

Single Day Event

*Make Clinical Data Visualization
More Enjoyable And Efficient*

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Why need clinical data visualization?

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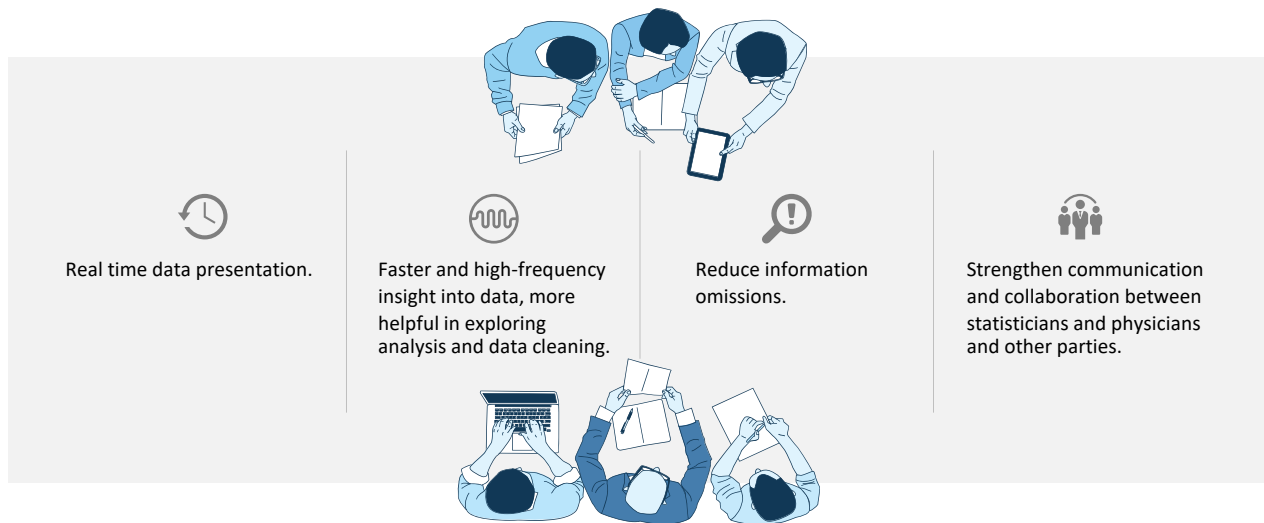
What is the excellent clinical data visualization?

03

Challenges and solutions for clinical data visualization

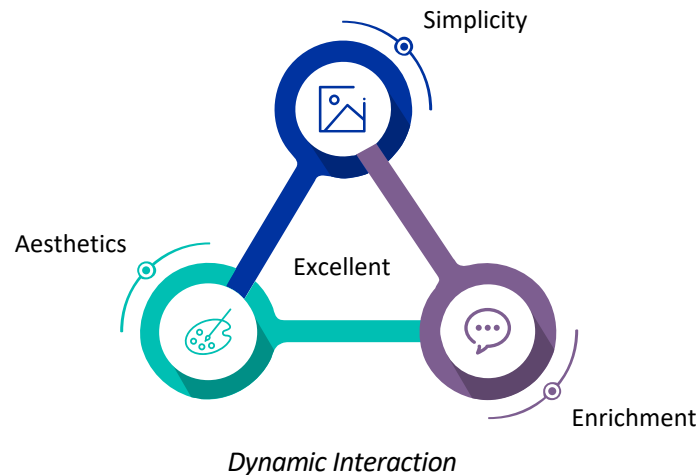
Why Need Clinical Data Visualization?

- ❑ Data visualization is primarily intended to communicate information clearly and efficiently through the graphic representation of data
- ❑ The benefits of clinical data visualization include, but are not limited to ...



What is the Excellent Clinical Data Visualization?

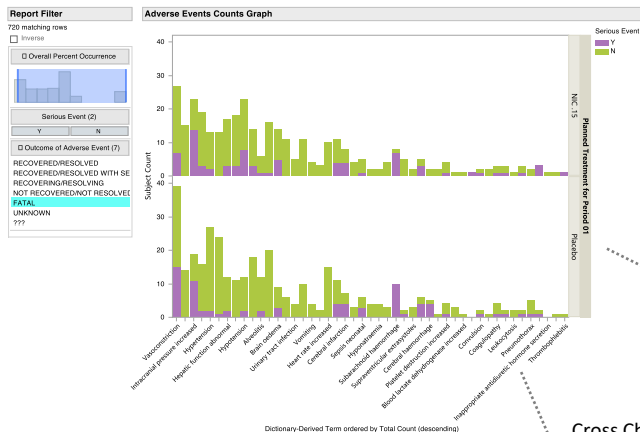
- ❑ Data visualization is both an art and a science
- ❑ Features of excellent data visualization
 - ✓ Simplicity
 - ✓ Enrichment
 - ✓ Aesthetic
- ❑ Other features of excellent clinical data visualization
 - ✓ Contain the appropriate indicators
 - ✓ Intuitively compare the results between the arms
 - ✓ Interactive linkage for association and extraction



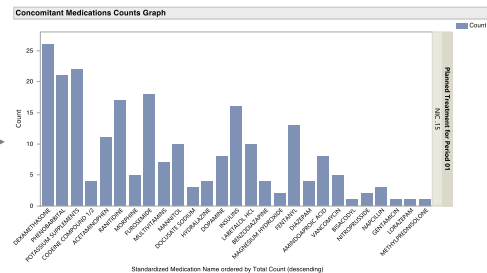


A Clinical Data Review Scenario

2% AE Occurrence, Fatal, Causality by Treatment ...

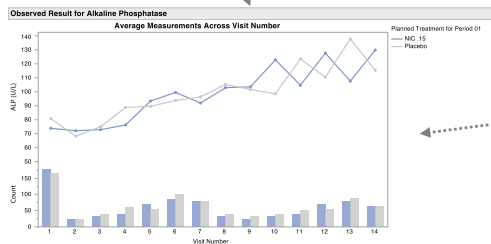


Cross Check - What Combined Medications have these subjects taken?

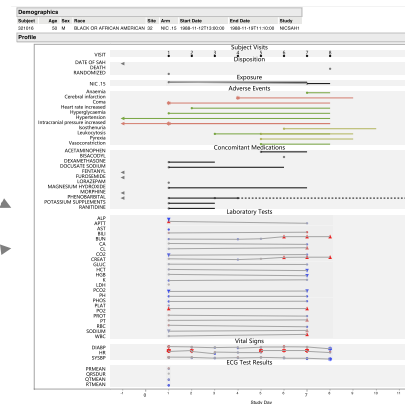


Drill Down - For selected subjects, is it possible to view their Patient Profile with one click?

Cross Check - Do these subjects have abnormal LB Findings?



Macro and Micro



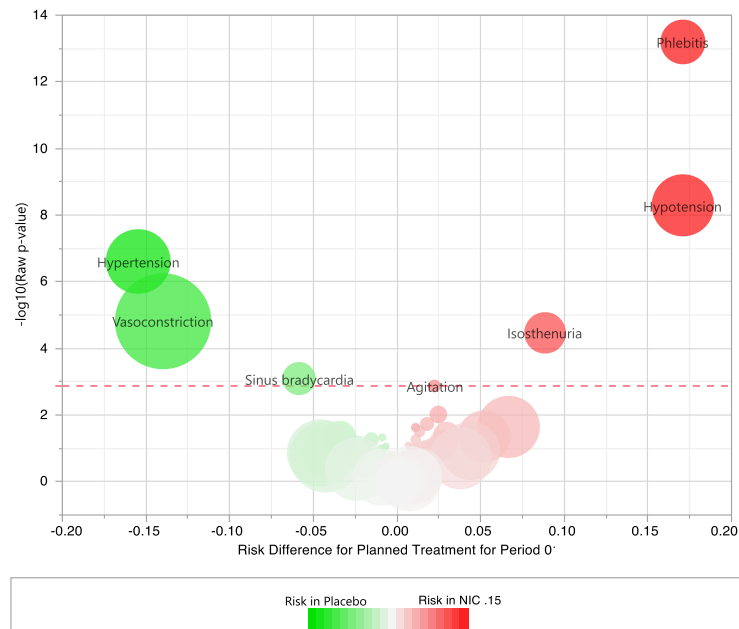


Visualization Case - Volcano Plot

❑ Purpose

- ✓ Screening for statistically significant adverse events between groups
- ✓ Then more detailed analysis of these adverse events

Role	Definition
X-axis	• Risk Difference • ΔAE Incidence% (NIC.15 - Placebo)
Y-axis	• Statistical Difference between Groups • $-\log_{10}(\text{Raw p-value})$
Color	• Green: AE occurred more in Placebo group • Red: AE occurred more in NIC.15 group
Bubble Size	• AE Occurrence Count
Label	• AE Term
Reference line	• Statistical Difference





Visualization Case - Compound Plot

- ❑ Purpose
- ✓ Describe the incidence of the key adverse events and the relative risk between groups
- ✓ Longitudinal comparison between different adverse events

Role	Definition
X-axis	- Left: AE incidence percent - Right: $\log_2(RR)$, 0 means $RR=1$
Y-axis	AE Term
Color	- Green: Placebo group - Red: NIC.15 group
Reference line	- Statistical Difference - Whether the 95% CI of RR contains 1



Visualization Case - Venn Plot

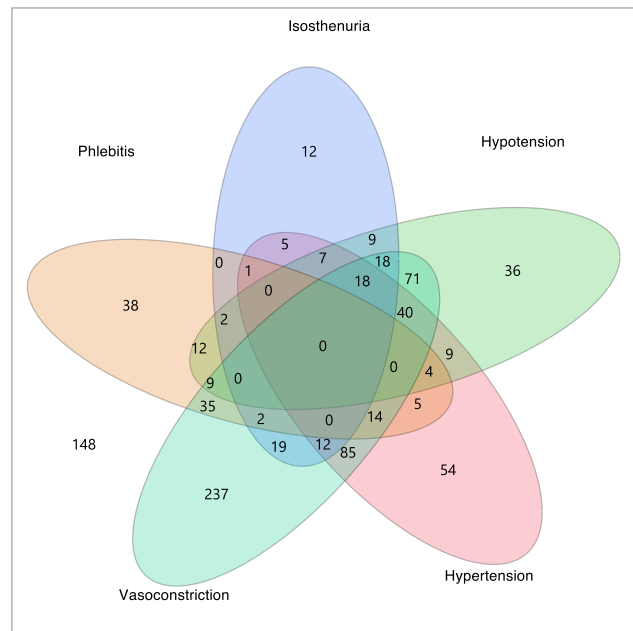
❑ Purpose

- ✓ Study the merge occurrence of the key adverse events
- ✓ Inferring the root cause by observing the merge concurrency of adverse events

Role	Definition
Color and Ellipse	5 key Adverse Events
Number	- Un-overlapping part: Number of patients with this adverse event alone - Overlapping part: Number of patients with these adverse events merge occurrence

❑ Example

- ✓ Vasoconstriction occurred alone in 237 cases
- ✓ Vasoconstriction and Hypotension merge occurred in 71 cases





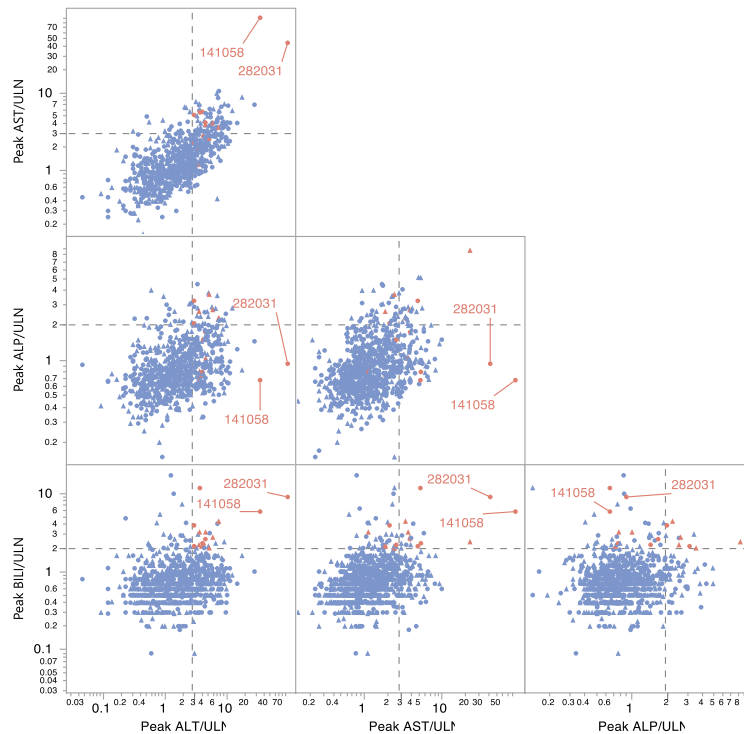
Visualization Case - Scatter Plot Matrix

□ Purpose

- ✓ Hepatic toxicity assessment is an important part of laboratory test and often includes 4 indicators

Indicator	Chinese Description
AST	谷草转氨酶
ALT	谷丙转氨酶
ALP	碱性磷酸酶
BILI	胆红素

- ✓ Hy's law is an important indicator for predicting severe hepatotoxicity in clinical trials
- ✓ The Peak Scatterplot Matrix flag the possible Hy's law cases:
 1. ALT or AST $\geq 3 \times \text{ULN}$ and BILI $\geq 2 \times \text{ULN}$ within 0 Days of ALT/AST elevation
 2. ULN: Upper Limited Normal

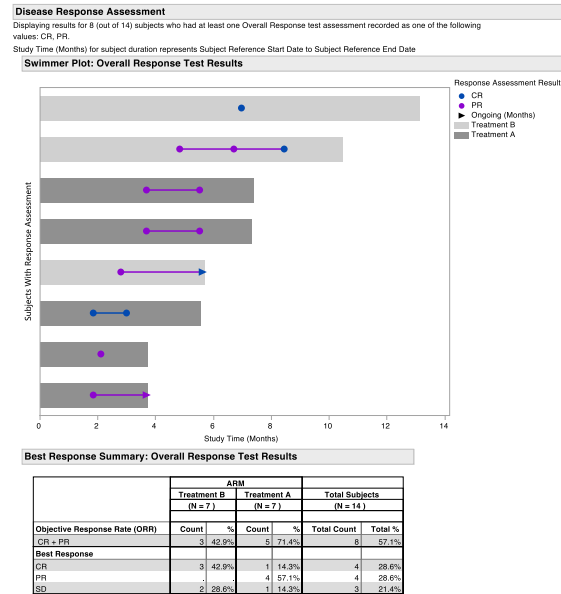
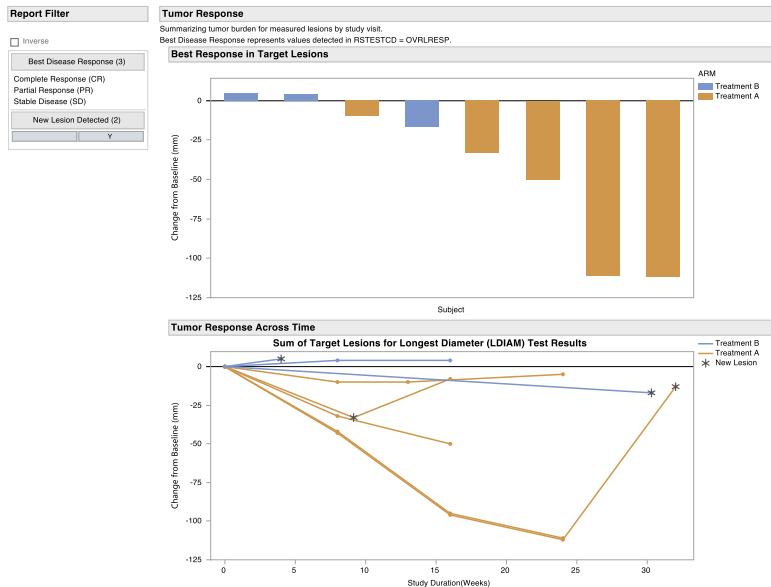




Oncology Visualization Case

❑ Purpose

- ✓ Reflect the extent of change in the target lesion per subject over the treatment and the trend over time
- ✓ Reflect disease progression per subject over the treatment

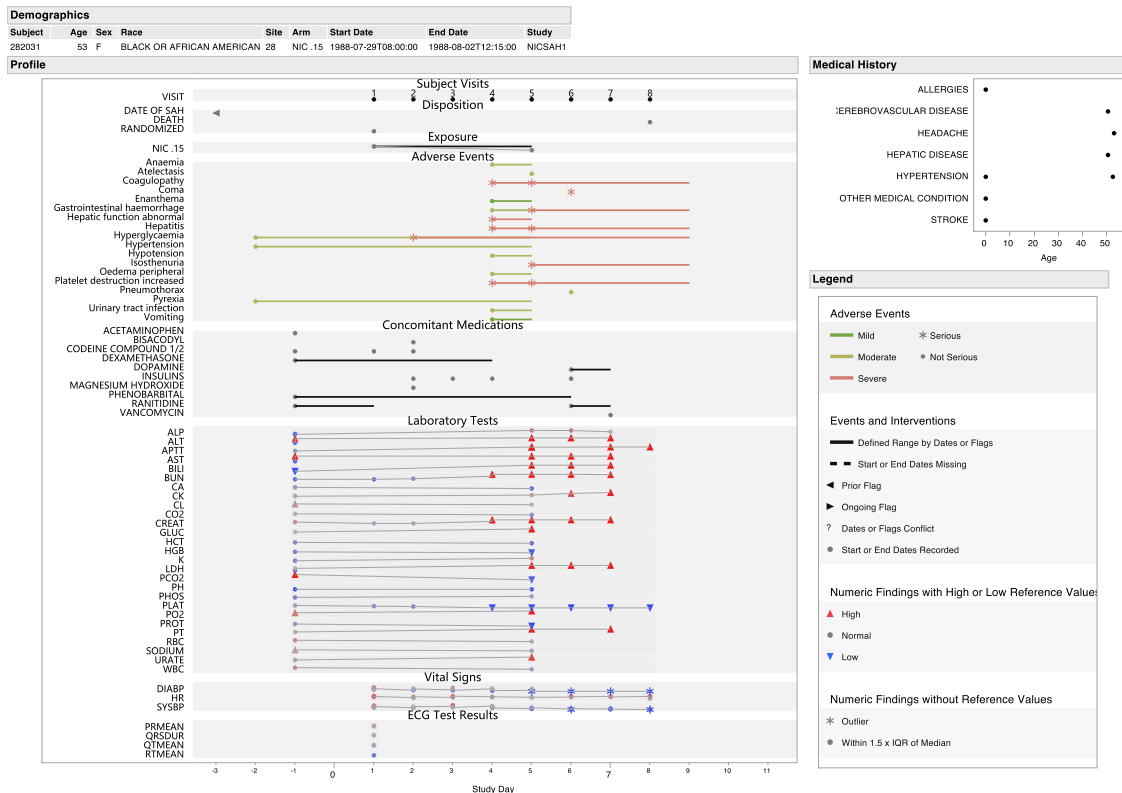




Visualization Case - Patient Profile

❑ Purpose

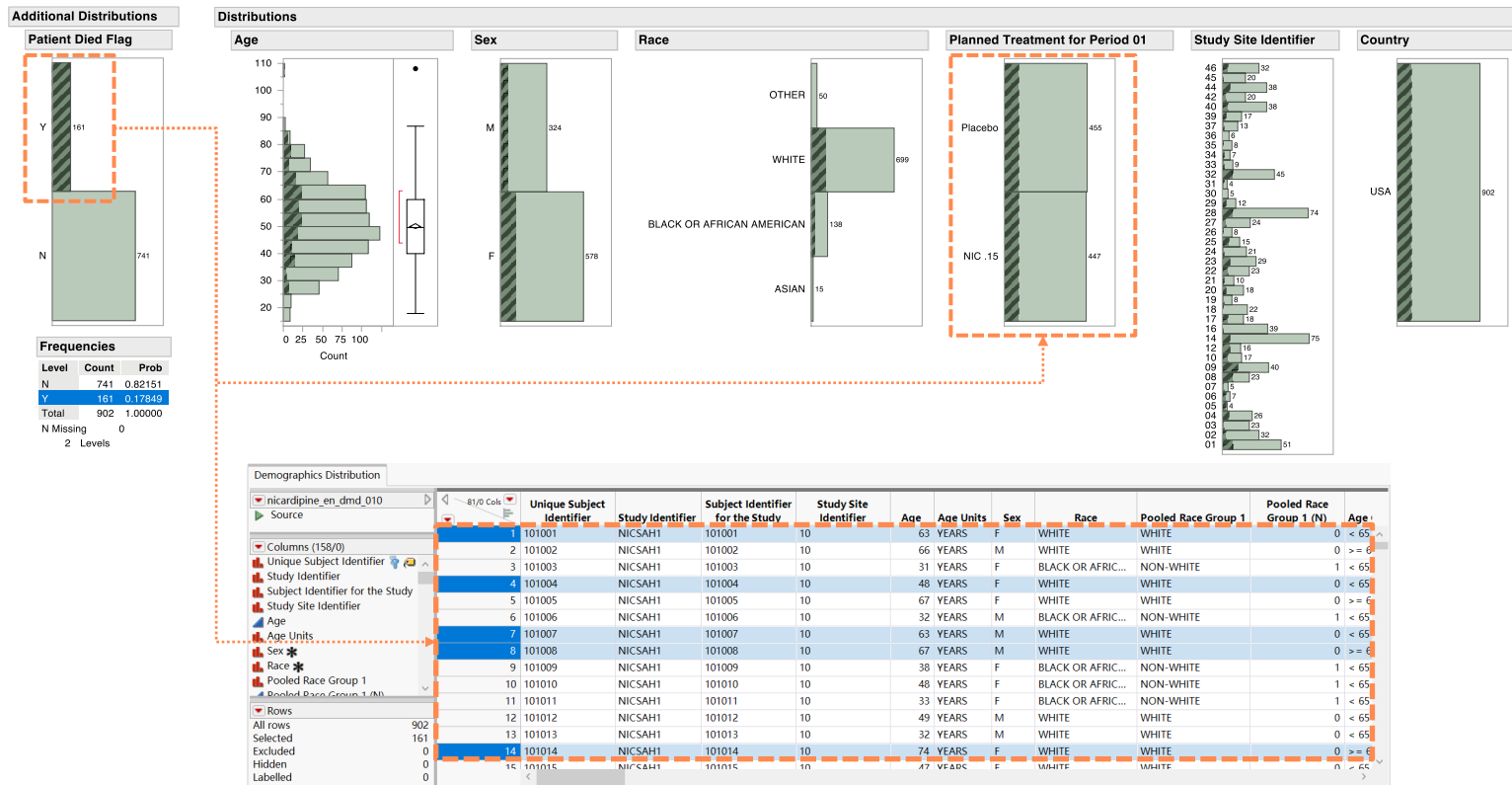
- ✓ Summary of subject personal safety information
 - ✓ The right figure integrates safety-related information from one of the Hy's law case subjects, which can be intuitively seen:
1. Concurrency of Adverse Events
 2. Concomitant Medications
 3. ECG Test Results
 4. Changes in Laboratory Test Results
 5. Changes in Vital Signs
 6. Time Relationship





Dynamic Interaction Case

Between Graph and Graph, Graph and Table, Graph and Data, Table and Data ...





Clinical Data Visualization Challenges

- ❑ Large amount of repetitive work is time-consuming and labor-intensive



- ❑ Insufficient timeliness



- ❑ Complex processes are difficult to promote



We wish the Professional and powerful tools would remember ...
The path to the Treasure !



A Simple Spider Plot Example

ID	Visit	Date	PSA Data
26001	第一周期,第一天	2018-09-21	255.40
32001	第一周期,第一天	2018-09-26	1202.00
26002	第一周期,第一天	2018-09-28	1.01
26004	第一周期,第一天	2018-09-29	191.90
26003	第一周期,第一天	2018-10-04	124.30
26001	第二周期,第一天	2018-10-19	429.60
32001	第二周期,第一天	2018-10-22	2997.00
17002	第一周期,第一天	2018-10-22	2914.00
20003	第一周期,第一天	2018-10-25	41.73
26004	第二周期,第一天	2018-10-25	322.20
02002	第一周期,第一天	2018-10-29	408.90
08001	第一周期,第一天	2018-10-30	19.69
03001	第一周期,第一天	2018-10-31	95.28
25001	第一周期,第一天	2018-11-01	664.10
26005	第一周期,第一天	2018-10-31	34.45
26003	第二周期,第一天	2018-11-01	204.80
27002	第一周期,第一天	2018-11-12	129.90
08002	第一周期,第一天	2018-11-15	261.70
26003	治疗结束	2018-11-16	237.10
26001	第三周期,第一天	2018-11-14	538.30
32001	第三周期,第一天	2018-11-19	4896.00
30002	第一周期,第一天	2018-11-22	319.60
20003	第二周期,第一天	2018-11-22	60.41
26004	第三周期,第一天	2018-11-22	358.60
02002	第二周期,第一天	2018-11-26	556.10
03001	第二周期,第一天	2018-11-28	159.80
08004	第一周期,第一天	2018-11-28	6.82
08001	第二周期,第一天	2018-11-29	20.84
26005	第二周期,第一天	2018-11-29	49.34
25001	第二周期,第一天	2018-11-29	961.90
21001	第一周期,第一天	2018-11-30	1644.00
29001	第一周期,第一天	2018-11-30	317.60
09005	第二周期,第一天	2018-12-02	260.80

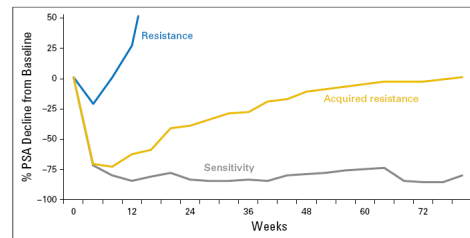
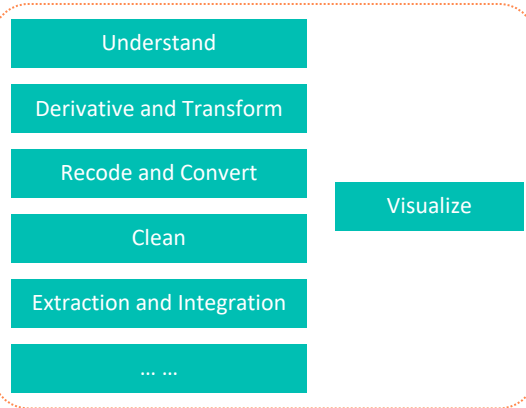


Fig A1. Three patterns of biomarker (eg, PSA) response to agents that effect cell kill. Shown are a substantial and durable decline consistent with marked sensitivity (gray line); a decline followed by a slow rise, indicative of partial sensitivity followed by acquired resistance (gold line); and a transient drop (or none at all) followed by an immediate rise, consistent with either de novo or intrinsic resistance (blue line). PSA, prostate-specific antigen.



Visualize





A Simple Spider Plot Example

Import Data and Derive New Variables

Log - JMP Pro

File Edit Tables DOE Analyze Graph Tools Add-Ins View Window Help

Filter

Type Message

Import Excel file: Simple Spider Plot_En.xls

New column: Start Date

New column: Weeks

Recode column: PSA Data

Change column info: PSA Data

Origin Result Timestamp

2021/10/22 20:34:28

2021/10/22 20:54:45

2021/10/22 21:05:30

2021/10/22 21:21:28

2021/10/22 21:50:33

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```
// Recode column: PSA Data
dt = Data Table( "Sheet" );
dt << Begin Data Update;
dt << Recode Column(
  dt:PSA Data,
  {Map Value(
    _rColOrig,
    {"<0.03", "0.03", ">5000", "5000", ">5000.00", "5000.00"},
    Unmatched( "_rColow" )
  )},
  Update Properties( 1 ),
  Target Column( :PSA Data )
);
dt << End Data Update;

// Change column info: PSA Data
Data Table( "Sheet" );PSA Data << Data Type( Numeric ) <<
Set Modeling Type( "Continuous" ) << Set Field Width( 12 );
```



Sheet - JMP Pro

File Edit Tables Rows Cols DOE Analyze Graph Tools Add-Ins View Window Help

Source

ID	Visit	Date	PSA Data	Start Date	Weeks
1	26001	第一周期,第一天	255.40	2018/09/21	0
2	32001	第一周期,第一天	1202.00	2018/09/26	0
3	26002	第一周期,第一天	1.01	2018/09/28	0
4	26004	第一周期,第一天	191.90	2018/09/29	0
5	26003	第一周期,第一天	124.30	2018/10/04	4
6	26001	第二周期,第一天	429.60	2018/09/21	4
7	32001	第二周期,第一天	2997.00	2018/09/26	4
8	17002	第一周期,第一天	2914.00	2018/10/22	0
9	20003	第一周期,第一天	41.73	2018/10/25	0
10	26004	第二周期,第一天	322.20	2018/09/29	4
11	02002	第一周期,第一天	408.90	2018/10/29	0
12	08001	第一周期,第一天	19.69	2018/10/30	0
13	03001	第一周期,第一天	95.28	2018/10/31	0
14	25001	第一周期,第一天	664.10	2018/11/01	0
15	26005	第一周期,第一天	34.45	2018/10/31	0
16	26003	第二周期,第一天	204.80	2018/10/04	4
17	27002	第一周期,第一天	129.90	2018/11/12	0

Columns (6/1)

ID

Visit

Date

PSA Data

Start Date

Weeks

Recode - PSA Data - JMP Pro

In Place

Count

Old Values (701)

New Values (701)

<0.03

>5000

5000.00

0.14

1.01

1.28

2.70

1.34

1.462

1.475

1.494

1.556

1.615

1.620

1.682

1.732

1.736

1.762

1.820

1.825

1.834

1.838

1.845

1.864

Filter

Group controls

☒ View Groups

☐ Show Only Grouped

☐ Show Only Ungrouped

Group

All

Only Modified

Only Unmodified

Changes

Scripting

☒ Script sequence of actions

☒ Compress sequence

Recode

Close

Help



A Simple Spider Plot Example

Extraction and Integration

Log - JMP Pro

File Edit Tables DOE Analyze Graph Tools Add-ins View Window Help

Filter

Type Message Origin Result Timestamp

- Import Excel file: Simple Spider Plot_En.xls
- New column: Start Date
- New column: Weeks
- Recode column: PSA Data
- Change column info: PSA Data
- Select matching cells
- Subset data table
- Clear row selection
- Change column name: PSA Data → PSA BSL Data
- Join data tables
- Close Data Table: Sheet
- Close Data Table: Subset of BSL
- New column: PSA% from BSL

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```
Include Nonmatches( 1, 0 ),
Preserve main table order( 1 ),
Output Table( "PSA Decline from BSL" );

// Close Data Table: Sheet
Close( "Sheet" );

// Close Data Table: Subset of BSL
Close( "Subset of BSL" );

// New column: PSA% from BSL
Data Table( "PSA Decline from BSL" ) << New Column( "PSA% from BSL",
Numeric,
"Continuous",
Format( "Percent", 12, 1 ),
Formula( (:PSA Data - :PSA BSL Data) / :PSA BSL Data )
);
```



PSA Decline from BSL - JMP Pro

File Edit Tables Rows Cols DOE Analyze Graph Tools Add-ins View Window Help

PSA Decline from BSL

ID	Weeks	PSA BSL Data	PSA Data	PSA% from BSL	
1	26001	0	255.4	255.4	0.0%
2	32001	0	1202	1202	0.0%
3	28002	0	1.01	1.01	0.0%
4	26004	0	191.9	191.9	0.0%
5	26003	0	124.3	124.3	0.0%
6	26001	4	255.4	429.6	68.2%
7	32001	4	1202	2997	149.3%
8	17002	0	2914	2914	0.0%
9	20003	0	41.73	41.73	0.0%
10	26004	4	191.9	322.2	67.9%
11	02002	0	408.9	408.9	0.0%
12	08001	0	19.69	19.69	0.0%
13	03001	0	95.28	95.28	0.0%
14	25001	0	664.1	664.1	0.0%
15	26005	0	34.45	34.45	0.0%
16	26003	4	124.3	204.8	64.8%
17	27002	0	129.9	129.9	0.0%
18	08002	0	26	26	0.0%
19	26003	6	12	12	0.0%
20	26001	8	25	25	0.0%
21	32001	8	1	1	0.0%
22	30002	0	3	3	0.0%
23	20003	4	41	41	0.0%
24	26004	8	19	19	0.0%
25	02002	4	40	40	0.0%
26	03001	4	95	95	0.0%
27	08004	0	6	6	0.0%
28	08001	4	19	19	0.0%
29	26005	4	34	34	0.0%
30	25001	4	66	66	0.0%
31	21001	0	1	1	0.0%
32	29001	0	3	3	0.0%
33	08005	0	28	28	0.0%
34	22002	0	53	53	0.0%
35	22001	0	10	10	0.0%
36	08002	4	26	26	0.0%
37	27002	4	12	12	0.0%
38	16001	0	58	58	0.0%
39	11002	0	16	16	0.0%
40	23001	0	198.6	198.6	0.0%
41	30002	4	319.6	203.2	-36.4%
42	02004	0	12.26	12.26	0.0%
43	32001	12	1202	5000	316.0%
44	25002	0	59.88	59.88	0.0%
45	20003	8	41.73	71.53	71.4%
46	02002	8	408.9	882	115.7%
47	08004	4	6.82	7.62	11.7%

Columns (5/1)

- ID
- Weeks
- PSA BSL Data
- PSA Data
- PSA% from BSL

PSA% from BSL - JMP Pro

'PSA% from BSL' in table 'PSA Decline from BSL'

Column Name: PSA% from BSL

☒ Lock

Data Type: Numeric

Modeling Type: Continuous

Format: Percent Width 12 Dec 1

☐ Use thousands separator (,)

Column Properties

Formula

Formula: (PSA Data - PSA BSL Data) / PSA BSL Data

Suppress Eval

Ignore Errors

Remove

OK Cancel Apply Help

Rows

All rows: 723

Selected: 0

Excluded: 0

Hidden: 0

Labeled: 0



A Simple Spider Plot Example

Construct the Graph

Log - JMP Pro

File Edit Tables DOE Analyze Graph Tools Add-Ins View Window Help

PSA Decline from BSL

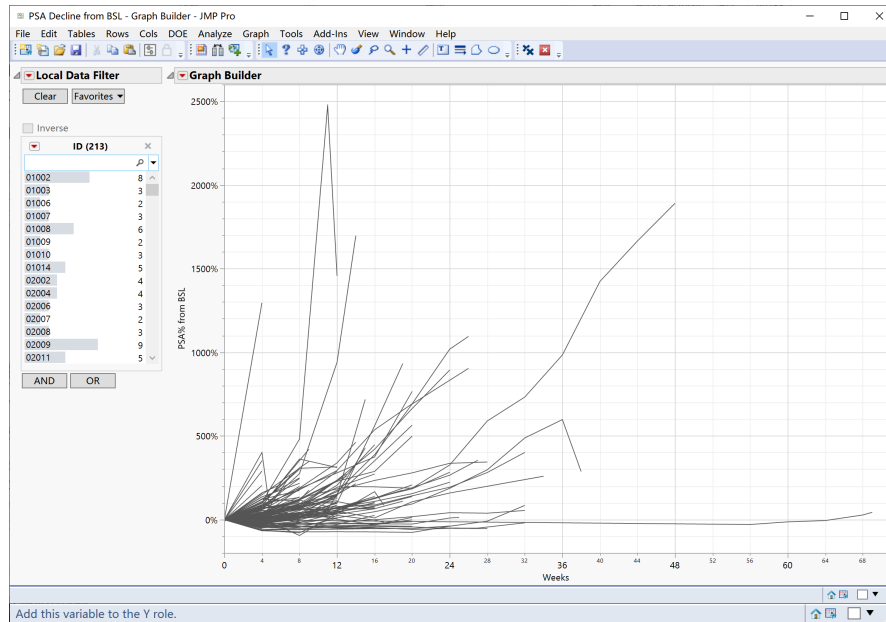
Filter

Type	Message	Origin	Result	Timestamp
Import	Import Excel file: Simple Spider Plot_En.xls			2021/10/22 20:34:28
New column	New column: Start Date			2021/10/22 20:54:43
New column	New column: Weeks			2021/10/22 21:05:30
Recode column	Recode column: PSA Data			2021/10/22 21:21:28
Change column info	Change column info: PSA Data			2021/10/22 21:50:33
Select matching cells	Select matching cells			2021/10/22 21:56:37
Subset data table	Subset data table			2021/10/22 21:58:01
Clear row selection	Clear row selection			2021/10/22 21:58:44
Change column name	Change column name: PSA Data → PSA BSL Data			2021/10/22 21:59:59
Join data tables	Join data tables			2021/10/22 22:11:14
Close Data Table: Sheet	Close Data Table: Sheet			2021/10/22 22:11:43
Close Data Table: Subset of BSL	Close Data Table: Subset of BSL			2021/10/22 22:11:49
New column	New column: PSA% from BSL			2021/10/22 22:18:53
Report snapshot	Report snapshot: PSA Decline from BSL - Graph Builder			2021/10/22 22:41:05

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```
// Report snapshot: PSA Decline from BSL - Graph Builder
Data Table( "PSA Decline from BSL" ) << Graph Builder(
  Size( 945, 661 ),
  Show Control Panel( 0 ),
  Show Legend( 0 ),
  Show Title( 0 ),
  Variables( X( :Weeks ), Y( :PSA% from BSL ), Overlay( :ID ) ),
  Elements( Line( X, Y, Legend( 0 ) ) ),
  Local Data Filter(
    Add Filter(
      columns( :ID ),
      Display( :ID, N Items( 15 ), Find( Set Text( "" ) ) )
    ),
  ),
  SendToReport(
    Dispatch(
      ( ),
      "Weeks",
      ScaleBox,
      {Min( 0 ), Max( 70.725 ), Inc( 12 ), Minor Ticks( 2 )},
      Label Row(
        {Show Major Grid( 1 ), Show Minor Grid( 1 ), Show Minor Labels( 1 )}
      )
    ),
    Dispatch(
      ( ),

```





A Simple Spider Plot Example

Save Auto-recording Script

The screenshot shows the JMP Pro interface with a message log window open. The log contains a list of actions performed, such as 'Import Excel file: Simple Spider Plot_En.xls', 'New column: Start Date', 'New column: Weeks', 'Recode column: PSA Data', 'Change column info: PSA Data', 'Select matching cells', 'Subset data table', 'Clear row selection', 'Change column name: PSA Data + PSA BSL Data', 'Join data tables', 'Close Data Table: Sheet', 'Close Data Table: Subset of BSL', 'New column: PSA% from BSL', and 'Report snapshot: PSA Decline from BSL - Graph Builder'. A context menu is open over the log, with options: 'Go To', 'Run Scripts', 'Color by Window' (checked), 'Clear', 'Clear Log', 'Filter', 'Action Recording', 'Save Script' (highlighted), 'To Script Window', 'To Clipboard', and 'Make into Data Table'. The script window at the bottom shows a series of Properties() calls for line colors and widths, and a Dispatch() call for a graph title.

```
Properties(
  209,
  {Line Color( 16 ), Line Width( 1 )},
  Item ID( "35001", 1 )
),
Properties(
  210,
  {Line Color( 16 ), Line Width( 1 )},
  Item ID( "35002", 1 )
),
Properties(
  211,
  {Line Color( 16 ), Line Width( 1 )},
  Item ID( "36002", 1 )
),
Properties(
  212,
  {Line Color( 16 ), Line Width( 1 )},
  Item ID( "37002", 1 )
),
Dispatch( {}, "graph title", TextBox, {Set Text( "PSA% from BSL" )} )
);
```



The screenshot shows the JMP Pro interface with a script window open. The script contains JSL code for importing an Excel file, opening a data table, creating new columns, recoding data, and saving the script. The script is as follows:

```
// Import Excel file: Simple Spider Plot_En.xls
// -- Data Table( "Sheet" )
Open(
  "$DESKTOP/2021 PHUSE SDE/Simple Spider Plot_En.xls",
  Worksheets( "Sheet" ),
  Use for all sheets( 1 ),
  Concatenate Worksheets( 0 ),
  Create Concatenation Column( 0 ),
  Worksheet Settings(
    1,
    Has Column Headers( 1 ),
    Number of Rows in Headers( 1 ),
    Headers Start on Row( 1 ),
    Data Starts on Row( 2 ),
    Data Starts on Column( 1 ),
    Data Ends on Row( 0 ),
    Data Ends on Column( 0 ),
    Replicated Spanned Rows( 1 ),
    Replicated Spanned Headers( 0 ),
    Suppress Hidden Rows( 1 ),
    Suppress Hidden Columns( 1 ),
    Suppress Empty Columns( 1 ),
    Treat as Hierarchy( 0 ),
    Multiple Series Stack( 0 ),
    Import Cell Colors( 0 ),
    Limit Column Detect( 0 ),
    Column Separator String( "-" )
  )
);

// New column: Start Date
Data Table( "Sheet" ) <- New Column( "Start Date",
  Numeric,
  "Continuous",
  Format( "y/m/d", 12 ),
  Input Format( "y/m/d" ),
  Formula( Col Minimum( :Date, :ID ) )
);

// New column: Weeks
Data Table( "Sheet" ) <- New Column( "Weeks",
  Numeric,
  "Continuous",
  Format( "Best", 12 ),
  Formula( Date Difference( :Start Date, :Date, "week" ) )
);

// Recode column: PSA Data
dt = Data Table( "Sheet" );
dt <- Begin Data Update;
dt <- Recode Column(
```

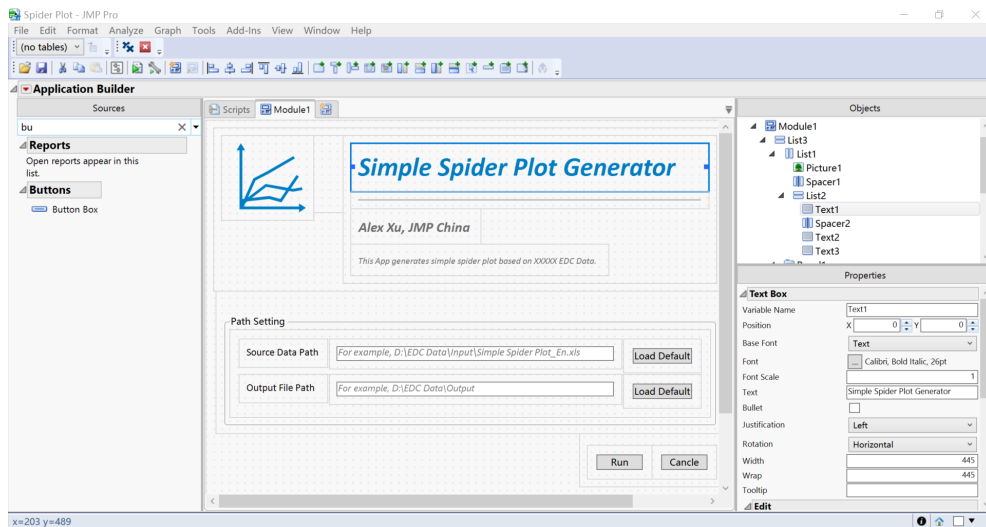
recap



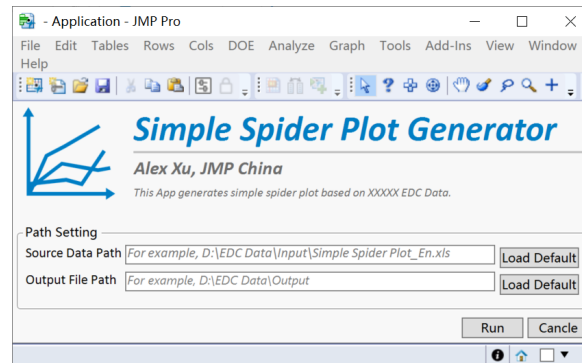
A Simple Spider Plot Example

Package the Recording Script to Custom App

Low Code App Development Platform



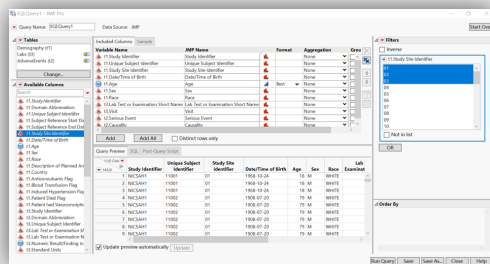
Custom App



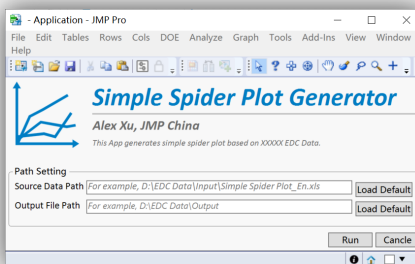


Automated Visualization of Clinical Data

A Feasible Workflow



ODBC Source Data Query



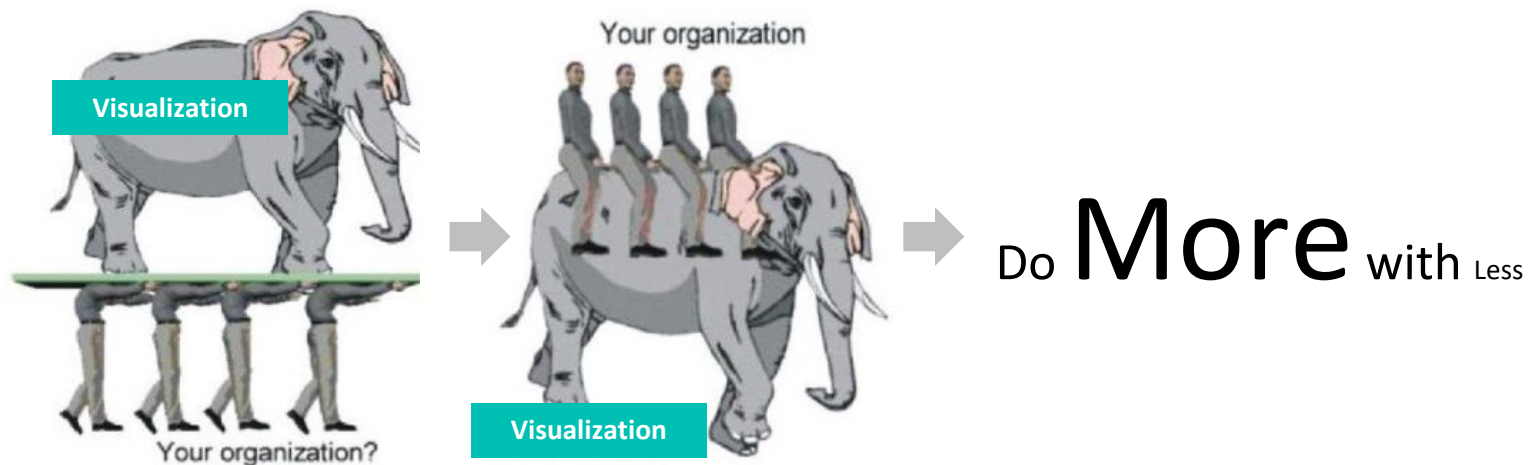
Custom App Data Processing



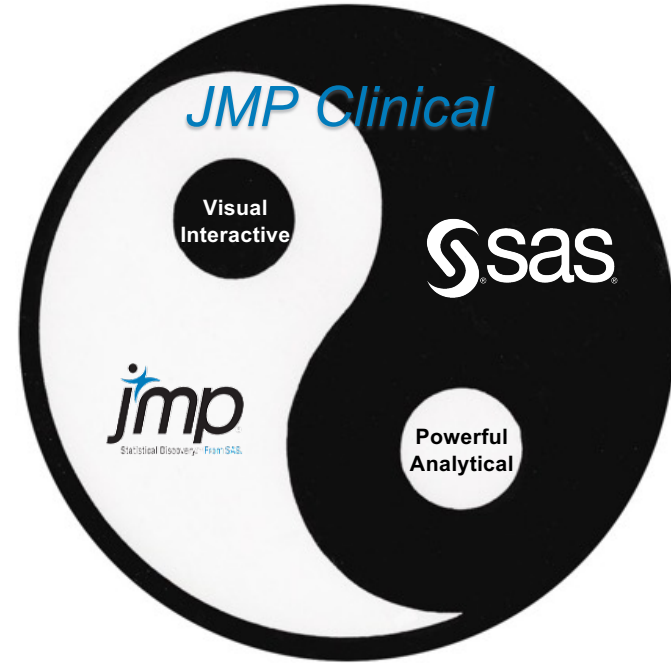
Analysis and Reporting

Summary

- ❑ Data visualization greatly helps researchers gain insight into clinical data and deliver information more clearly and efficiently
- ❑ Automated visualization of clinical data driven by data standardization can further improve efficiency, increase timeliness of analysis and rapid deployment across the enterprise
- ❑ Professional and powerful tools are essential



JMP Clinical® Streamline Analysis Solution



All the results were generated by
JMP Clinical or JMP

JMP® Empowers the Pharmaceutical and Biotechnology Industries



Note: Customers include but are not limited to ...

Thank You

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**The Global Healthcare
Data Science Community**

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