

CDISC Analysis Results Standards - Approach and Development Update

Paper DS09

Karl Wallendszus, Senior Analyst/Programmer, Oxford Population Health, University of Oxford

Hansjörg Frenzel, Senior Principal Global Data Standards Consultant, ICON Plc





Meet the Speaker

Karl Wallendszus

Title: Senior Analyst/Programmer

Organization: Oxford Population Health, University of Oxford

Karl Wallendszus is a statistical programmer in the Nuffield Department of Population Health in the University of Oxford. Over the last 30 years he has worked on a number of large clinical trials in cardiology and kidney disease as well as the RECOVERY trial of treatments for COVID-19. Several of these studies have had an important impact on clinical practice. He has been using CDISC standards since 2010, which at the time was unusual for an academic institution. Karl joined the CDISC Analysis Results Standard team in late 2020.



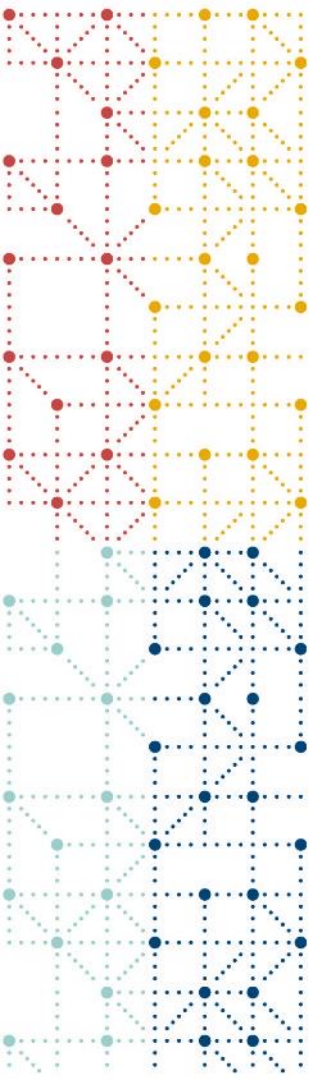
Meet the Speaker

Hansjörg Frenzel

Title: Senior Principal Global Data Standards Consultant

Organization: ICON plc

Hansjörg Frenzel is a Senior Principal Global Data Standards Consultant at ICON PLC, developing TFL Standards within the company. Hansjörg was part of a team that developed a proof-of-concept application for metadata driven TFL generation, which was further developed and is now in use company wide. This tool provides libraries of metadata configured tables based on those TFL standards to SAS developers. Hansjörg joined the CDISC Analysis Results Standard Team in March 2020.



Agenda

1. Introduction
2. Analysis Results Current State
3. Analysis Results Standards
 - Analysis Results Dataset Model
 - ARM Technical Specification
4. Analysis Result Standards Implementation
5. Analysis Results Desired Future State
6. Analysis Results Standards Deliverables



Introduction

- Results in clinical trials are rarely machine readable
- Difficult to automate their generation, make them reproducible, trace their origin or reuse them for further outputs
- The Clinical Data Interchange Consortium (CDISC) develops data standards for clinical trials which have been widely adopted by industry, regulators, and, increasingly, academia
- A standard way of representing and describing analysis results and associated metadata is therefore desirable

Row	STUDYID	USUBJID	MIDS	CEDECOD	WASAEYN	ASTDTIM
1	XYZ	000001	HYPO 1	Hypoglycemia	Y	07SEP2012 22:29:00
2	XYZ	000001	HYPO 2	Hypoglycemia	N	10SEP2012 09:12:00
3	XYZ	000001	HYPO 3	Hypoglycemia	N	10SEP2012 23:05:00
4	XYZ	000001	HYPO 4	Hypoglycemia	N	11SEP2012 15:24:00
5	XYZ	000001	HYPO 5	Hypoglycemia	N	18SEP2012 11:39:00
6	XYZ	000002	HYPO 1	Hypoglycemia	N	22OCT2012 13:28:00
7	XYZ	000002	HYPO 2	Hypoglycemia	N	25OCT2012 13:59:00
8	XYZ	000002	HYPO 3	Hypoglycemia	N	17Nov2012 05:01:00

[illegible]

Table	DISPL	ANAL
Meta	RESU	ANAL
DISP	PARA	ANAL
DISP	PARAMCD	
	ANALYSIS VAR	
RES	ANALYSIS REA	
PAR	ANALYSIS PUR	
PAR	ANALYSIS DAT	

6



Analysis Results Current State

- Static results created for Clinical Study Report
- May be hundred of tables in PDF format, often difficult to navigate
- No or limited traceability (e.g., to protocol, SAP, ADaM data)
- Expensive to generate and only used once, no or limited reusability
- ARM v1.0 describes *metadata* about displays (PDF) and results (at high level), no formal analysis and results model or results data.
- Lack of features to drive automation
- Limited regulatory use cases

Analysis Results Standards Goals



Analysis Results Metadata Technical Specification (ARM-TS), to support automation, traceability, and creation of data displays

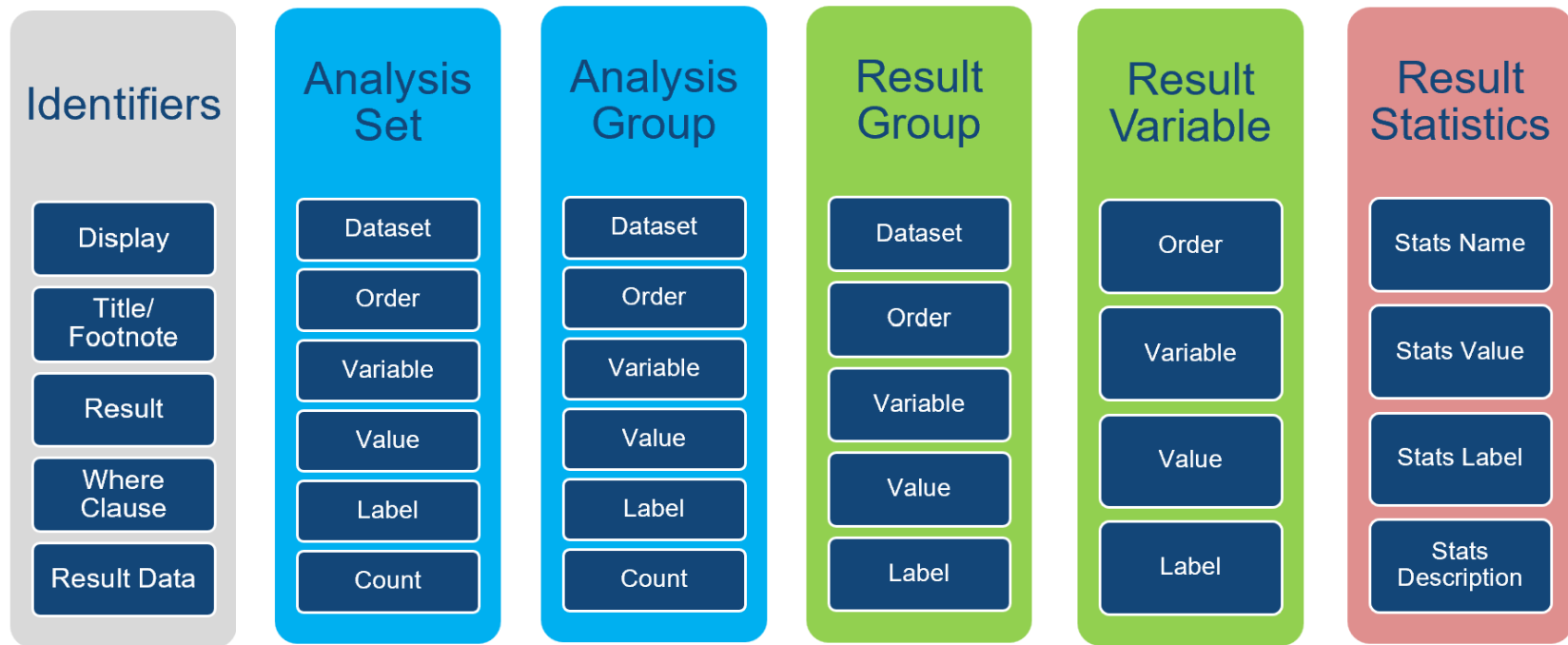


Define an Analysis Results Data (ARD) structure, to support reuse and reproducibility of results data



Illustrate and exercise ARD and ARM-TS with a set of common data displays

Analysis Result Dataset Model – Key Elements*



* Work in progress

ARM Technical Specification*

- Prospective focus on automation, traceability, and creation of data displays
- Linked, modular, flexible and tool agnostics
- Supports meta-programming
- Serves a different purpose than ARM for Define-XML

Output	StudyID
	AnalysisTask
	AnalysisSetLabel
	OutputOrder
	DisplayID
	Filename
	OutputVersion
	FileType
	StyleID
Display	DisplayID
	ReferenceDisplayID
	Version
	Name
	Title
	DisplaySectionID
	AnalysisSetID
	AnalysisGroupID
Result	DisplayTemplateID
	Document
	DisplayID
	AnalysisResultID
	Version
	ResultDescription
	DisplayPattern
	Reason
	Purpose
	Dataset
	AnalysisVariable
	AnalysisGroupID
	WhereClauseID
	GroupingByVar
	GroupingByOrdFmt
	Documentation
Style	ProgrammingCodeContext
	ProgrammingCode
	CodeReference
	StyleID
Display Section	StyleContext
	ElementName
	ElementValue
Display Section	DisplaySectionID
	ReferenceDisplayID
	Section
	SectionSubID
	Order
	Label
	Text
	Reference
Analysis Set	AnalysisSetID
	Dataset
	Order
	Variable
	Comparator
	Value
	Label
Analysis Group	CompoundExpression
	AnalysisGroupID
	Dataset
	Order
	Variable
	Comparator
	Value
Template	Label
	CompoundExpression
	DisplayTemplateID
	TemplateContext
Where Clause	ElementName
	ElementValue
	WhereClauseID
	Dataset
	Order
	Variable
	Comparator
	Value
	Label
	Compound Expression

*Work in progress

Principles for CDISC ARS Implementation



Automation

	AGE	RACE	RFKENOTC	RFKSTOTC	SAFL	SEX	SITEID	STUDYID	SUBJID	TRTGRP
Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
1	31	ASIAN		-08	Y	M	001	PRASD-TFLV-4	001-0001	TRT A
2	20	OTHER		-19	Y	M	001	PRASD-TFLV-4	001-0002	TRT B
3	22	NATIVE HAWAIIAN OR O		-21	Y	M	001	PRASD-TFLV-4	001-0003	TRT B
4	38	ASIAN		-04	Y	M	001	PRASD-TFLV-4	001-0004	TRT B
5	27	OTHER	2021-04-03	2021-03-24	Y	M	001	PRASD-TFLV-4	001-0005	TRT A
6	57	ASIAN	2021-09-11	2021-05-12	Y	F	001	PRASD-TFLV-4	001-0006	TRT A

ADaM

```

<results>
<list-item>
  <analysis_result_id>T14201-VS-01</analysis_result_id>
  <version>1</version>
  <result_description>SBP by visit</result_description>
  <display_pattern/>
  <reason>SPECIFIED IN SAS</reason>/>
  <purpose>SECOND</purpose>
  <dataset>ADVS</dataset>
  <where_clause>S</where_clause>
  <analysis_vari
  <analysis_group_id>T14201-VS</analysis_group_id>
  <grouping_by_var1>PARAMCD</grouping_by_var1/>
  <grouping_by_var2>AVISITN</grouping_by_var2/>
  <programming_code_context>SAS 9.4</programming_code_context/>
  <programming_code>analyze_vs.sas</programming_code/>
</list-item>
</results>

```

ARM-TS

Analysis programs

StudyID	AnalysisGrpVar_1Label	ResultByVar_1Val	ResultByVar_1Label	ResultByVar_2Label	AnalysisVar	StatsName	StatsLabel	StatsVal
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	184
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.8
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	137
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	80
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	255
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	124
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.81
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	186
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.9
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	100
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	252
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	122
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.57
CDISC Pilot 01	Xanomeline High Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	194
CDISC Pilot 01	Xanomeline High Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	138.8
CDISC Pilot 01	Xanomeline High Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138

ARD

Automation

Study - CDISC Pilot 01

Table 14.3.3
Summary of Observed and Change from Baseline by Scheduled Visits - Vital Signs
Safety Population

Parameter (Units) Visit	Placebo (N=255)	Xanomeline Low Dose (N=252)	Xanomeline High Dose (N=252)	Total (N=759)
Baseline				
Systolic Blood Pressure (mmHg)				
n	255	252	252	759
Mean (SD)	136.8 (17.81)	136.9 (17.57)	138.8 (18.74)	137.5 (18.04)
Median	137	138	138	138
Q1, Q3	124, 150	122, 150	125, 150	124, 150
Min, Max	80, 184	100, 186	100, 194	80, 194
Week 2				
n				746
Mean (SD)				133.8 (17.41)
Median				131
Q1, Q3				121, 144
Min, Max				86, 191
Week 2 Change from Baseline				
n				743
Mean (SD)	-3.3 (14.60)	-1.8 (15.32)	-6.1 (15.57)	-3.7 (15.25)
Median	-2	-6	-6	-3
Q1, Q3	-12, 4	-10, 8	-16, 4	-12, 6
Min, Max	-38, 40	-48, 40	-52, 40	-52, 40

Note: Baseline is defined as the last assessment that is non-missing prior to first dose of investigational product.

Source dataset: adrs, Generated on: 2022-09-20T10:40:52
Program: analyze_vs.sas, Output: VS-02-Chg-Vital.ctf, Generated on: 2022-09-20T11:17:14

Output table

Reproducibility

	AGE	RACE	RFKENDTC	RFKSTOTC	SAFL	SEX	SITEID	STUDYID	SUBJID	TRTGRP
1	31	ASIAN				M	001	PRASD-TFLV-4	001-0001	TRT A
2	20	OTHER				M	001	PRASD-TFLV-4	001-0002	TRT B
3	22	NATIVE HAWAIIAN OR O				M	001	PRASD-TFLV-4	001-0003	TRT B
4	38	ASIAN				M	001	PRASD-TFLV-4	001-0004	TRT B
5	27	OTHER	2021-04-03	2021-03-24	Y	M	001	PRASD-TFLV-4	001-0005	TRT A
6	57	ASIAN	2021-09-11	2021-05-12	Y	F	001	PRASD-TFLV-4	001-0006	TRT A

ADaM

```

<results>
  <list-item>
    <analysis_result_id>T14201-VS-01</analysis_result_id>
    <version>1</version>
    <result_description>SBP by visit</result_description>
    <display_pattern/>
    <reason>SPECIFIED IN SAS</reason>/>
    <purpose>SECOND</purpose>
    <dataset>ADVS</dataset>
    <clause>
      <grouping_by_var1>PARAMCD</grouping_by_var1>
      <grouping_by_var2>AVISITN</grouping_by_var2>/>
    <programming_code_context>SAS 9.4</programming_code_context>/>
    <programming_code>analyze_vs.sas</programming_code>/>
  </list-item>
</results>

```

ARM-TS

Alternative programs

Reproducibility

StudyID	AnalysisGrpVar_1Label	ResultByVar_1Val	ResultByVar_1Label	ResultByVar_2Label	AnalysisVar	StatsName	StatsLabel	StatsVal
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	184
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.8
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	137
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	80
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	255
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	124
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.81
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	186
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.9
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	100
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	252
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	122
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.57
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	194
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	138.8
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138

ARD

StudyID	AnalysisGrpVar_1Label	ResultByVar_1Val	ResultByVar_1Label	ResultByVar_2Label	AnalysisVar	StatsName	StatsLabel	StatsVal
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	184
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.8
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	137
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	80
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	255
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	124
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.81
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	186
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.9
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	100
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	252
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	122
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.57
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	194
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	138.8
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138

ARD

Compare

Reusability

	AGE	RACE	RFKENDTC	RFKSTOTC	SAFL	SEX	SITEID	STUDYID	SUBJID	TRTGRP
	Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q1
1	31	ASIAN		-08	Y	M	001	PRASD-TFLV-4	001-0001	TRT A
2	20	OTHER		19	Y	M	001	PRASD-TFLV-4	001-0002	TRT A
3	22	NATIVE HAWAIIAN OR O		-21	Y	M	001	PRASD-TFLV-4	001-0003	TRT B
4	38	ASIAN		-04	Y	M	001	PRASD-TFLV-4	001-0004	TRT B
5	27	OTHER	2021-04-03	2021-03-24	Y	M	001	PRASD-TFLV-4	001-0005	TRT A
6	57	ASIAN	2021-09-11	2021-05-12	Y	F	001	PRASD-TFLV-4	001-0006	TRT A

ADaM

```

<results>
  <list-item>
    <analysis_result_id>T14201-VS-01</analysis_result_id>
    <version>1</version>
    <result_description>SBP by visit</result_description>
    <display_pattern/>
    <reason>SPECIFIED IN SAS</reason>/>
    <purpose>SECOND</purpose>
    <dataset>ADVS</dataset>
    <where_clause>S</where_clause>
    <analysis_vari
    <analysis_group_id>T14201-VS-01</analysis_group_id>
    <grouping_by_var1>PARAMCD</grouping_by_var1>/>
    <grouping_by_var2>AVISITN</grouping_by_var2>/>
    <programming_code_context>SAS 9.4</programming_code_context>/>
    <programming_code>analyze_vs.sas</programming_code>/>
  </list-item>
</results>

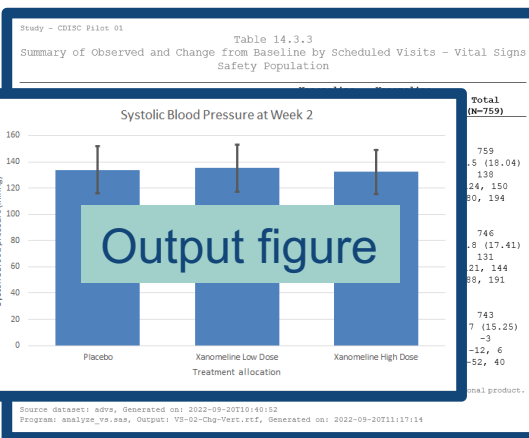
```

ARM-TS

StudyID	AnalysisGrpVar_1Label	ResultByVar_1Val	ResultByVar_1Label	ResultByVar_2Label	AnalysisVar	StatsName	StatsLabel	StatsVal
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	184
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.8
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	137
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	80
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	255
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	124
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Placebo	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.81
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	186
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.9
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	100
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	252
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	122
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Xanomeline Low Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.57
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	194
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	138.8
CDISC Pilot 01	Xanomeline High Dose	SYSPB	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138

ARD

Reusability



Output figure

Traceability

	AGE	RACE	RFKENDTC	RFKSTOTC	SAFL	SEX	SITEID	STUDYID	SUBJID	TRTGRP
Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
1	31	ASIAN		-08	Y	M	001	PRASD-TFLV-4	001-0001	TRT A
2	20	OTHER		-19	Y	M	001	PRASD-TFLV-4	001-0002	TRT A
3	22	NATIVE HAWAIIAN OR O		-21	Y	M	001	PRASD-TFLV-4	001-0003	TRT B
4	38	ASIAN		-04	Y	M	001	PRASD-TFLV-4	001-0004	TRT B
5	27	OTHER	2021-04-03	2021-03-24	Y	M	001	PRASD-TFLV-4	001-0005	TRT A
6	57	ASIAN	2021-09-11	2021-05-12	Y	F	001	PRASD-TFLV-4	001-0006	TRT A

ADaM

```

<results>
  <list-item>
    <analysis_result_id>T14201-VS-01</analysis_result_id>
    <version>1</version>
    <result_description>SBP by visit</result_description>
    <display_pattern/>
    <reason>SPECIFIED IN SDG/SPACER/</reason>
    <purpose>SECOND</purpose>
    <dataset>ADVS</dataset>
    <where_clause>S</where_clause>
    <analysis_vari
    <analysis_group_id>T14201-VS-01</analysis_group_id>
    <grouping_by_var1>PARAMCD</grouping_by_var1>
    <grouping_by_var2>AVISITN</grouping_by_var2>
    <programming_code_context>SAS 9.4</programming_code_context>
    <programming_code>analyze_vs.sas</programming_code>
  </list-item>
</results>

```

ARM-TS

StudyID	AnalysisGrpVar_1Label	ResultByVar_1Val	ResultByVar_1Label	ResultByVar_2Label	AnalysisVar	StatsName	StatsLabel	StatsVal
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	184
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.8
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	137
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	80
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	255
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	124
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Placebo	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.81
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	186
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	136.9
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MIN	Minimum	100
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	N	Number	252
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q1	Quartile 1	122
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	Q3	Quartile 3	150
CDISC Pilot 01	Xanomeline Low Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	STD	Standard deviation	17.57
CDISC Pilot 01	Xanomeline High Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MAX	Maximum	194
CDISC Pilot 01	Xanomeline High Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEAN	Mean	138.8
CDISC Pilot 01	Xanomeline High Dose	SYSPBP	Systolic Blood Pressure (mmHg)	Baseline	AVAL	MEDIAN	Median	138

ARD

Traceability

Study - CDISC Pilot 01

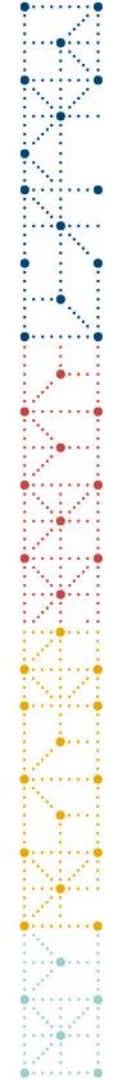
Table 14.3.3
Summary of Observed and Change from Baseline by Scheduled Visits - Vital Signs
Safety Population

Parameter (Units) Visit	Placebo (N=255)	Xanomeline Low Dose (N=252)	Xanomeline High Dose (N=252)	Total (N=759)
Baseline				
Systolic Blood Pressure (mmHg)				
n	255	252	252	759
Mean (SD)	136.8 (17.81)	136.9 (17.57)	138.8 (18.74)	137.5 (18.04)
Median	137	138	138	138
Q1, Q3	124, 150	122, 150	125, 150	124, 150
Min, Max	80, 184	100, 186	100, 194	80, 194
Week 2				
n				746
Mean (SD)				133.8 (17.41)
Median				131
Q1, Q3				121, 144
Min, Max				86, 191
Week 2 Change from Baseline				
n				743
Mean (SD)	-3.3 (14.60)	-1.8 (15.32)	-6.1 (15.57)	-3.7 (15.25)
Median	-2	-6	-6	-3
Q1, Q3	-12, 4	-10, 8	-16, 4	-12, 6
Min, Max	-38, 40	-48, 40	-52, 40	-52, 40

Note: Baseline is defined as the last assessment that is non-missing prior to first dose of investigational product.

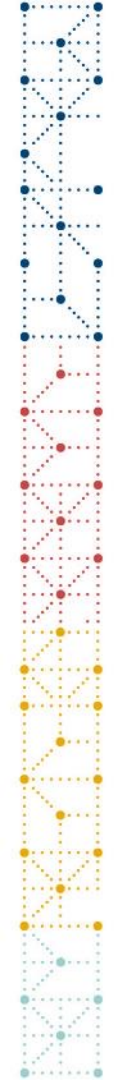
Source dataset: adrs, Generated on: 2022-09-20T10:40:52
Program: analyze_vs.sas, Output: VS-02-Chg-Vital.ctf, Generated on: 2022-09-20T11:17:14

Output table



Analysis Results Desired Future State

- Formal model for describing analyses and results as data
- Facilitate automated generation of results
- From electronic (PDF) to machine readable results, with context and metadata to source
- Improved navigation and reusability of analyses and results
- Support storage, access, processing and reproducibility of results
- Traceability to Protocol/SAP and to input ADaM data
- Open-source tools to design, specify, build and generate analysis results



Analysis Results Standards Deliverables

- Content Scope: common safety analyses
- Deliverables for v1.0
 - ARM Technical Specification
 - New Model and Implementation Guide to represent analysis results
 - Terminology
 - Identification of Conformance Rules
- Expected publication 2023



Thank you

Contact:

karl.wallendszus@ndph.ox.ac.uk

hansjoerg.frenzel@iconplc.com

