ARS in Action:
An implementation in R

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Introduction
What if I told you…

each result
What if I told you...

for all outputs in a study
What if I told you…

each result for all outputs in a study Can be calculated…
What if I told you…

each result for all outputs in a study can be calculated…

• with one click
What if I told you…

each result for all outputs in a study Can be calculated…

• with one click
• referencing only metadata
What if I told you…

each result for all outputs in a study Can be calculated…

• with one click
• referencing only metadata
• using open-source technology
What if I told you…

each result for all outputs in a study can be calculated…

- with one click
- referencing only metadata
- using open-source technology

Now, it’s possible!
Process overview
Process overview

Study documents → ARS Model → Results → Outputs / Display
Process overview

1. Study documents
2. ARS Model
3. Results
4. Outputs / Display
Process overview

- Study documents
- SAP Shells Protocol
- ARS Model
- Results
- Outputs / Display
Process overview

1. Study documents
2. ARS Model
3. Results
4. Outputs / Display

SAP Shells Protocol
Process overview

SAP Shells Protocol

Study documents → ARS Model → Results → Outputs / Display
Process overview

SAP Shells Protocol

Study documents

ARS Model

Contains metadata to produce results - e.g. Excel workbook

Results

Outputs / Display
Process overview

SAP Shells Protocol

Contains metadata to produce results - e.g. Excel workbook

Study documents -> ARS Model -> Results -> Outputs / Display
Process overview

SAP Shells Protocol

Study documents

ARS Model

Contains metadata to produce results - e.g. Excel workbook

“Engine”

Results

Outputs / Display

Contains metadata to produce results - e.g. Excel workbook
Process overview

Study documents

ARS Model

Results

Outputs / Display

SAP Shells Protocol

Contains metadata to produce results
- e.g. Excel workbook

“Engine”
Process overview

SAP Shells Protocol

Study documents

ARS Model

Contains metadata to produce results - e.g. Excel workbook

Single dataset containing all results

Results

Outputs / Display

“Engine”
Process overview

SAP Shells Protocol

Study documents

ARS Model

Contains metadata to produce results - e.g. Excel workbook

Results

Single dataset containing all results

Outputs / Display

“Engine”
Process overview

SAP Shells Protocol

Study documents

ARS Model

Contains metadata to produce results - e.g. Excel workbook

Results

Single dataset containing all results

“Engine”

Conversion tool

Outputs / Display
Process overview

- SAP Shells Protocol
- Study documents
- Contains metadata to produce results - e.g. Excel workbook
- Single dataset containing all results
- “Engine”
- Conversion tool
- Outputs / Display
Process overview

SAP Shells Protocol

Study documents

Contains metadata to produce results - e.g. Excel workbook

ARS Model

Single dataset containing all results

Results

Static or interactive

Outputs / Display

“Engine” Conversion tool
Process overview

Study documents → ARS Model → Results → Outputs / Display
Hackathon project: ARS in action
Hackathon project

Reporting Event (CSR, DSUR, IB, etc.)

Analyses of Interest

Analysis Results
Data (ARD)

Analysis Results
Metadata (Technical Specs)

Outputs / Displays

Analysis Programming

Prospective!

ADaM Specs &
Programming

Automation Engine

SAP / Mock-up
shells

Standard TFL
Templates

Machine-readable!

Machine-readable!

Results along with
Metadata

Data Visualization

Data Visualization

Automation Engine

Automation Engine

RTF/PDF/HTML

Outputs / Displays

Machine-readable!

Specs Ingestion

ADaM

JSON, Excel, YAML, etc.

JSON, SAS, R, YAML, etc.

CSR Publishing

SAS / R / Python

Automation Engine

Results along with
Metadata

Analyses of
Interest
Hackathon project

Example study: [cdisc-org/sdtm-adam-pilot-project Public]
Hackathon project

Example study: cdisc-org/sdtm-adam-pilot-project

Objective: Calculate all results (formatted) required for the safety outputs
Example study:

Objective: Calculate all results (formatted) required for the safety outputs

### 1. Demographics table

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Placebo (N=XX)</th>
<th>Xanomeline Low Dose (N=XX)</th>
<th>Xanomeline High Dose (N=XX)</th>
<th>p-value [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>X,XXXX</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>XX.X (XX.XX)</td>
<td>XX.X (XX.XX)</td>
<td>XX.X (XX.XX)</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>XX.X</td>
<td>XX.X</td>
<td>XX.X</td>
<td></td>
</tr>
<tr>
<td>Q1, Q3</td>
<td>XX.X, XX.X</td>
<td>XX.X, XX.X</td>
<td>XX.X, XX.X</td>
<td></td>
</tr>
<tr>
<td>Min, Max</td>
<td>XX, XX</td>
<td>XX, XX</td>
<td>XX, XX</td>
<td></td>
</tr>
<tr>
<td><strong>Age GROUP, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 65 years</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>X,XXXX</td>
</tr>
<tr>
<td>≥ 65 years</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>X,XXXX</td>
</tr>
<tr>
<td>Female</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>X,XXXX</td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td></td>
</tr>
</tbody>
</table>
Example study:

**Objective:** Calculate all results (formatted) required for the safety outputs

### 2. Summary of Treatment-Emergent Adverse Events

<table>
<thead>
<tr>
<th>Categories, n (%)</th>
<th>Placebo (N=XX)</th>
<th>Xanomeline Low Dose (N=XX)</th>
<th>Xanomeline High Dose (N=XX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects with at least one event</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEAE</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
</tr>
<tr>
<td>Related TEAE</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
</tr>
<tr>
<td>Serious TEAE</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
</tr>
<tr>
<td>Related Serious TEAE</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
</tr>
<tr>
<td>TEAE Leading to Death</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
</tr>
<tr>
<td>Related TEAE Leading to Death</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
</tr>
<tr>
<td>TEAE Leading to Dose Modification [a]</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
</tr>
<tr>
<td>TEAE Leading to Treatment Discontinuation</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
</tr>
</tbody>
</table>
Example study:

Objective: Calculate all results (formatted) required for the safety outputs

3. Summary of TEAE by System Organ Class and Preferred Term

<table>
<thead>
<tr>
<th>System Organ Class</th>
<th>Preferred Term</th>
<th>Placebo (N=XX)</th>
<th>Xanomeline Low Dose (N=XX)</th>
<th>Xanomeline High Dose (N=XX)</th>
<th>Fisher’s Exact p-values [b]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Placebo vs.</td>
<td>Xanomeline vs. Low Dose</td>
<td>Xanomeline vs. High Dose</td>
<td></td>
</tr>
<tr>
<td>Number of subjects with at least one event</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>XX (XX.X)</td>
<td>X.XXX</td>
<td>X.XXX</td>
</tr>
</tbody>
</table>

<SOC 1>

<Preferred Term 1>

...<Preferred Term n>

<SOC 2>

<Preferred Term 1>

...<Preferred Term n>
Example study:

Objective: Calculate all results (formatted) required for the safety outputs

4. Summary of Observed and Change from Baseline by Scheduled Visits – Vital Signs

<table>
<thead>
<tr>
<th>Parameter (Units)</th>
<th>Visit</th>
<th>Placebo (N=XX)</th>
<th>Xanomeline Low Dose (N=XX)</th>
<th>Xanomeline High Dose (N=XX)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Observed</td>
<td>Change from Baseline</td>
<td>Observed</td>
</tr>
<tr>
<td>n</td>
<td></td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td></td>
<td>XX.X (XX.XX)</td>
<td>XX.X (XX.XX)</td>
<td>XX.X (XX.XX)</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td>xx.X</td>
<td>xx.X</td>
<td>xx.X</td>
</tr>
<tr>
<td>Min, Max</td>
<td></td>
<td>xx.xx</td>
<td>xx.xx</td>
<td>xx.xx</td>
</tr>
</tbody>
</table>

...
Documents -> Model

Study documents → ARS Model → Results → Outputs / Display
Documents -> Model

Study documents ➔ ARS Model ➔ Results ➔ Outputs / Display
Documents -> Model

Study documents -> ARS Model -> Results -> Outputs / Display
## Documents -> Model

### ARS Model Results

<table>
<thead>
<tr>
<th>Level</th>
<th>Name</th>
<th>Order</th>
<th>analysisId</th>
<th>outputId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Summary of Demographics</td>
<td>1</td>
<td>An01_05_SAFT_Summ_ByTrt</td>
<td>Out14-1-1</td>
</tr>
<tr>
<td>2</td>
<td>Summary of Subjects by Treatment</td>
<td>1</td>
<td>An03_01_Age_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Age</td>
<td>2</td>
<td>An03_01_Age_Com_Brt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Summary by Treatment</td>
<td>3</td>
<td>An03_02_Age.grp_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Comparison by Treatment</td>
<td>2</td>
<td>An03_02_Age.grp_Com_Brt</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Age Group</td>
<td>3</td>
<td>An03_02_Age.grp_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Comparison of Subjects by Treatment</td>
<td>2</td>
<td>An03_02_Age.grp_Com_Brt</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sex</td>
<td>4</td>
<td>An03_03_Sex_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Summary of Subjects by Treatment</td>
<td>1</td>
<td>An03_03_Sex_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Comparison of Subjects by Treatment</td>
<td>2</td>
<td>An03_03_Sex_Com_Brt</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Ethnicity</td>
<td>5</td>
<td>An03_04_Ethnic_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Summary of Subjects by Treatment</td>
<td>1</td>
<td>An03_04_Ethnic_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Comparison of Subjects by Treatment</td>
<td>2</td>
<td>An03_04_Ethnic_Com_Brt</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Race</td>
<td>6</td>
<td>An03_05_Race_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Summary of Subjects by Treatment</td>
<td>1</td>
<td>An03_05_Race_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Comparison of Subjects by Treatment</td>
<td>2</td>
<td>An03_05_Race_Com_Brt</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Height</td>
<td>7</td>
<td>An03_06_Height_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Summary by Treatment</td>
<td>1</td>
<td>An03_06_Height_Summ_ByTrt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Comparison by Treatment</td>
<td>2</td>
<td>An03_06_Height_Com_Brt</td>
<td></td>
</tr>
</tbody>
</table>
Documents -> Model

Study documents -> ARS Model -> Results -> Outputs / Display
Documents -> Model

- Study documents
- ARS Model
- Results
- Outputs / Display
Documents -> Model

Study documents ➡ ARS Model ➡ Results ➡ Outputs / Display
Documents -> Model

Study documents → ARS Model → Results → Outputs / Display
Documents -> Model

Study documents → ARS Model → Results → Outputs / Display
Model -> Results

Study documents -> ARS Model -> Results -> Outputs / Display
Model -> Results

Study documents → ARS Model → Results → Outputs / Display

Method used:

“Common Safety displays.xlsx"
Model -> Results

Method used:

```
# title: excel_to_r
# purpose: Reads in reporting event in .xlsx format and produces analysis results dataset
# Author: Malan Bosman
# date: 27Jun2023
```

"Common Safety displays.xlsx"

Results dataset
Model -> Results

Method used:

"Common Safety displays.xlsx"

Results dataset
Model -> Results

Method used:

“Common Safety displays.xlsx”

Results dataset
Model -> Results

Method used:
“Common Safety displays.xlsx”

Results dataset
Model -> Results

Method used:

“Common Safety displays.xlsx”

Results dataset
Method used:

“Common Safety displays.xlsx”

Results dataset
Model -> Results

Method used:

"Common Safety displays.xlsx"

Results dataset
Model -> Results

Method used:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>id</td>
<td>version</td>
</tr>
<tr>
<td>2</td>
<td>CSD</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Common Safety Displays</td>
<td></td>
</tr>
</tbody>
</table>

Highlights:
Model -> Results

Method used:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>id</td>
<td>version name</td>
</tr>
<tr>
<td>2</td>
<td>CSD</td>
<td>1 Common Safety Displays</td>
</tr>
</tbody>
</table>

Highlights:

- Performs groupings
- Subsets data
- Basic method: Nested loops through “ListOfPlannedAnalyses”, then each Operation linked to the AnalysisMethod (linked to each Analysis)
- Chunk of code performing each operation appends rows after each operation to create Analysis Results dataset
- Applies correct pattern / format to result
Results -> Outputs / display

Study documents → ARS Model → Results → Outputs / Display
Results -> Outputs / Display

Study documents -> ARS Model -> Results -> Outputs / Display

Static
Results -> Outputs / Display

1. Study documents
2. ARS Model
3. Results
4. Outputs / Display

Static
Interactive
### Basic R-Shiny

#### Common Safety Displays

Select output: Out14-1-1

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Characteristic</th>
<th>Placebo (N=85)</th>
<th>Xanomeline High Dose (N=84)</th>
<th>Xanomeline Low Dose (N=84)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>n</td>
<td>86</td>
<td>84</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>Mean</td>
<td>75.2</td>
<td>74.4</td>
<td>75.7</td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>SD</td>
<td>8.59</td>
<td>7.89</td>
<td>8.29</td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>Median</td>
<td>76.0</td>
<td>76.0</td>
<td>77.5</td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>Q1</td>
<td>69.0</td>
<td>70.0</td>
<td>71.0</td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>Q3</td>
<td>82.0</td>
<td>80.0</td>
<td>82.0</td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>Min</td>
<td>52</td>
<td>56</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>Max</td>
<td>89</td>
<td>88</td>
<td>88</td>
<td>0.000000000000004</td>
</tr>
</tbody>
</table>
### Table 14.1.1

**Summary of Demographics**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Placebo (N=XX)</th>
<th>Xanomeline Low Dose (N=XX)</th>
<th>Xanomeline High Dose (N=XX)</th>
<th>p-value [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age [years]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>XX. X (XX, XX)</td>
<td>XX. X (XX, XX)</td>
<td>XX. X (XX, XX)</td>
<td>X.XXXX</td>
</tr>
<tr>
<td>Median</td>
<td>XX. X</td>
<td>XX. X</td>
<td>XX. X</td>
<td></td>
</tr>
<tr>
<td>Q1, Q3</td>
<td>XX, XX, XX. X</td>
<td>XX, XX, XX. X</td>
<td>XX, XX, XX. X</td>
<td></td>
</tr>
<tr>
<td>Min, Max</td>
<td>XX, XX</td>
<td>XX, XX</td>
<td>XX, XX</td>
<td></td>
</tr>
<tr>
<td><strong>Age Group, n [%]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 65 years</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>X.XXXX</td>
</tr>
<tr>
<td>≥ 65 years</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender, n [%]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>X.XXXX</td>
</tr>
<tr>
<td>Female</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity, n [%]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>X.XXXX</td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td>XX (XX. X)</td>
<td></td>
</tr>
</tbody>
</table>

**Basic R-Shiny app:**

```r
library(shiny)

# Data
data <- read.csv("demographics.csv")

# UI
ui <- fluidPage(
  titlePanel("Study - CBISC 360"),
  column(2, tagList(
    basicShinyOutput("Summary of Demographics"),
    summaryOutput("Safety Population"))
)

# Server
server <- function(input, output) {
  output$Summary of Demographics <- basicShinyOutput("Summary of Demographics")
  output$safety_population <- summaryOutput("Safety Population")
}

# Run the application
shinyApp(ui, server)
```

```shell
R -e "library(shiny)
  data <- read.csv("demographics.csv")
  library(shiny)
  ui <- fluidPage(
    titlePanel("Study - CBISC 360"),
    column(2, tagList(
      basicShinyOutput("Summary of Demographics"),
      summaryOutput("Safety Population"))
  )
  server <- function(input, output) {
    output$Summary of Demographics <- basicShinyOutput("Summary of Demographics")
    output$safety_population <- summaryOutput("Safety Population")
  }
  shinyApp(ui, server)"
```
Study documents

ARS Model

Results

Outputs / Display

Results -> Outputs / Display

Shell:

Basic R-Shiny app:

Table 14.1.1
Summary of Demographics
Safety Population

| Characteristics       | Placebo (N=XX) | Xanomeline Low Dose (N=XX) | Xanomeline High Dose (N=XX) | p-value [1]
|-----------------------|----------------|-----------------------------|-------------------------------|----------
| Age (years) n (%)     |                |                             |                               |          
| < 65 years            | XX (XX.X)      | XX (XX.X)                   | XX (XX.X)                     | X.XXXX   
| ≥ 65 years            | XX (XX.X)      | XX (XX.X)                   | XX (XX.X)                     | X.XXXX   
| Gender, n (%)         |                |                             |                               |          
| Male                  | XX (XX.X)      | XX (XX.X)                   | XX (XX.X)                     | X.XXXX   
| Female                | XX (XX.X)      | XX (XX.X)                   | XX (XX.X)                     | X.XXXX   
| Ethnicity, n (%)      |                |                             |                               |          
| Hispanic or Latino    | XX (XX.X)      | XX (XX.X)                   | XX (XX.X)                     | X.XXXX   
| Not Hispanic or Latino| XX (XX.X)      | XX (XX.X)                   | XX (XX.X)                     | X.XXXX   

Analysis

| Characteristic       | Placebo (N=86) | Xanomeline High Dose (N=84) | Xanomeline Low Dose (N=84) | p-value |
|----------------------|----------------|-----------------------------|----------------------------|---------
| Age (Years) n        | 86             | 84                          | 84                          |         
| Age (Years) Mean     | 73.2           | 74.4                        | 75.7                        |         
| Age (Years) Median   | 76.0           | 76.0                        | 77.5                        |         
| Age (Years) SD       | (8.59)         | (7.89)                      | (8.29)                      |         
| Age (Years) Q1       | 69.0           | 70.0                        | 71.0                        |         
| Age (Years) Q3       | 82.0           | 80.0                        | 82.0                        |         
| Age (Years) Min      | 52             | 56                          | 51                          |         
| Age (Years) Max      | 89             | 88                          | 88                          |         

Show 100 entires
Concluding thoughts
Concluding thoughts

Automation
- Aim for automation
- Across industry

Open-source
- Quicker adoption
- Easier collaboration

User Experience
- Make it a priority
- Part of design
Next steps:

### Common Safety Displays

Select output: Out14-1-1

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<th>Characteristic</th>
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<th>Xanomeline High Dose (N=84)</th>
<th>Xanomeline Low Dose (N=84)</th>
<th>p-value</th>
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</table>
Github repo: malanbos / ARS_R

E-mail: Malan.bosman@iconplc.com