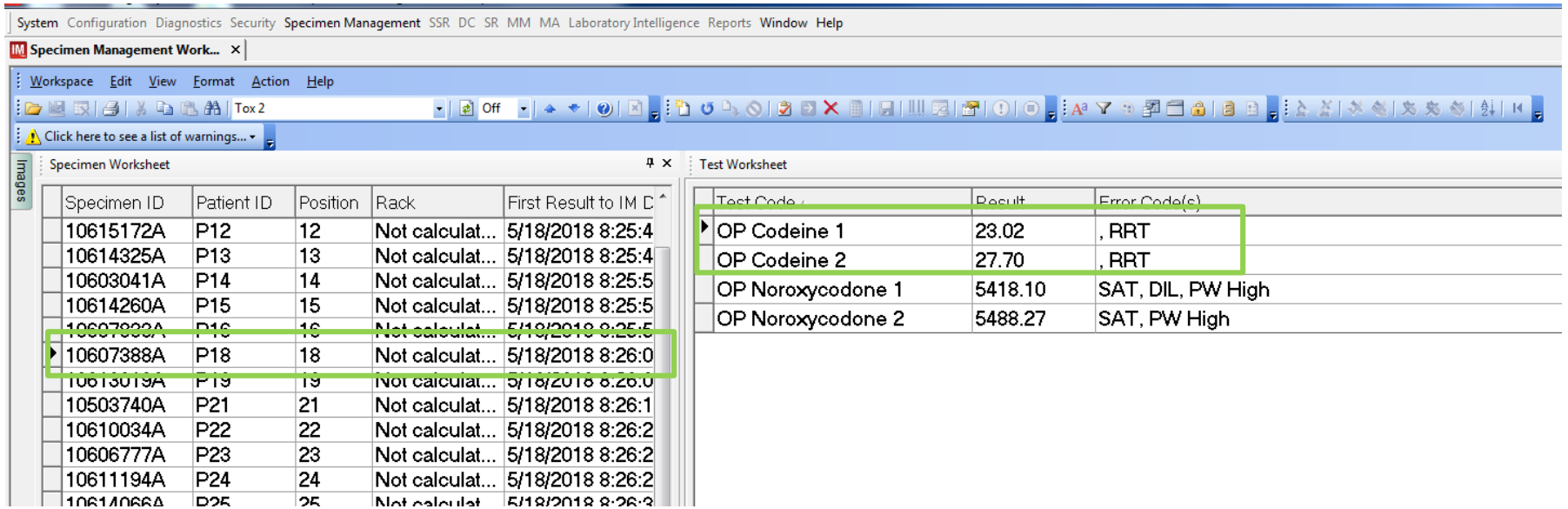
Example 4: Can You Figure Out Which Sample Has A Problem?



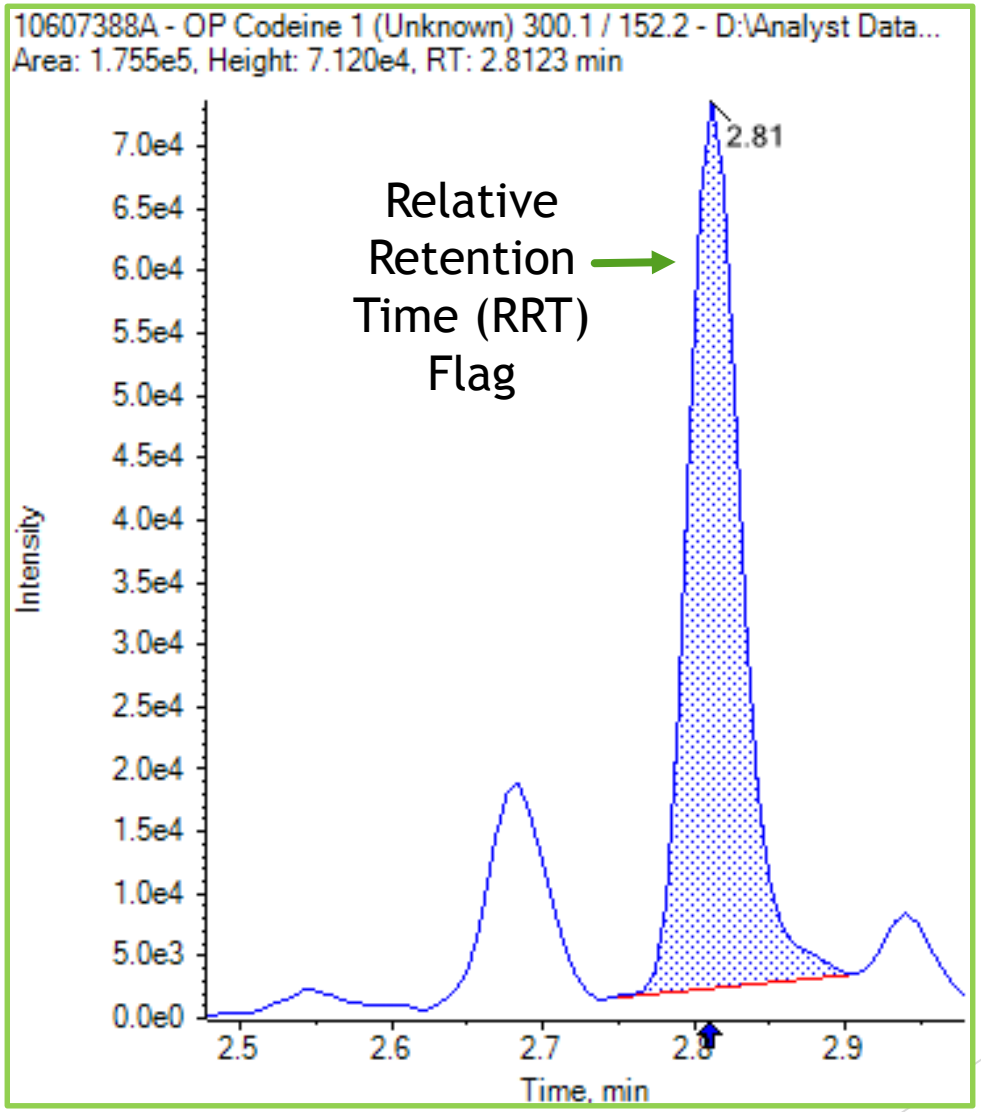
Example 4: This Patient Sample Has a Relative Retention Time (RRT) Error



Example 4: Here Are The Flags In DI



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?

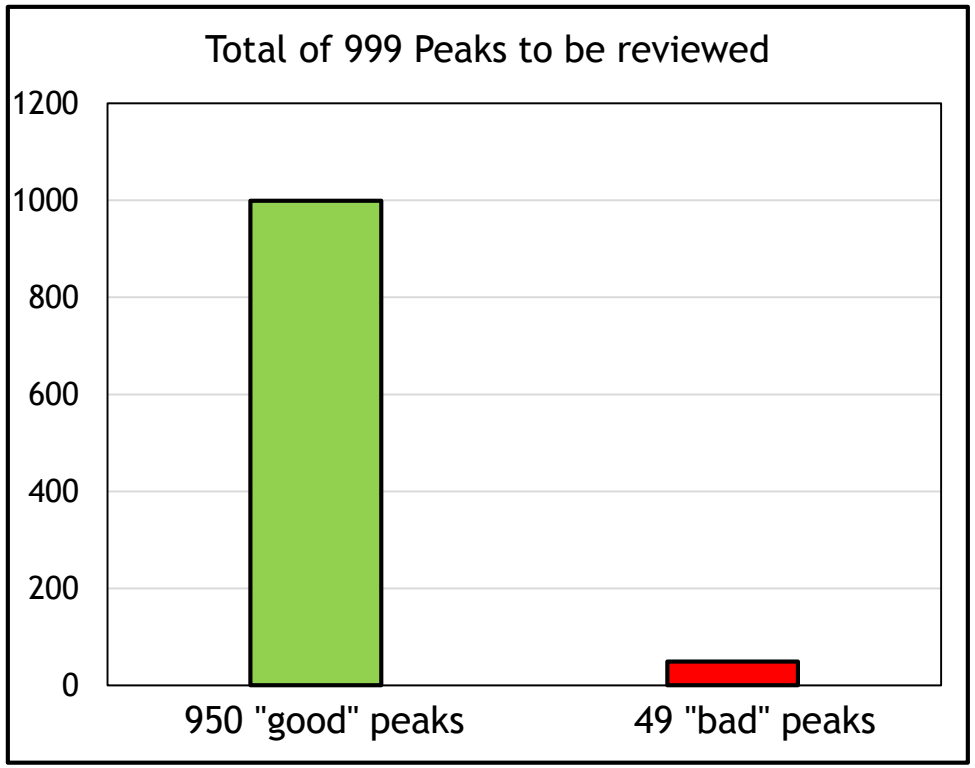
- Made all rules fire at least once
  - Not an easy task!
- Tried combinations of rule firing
- Analyzed multiple production patient batches both manually and by DI
  - Compared results and time

These Are The Goals

- Improve Efficiency (time)
- Reduce Errors
- Standardize Processes

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! I Promise!

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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**"

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

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

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

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

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	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
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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