

APIs through SAS, endless possibilities

Davide Marinucci

May 12, 2023 - IX Italian CDISC UN Day



Agenda

APIs

3

PROC HTTP

7

CDISC LIBRARY

11

EXAMPLE 1: SDTM_COMP

17

EXAMPLE 2: LABEL SDTM

22

ROUND UP

25

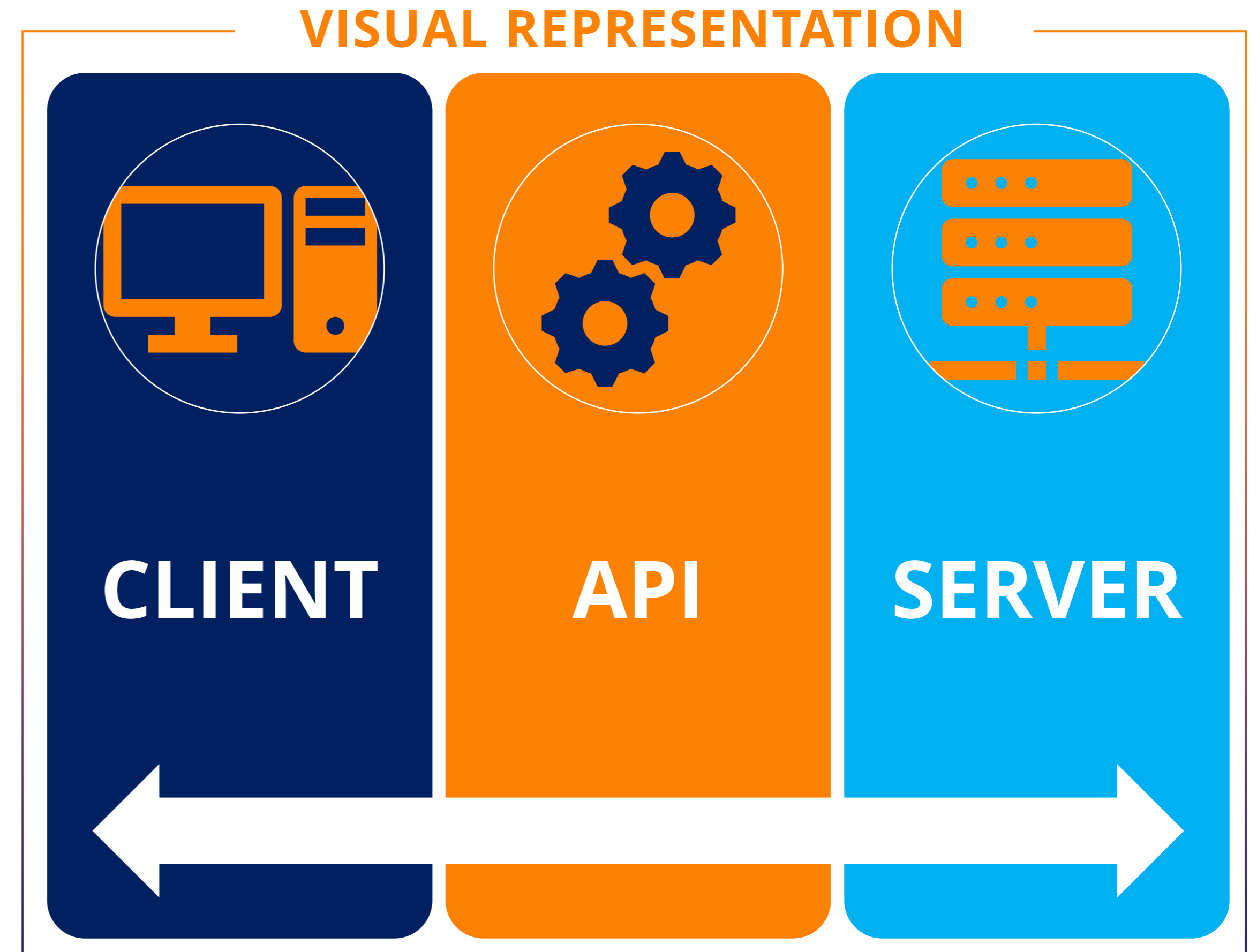
APIs



What are APIs?

An API, or application programming interface, is a set of defined rules that enable different applications to communicate with each other.

- **API architecture** is usually explained in terms of client and server. The application sending the request is called the client, and the application sending the response is called the server.

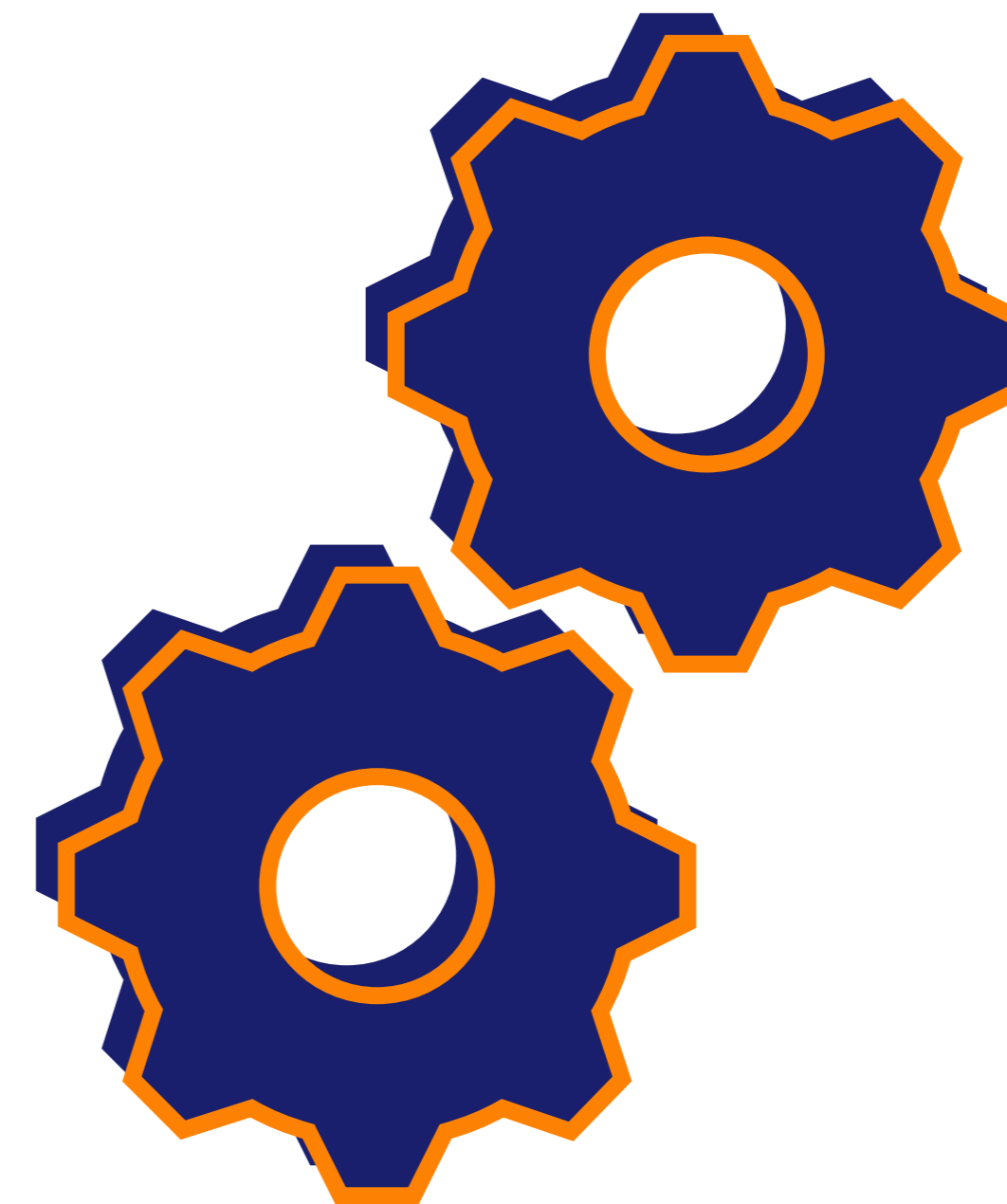


Types of APIs

What are REST APIs?

A REST API is an API that conforms to the design principles of the REST, or representational state transfer architectural style.

- **REST (Representational State Transfer)** defines a set of functions like GET, PUT, DELETE, etc. that clients can use to access server data. Clients and servers exchange data using HTTP.



PROC HTTP



PROC HTTP

PROC HTTP is a powerful SAS procedure for creating HTTP requests to establish a communication between client and server

- > **PROC HTTP** issues HTTP requests;
- > Allows an open-ended set of methods conforming to HTTP/1.1 standard (features);
- > Custom request headers can be specified in a HEADERS statement or by submitting a fully formatted input file from a fileref;
- > Uses connection caching and cookie caching by default for web servers that support it;
- > Authentication specification feature allows for one or multiple authentication types to be specified for a request.

SYNTAX

```
PROC HTTP URL="URL-to-target</redirect/n>"
  <METHOD=<">http-method<">>
  <authentication-type-options>
  <caching-options>
  <header-options>
  <proxy-server-connection-options>
  <web-server-authentication-options>
  <EXPECT_100_CONTINUE>
  <FOLLOWLOC | NOFOLLOWLOC>
  <HTTP_TOKENAUTH>
  <IN=<fileref | FORM (arguments) | MULTI <options> (parts) | "string">>
  <MAXREDIRECTS=n>
  <OUT=fileref>
  <QUERY=("parm1"="value1" "parm2"="value2" ...)>
```


PROC HTTP: Syntax

> **URL="URL-to-target"**: Specifies a fully qualified URL path that identifies the endpoint for the HTTP request;

> **HEADER-options:**

```
HEADERS "HeaderName"="HeaderValue" <"HeaderName-n"="HeaderValue-n">;
```

is a name and value pair that represents a header name and its value. The HeaderName can be a standard header name or a custom header name;

> **IN**: Specifies the input data. There are multiple ways to submit input data.

SYNTAX

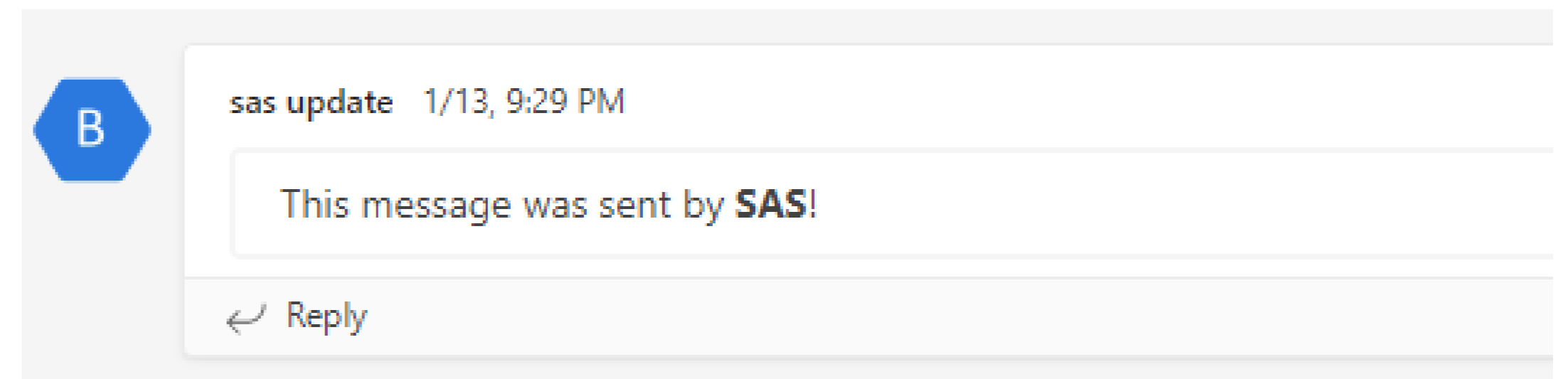
```
PROC HTTP URL="URL-to-target</redirect/n>"  
  <METHOD=<">http-method<">>  
  <authentication-type-options>  
  <caching-options>  
  <header-options>  
  <proxy-server-connection-options>  
  <web-server-authentication-options>  
  <EXPECT_100_CONTINUE>  
  <FOLLOWLOC | NOFOLLOWLOC>  
  <HTTP_TOKENAUTH>  
  <IN=<fileref | FORM (arguments) | MULTI <options> (parts) | "string">>  
  <MAXREDIRECTS=n>  
  <OUT=fileref>  
  <QUERY=("parm1"="value1" "parm2"="value2" ...)>
```

EXAMPLE: SAS_TEAMS

PROC HTTP can send custom messages to a MS Teams group chat via an HTTP request to the Teams API endpoint. This enables automated notifications or alerts, such as status updates or error messages, to be posted in a specific Teams channel.

```
2 filename resp temp;
3 options noquotelenmax;
4
5 proc http
6   url="YOUR URL"
7   method="POST"
8   in=
9     '{
10      "$schema": "http://adaptivecards.io/schemas/adaptive-card.json",
11      "type": "AdaptiveCard",
12      "version": "1.0",
13      "summary": "Test message from SAS",
14      "text": "This message was sent by **SAS**!"
15    }'
16   out=resp;
17 run;
18
```

OUTPUT



CDISC Library

 **AliraHealth**



INTRODUCTION

- **CDISC Library** uses linked data and a REST API to deliver CDISC standards metadata to software applications;
- **Provides** access to new relationships between standards as well as a substantially increased number of versioned CDISC standards and controlled terminology packages
- **Authoritative** source of **CDISC** standards metadata;
- **Multiple** ways to access it.



How to access CDISC LIBRARY?

CDISC LIBRARY BROWSER

CDISC LIBRARY Data Standards Browser

Search

SDTM v2.0

Status: Final | Effective Date: 2021-11-29 | Implemented By: SDTMIG v3.4

Classes: General Observations, Interventions, Events, Findings, Findings About, Special-Purpose, Associated Persons, Trial Design, Study Reference, Relationship

General Observations

Name: General Observations

Description: The majority of observations collected during a study can be divided among three general classes: Interventions, Events, or Findings. Datasets based on any of the general observation classes share a set of common Identifier and Timing variables. As a general rule, any valid Identifier or Timing variable is permissible for use in any submission dataset based on a general observation class. (Source: SDTM v2.0, Section 3.1)

Ordinal	Name	Label	Data Type	Role	Qualifies ...	Described Value Domain	Notes	Usage Restrictions	Definition	Variable ...	Examples
1	STUDYID	Study Identifier	Char	Identifier					A sequence of characters used by the sponsor to uniquely identify the study.	C83082	
2	DOMAIN	Domain Abbreviation	Char	Identifier			2-character abbreviation. The domain abbreviation is also used as a prefix for variables to ensure uniqueness when datasets are merged.		An abbreviation for a collection of observations, with a topic-specific commonality.	C49558	
3	USUBJID	Unique Subject Identifier	Char	Identifier					A sequence of characters used to uniquely identify a subject across all studies for all applications or submissions involving the product.	C69256	
4	POOLID	Pool Identifier	Char	Identifier			Used for results that are not assignable to a specific subject.		A sequence of characters used to uniquely identify a group of subjects that have been pooled together.	C117053	

CDISC LIBRARY API

Primary key
Secondary key

XX
XX

CDISC Library Pathway

The CDISC Library API (formerly known as "SHARE API") allows to retrieve CDISC standards content using a set of RESTful web services as well as querying the library for specific pieces of information.

EXAMPLE: CDISC Library PATH:

GET

/mdr/sdtmig/{version}/datasets/{dataset}/variables/{var} /mdr/sdtmig/{version}/datasets/{dataset}/variables/{var}



Server: [HTTPS://LIBRARY.CDISC.ORG/API](https://library.cdisc.org/api)

LINK:

<https://www.cdisc.org/cdisc-library/api-documentation#/>

How to access CDISC LIBRARY using SAS?

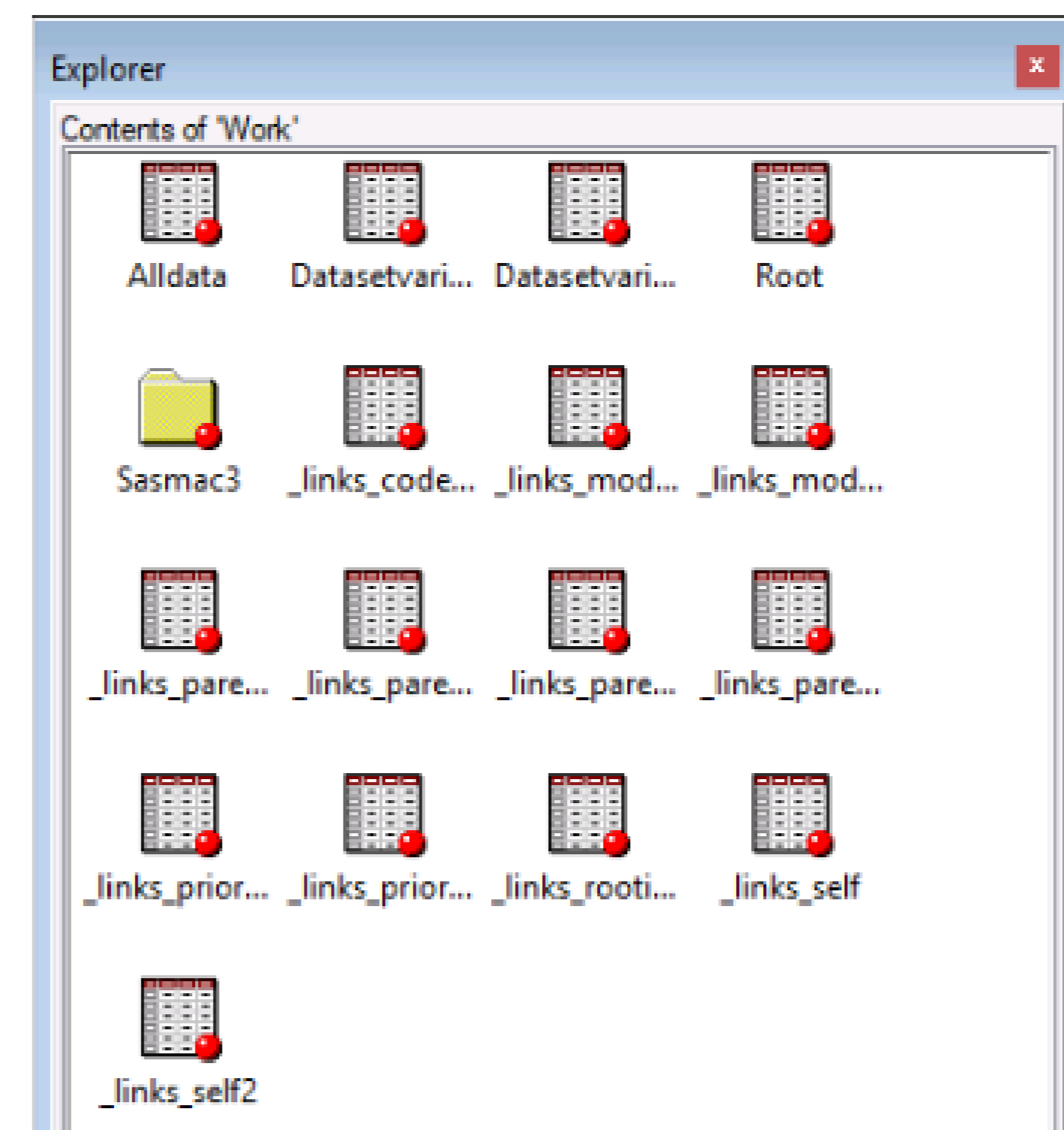
- > **PROC HTTP:** The HTTP procedure issues Hypertext Transfer Protocol (HTTP) requests;
- > **URL:** CDISC Library PATH;
- > **LIBNAME _libname_JSON fileref=response:** Convert JSON response from the server to usable datasets in.

```
4 filename response "&temp_path.\response.json" ;
5 proc http
6     url="https://library.cdisc.org/api/mdr/sdtmig/3-4/datasets/DM"
7     out=response;
8     headers
9         "api-key"="INSERT YOUR API KEY"
10        "Accept"="application/json";
11 run;
12
13 libname space JSON fileref=response ;
14 proc copy inlib=space outlib=work;
15 run;
```

CDISC Library Query Results

Example: DatasetVariable

description	label	name	ordinal	role	simpleDatatype
Unique identifier for a study.	Study Identifier	STUDYID	1	Identifier	Char
Two-character abbreviation for the domain.	Domain Abbreviation	DOMAIN	2	Identifier	Char
Identifier used to uniquely identify a subject across all studies for all applications or submissions involving the product. This must be a unique number, and could be a compound identifier formed by concatenating STUDYID-SITEID-SUBJID.	Unique Subject Identifier	USUBJID	3	Identifier	Char
Subject identifier, which must be unique within the study. Often the ID of the subject as recorded on a CRF.	Subject Identifier for the Study	SUBJID	4	Topic	Char
Reference Start Date/time for the subject in ISO 8601 character format. Usually equivalent to date/time when subject was first exposed to study treatment. See Assumption 9 for additional detail on when RFSTDTC may be null.	Subject Reference Start Date/Time	RFSTDTC	5	Record Qualifier	Char
Reference End Date/time for the subject in ISO 8601 character format. Usually equivalent to the date/time when subject was determined to have ended the trial, and often equivalent to date/time of last exposure to study treatment. Required for all randomized subjects; null for screen failures or unassigned subjects.	Subject Reference End Date/Time	RFENDTC	6	Record Qualifier	Char
First date/time of exposure to any protocol-specified treatment or therapy, equal to the earliest value of EXSTDTC.	Date/Time of First Study Treatment	RFXSTDTC	7	Record Qualifier	Char
Last date/time of exposure to any protocol-specified treatment or therapy, equal to the latest value of EXENDTC (or the latest value of EXSTDTC if EXENDTC was not collected or is missing).	Date/Time of Last Study Treatment	RFXENDTC	8	Record Qualifier	Char



Example 1: SDTM Comparison



SDTM_COMP

The SDTM_COMP macro compares two distinct versions of a selected SDTM dataset with the purpose of facilitating the conversion of an existing SDTM dataset to a recent version.



SDTM Comparison: Output

The macro generates an *xlsx* file named *&Name_xlsx* and it provides two sheets of information. This can be summed up into two different categories:

SPEC COMPARE

Item	Description	Version 3-2	Version 3-4
1 DM	Number of variables	28	32
2 ACTARMUD	Variable to be added (Exp)		
3 ARMNRS	Variable to be added (Exp)		
4 RFCENDTC	Variable to be added (Perm)		
5 RFCSTDTC	Variable to be added (Perm)		
6 ACTARM	Difference between core specification per var	Req	Exp
7 ACTARMCD	Difference between core specification per var	Req	Exp
8 ARM	Difference between core specification per var	Req	Exp
9 ARMCD	Difference between core specification per var	Req	Exp
10 BRTHDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
11 COUNTRY	Value Domain Updated	ISO 3166-1 Alpha-3	
12 DMDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
13 DTHDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
14 RFENDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
15 RFICDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
16 RFPENDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
17 RFSTDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
18 RFXENDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
19 RFXSTDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval

DATASET COMPARE

Description	Item
Variable to be added in our actual SDTM dataset. CORE (Exp)	ACTARMUD
Variable to be added in our actual SDTM dataset. CORE (Exp)	ARMNRS
Variable to be added in our actual SDTM dataset. CORE (Perm)	DMDTC
Variable to be added in our actual SDTM dataset. CORE (Perm)	DMDY
Variable to be added in our actual SDTM dataset. CORE (Perm)	ETHNIC
Variable to be added in our actual SDTM dataset. CORE (Perm)	INVID
Variable to be added in our actual SDTM dataset. CORE (Perm)	RFCENDTC
Variable to be added in our actual SDTM dataset. CORE (Perm)	RFCSTDTC

SDTM Comparison: SPEC Compare

SPEC COMPARE is the first page of the xlsx output, It provides information related to the comparison between the two different versions of the SDTM dataset

TYPES OF COMPARISON

- > Number of variables
- > Variables to be added
- > Differences in CORE specification
 - REQ
 - EXP
 - PERM
- > Value domain update

XLSX OUTPUT

Item	Description	Version 3-2	Version 3-4
1 DM	Number of variables	28	32
2 ACTARMUD	Variable to be added (Exp)		
3 ARMNRS	Variable to be added (Exp)		
4 RFCENDTC	Variable to be added (Perm)		
5 RFCSTDTC	Variable to be added (Perm)		
6 ACTARM	Difference between core specification per var	Req	Exp
7 ACTARMCD	Difference between core specification per var	Req	Exp
8 ARM	Difference between core specification per var	Req	Exp
9 ARMCD	Difference between core specification per var	Req	Exp
10 BRTHDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
11 COUNTRY	Value Domain Updated	ISO 3166-1 Alpha-3	
12 DMDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
13 DTHDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
14 RFENDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
15 RFICDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
16 RFPENDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
17 RFSTDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
18 RFXENDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval
19 RFXSTDTC	Value Domain Updated	ISO 8601	ISO 8601 datetime or interval

SDTM Comparison: Dataset Compare

DATA COMPARE sheet shows the missing variables as a result of the comparison between our existing SDTM dataset and the selected «recent» version

TYPES OF COMPARISON

- > Variables to be added
- > Differences in CORE specification
 - REQ
 - EXP
 - PERM

XLSX OUTPUT

Description	Item
Variable to be added in our actual SDTM dataset. CORE (Exp)	ACTARMUD
Variable to be added in our actual SDTM dataset. CORE (Exp)	ARMNRS
Variable to be added in our actual SDTM dataset. CORE (Perm)	DMDTC
Variable to be added in our actual SDTM dataset. CORE (Perm)	DMDY
Variable to be added in our actual SDTM dataset. CORE (Perm)	ETHNIC
Variable to be added in our actual SDTM dataset. CORE (Perm)	INVID
Variable to be added in our actual SDTM dataset. CORE (Perm)	RFCENDTC
Variable to be added in our actual SDTM dataset. CORE (Perm)	RFCSTDTC

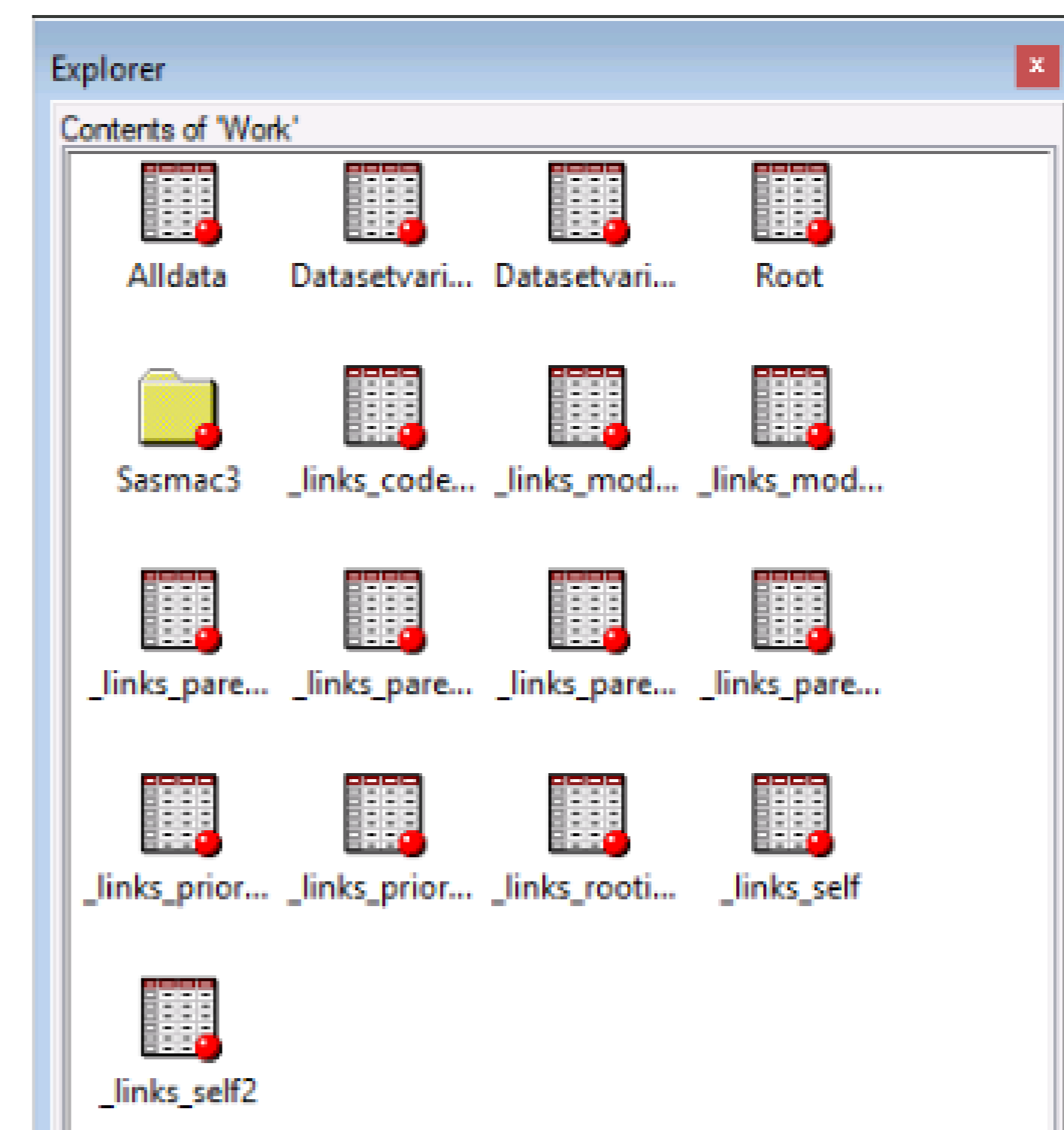
Example 2: SDTM Labels



SDTM Labels: DatasetVariable

DatasetVariable

description	label	name	ordinal	role	simpleDatatype
Unique identifier for a study.	Study Identifier	STUDYID	1	Identifier	Char
Two-character abbreviation for the domain.	Domain Abbreviation	DOMAIN	2	Identifier	Char
Identifier used to uniquely identify a subject across all studies for all applications or submissions involving the product. This must be a unique number, and could be a compound identifier formed by concatenating STUDYID-SITEID-SUBJID.	Unique Subject Identifier	USUBJID	3	Identifier	Char
Subject identifier, which must be unique within the study. Often the ID of the subject as recorded on a CRF.	Subject Identifier for the Study	SUBJID	4	Topic	Char
Reference Start Date/time for the subject in ISO 8601 character format. Usually equivalent to date/time when subject was first exposed to study treatment. See Assumption 9 for additional detail on when RFSTDTC may be null.	Subject Reference Start Date/Time	RFSTDTC	5	Record Qualifier	Char
Reference End Date/time for the subject in ISO 8601 character format. Usually equivalent to the date/time when subject was determined to have ended the trial, and often equivalent to date/time of last exposure to study treatment. Required for all randomized subjects; null for screen failures or unassigned subjects.	Subject Reference End Date/Time	RFENDTC	6	Record Qualifier	Char
First date/time of exposure to any protocol-specified treatment or therapy, equal to the earliest value of EXSTDTC.	Date/Time of First Study Treatment	RFXSTDTC	7	Record Qualifier	Char
Last date/time of exposure to any protocol-specified treatment or therapy, equal to the latest value of EXENDTC (or the latest value of EXSTDTC if EXENDTC was not collected or is missing).	Date/Time of Last Study Treatment	RFXENDTC	8	Record Qualifier	Char



SDTM Labels: In Action

BEFORE

	NAME	TYPE	LENGTH	VARNUM	LABEL
1	ACTARM	2	50	23	
2	ACTARMCD	2	10	22	
3	AGE	1	8	16	
4	AGEU	2	5	17	
5	ARM	2	50	21	
6	ARMCD	2	10	20	
7	BRTHDTC	2	20	15	
8	COUNTRY	2	3	24	
9	DOMAIN	2	2	2	
10	DTHDTC	2	20	11	
11	DTHFL	2	2	12	
12	INVNAM	2	50	14	
13	RACE	2	30	19	
14	RFENDTC	2	20	6	
15	RFICDTC	2	20	9	
16	RFPENDTC	2	20	10	
17	RFSTDTC	2	20	5	
18	RFXENDTC	2	20	8	
19	RFXSTDTC	2	20	7	
20	SEX	2	2	18	
21	SITEID	2	20	13	
22	STUDYID	2	15	1	
23	SUBJID	2	15	4	
24	USUBJID	2	30	3	

AFTER

	NAME	TYPE	LENGTH	VARNUM	LABEL
1	ACTARM	2	200	23	Description of Actual Arm
2	ACTARMCD	2	200	22	Actual Arm Code
3	AGE	1	8	16	Age
4	AGEU	2	200	17	Age Units
5	ARM	2	200	21	Description of Planned Arm
6	ARMCD	2	200	20	Planned Arm Code
7	BRTHDTC	2	200	15	Date/Time of Birth
8	COUNTRY	2	200	24	Country
9	DOMAIN	2	200	2	Domain Abbreviation
10	DTHDTC	2	200	11	Date/Time of Death
11	DTHFL	2	200	12	Subject Death Flag
12	INVNAM	2	200	14	Investigator Name
13	RACE	2	200	19	Race
14	RFENDTC	2	200	6	Subject Reference End Date/Time
15	RFICDTC	2	200	9	Date/Time of Informed Consent
16	RFPENDTC	2	200	10	Date/Time of End of Participation
17	RFSTDTC	2	200	5	Subject Reference Start Date/Time
18	RFXENDTC	2	200	8	Date/Time of Last Study Treatment
19	RFXSTDTC	2	200	7	Date/Time of First Study Treatment
20	SEX	2	200	18	Sex
21	SITEID	2	200	13	Study Site Identifier
22	STUDYID	2	200	1	Study Identifier
23	SUBJID	2	200	4	Subject Identifier for the Study
24	USUBJID	2	200	3	Unique Subject Identifier

ROUND UP



APIs ARE THE FUTURE

APIs have become the backbone of the modern digital ecosystem, connecting disparate technologies and unlocking endless possibilities for innovation and growth across industries, including healthcare

PROs:

- > Direct access to the source data;
- > Data available in dataset structure;
- > Directly usable in our workflow;
- > Scalable to the different version requested;
- > Security.

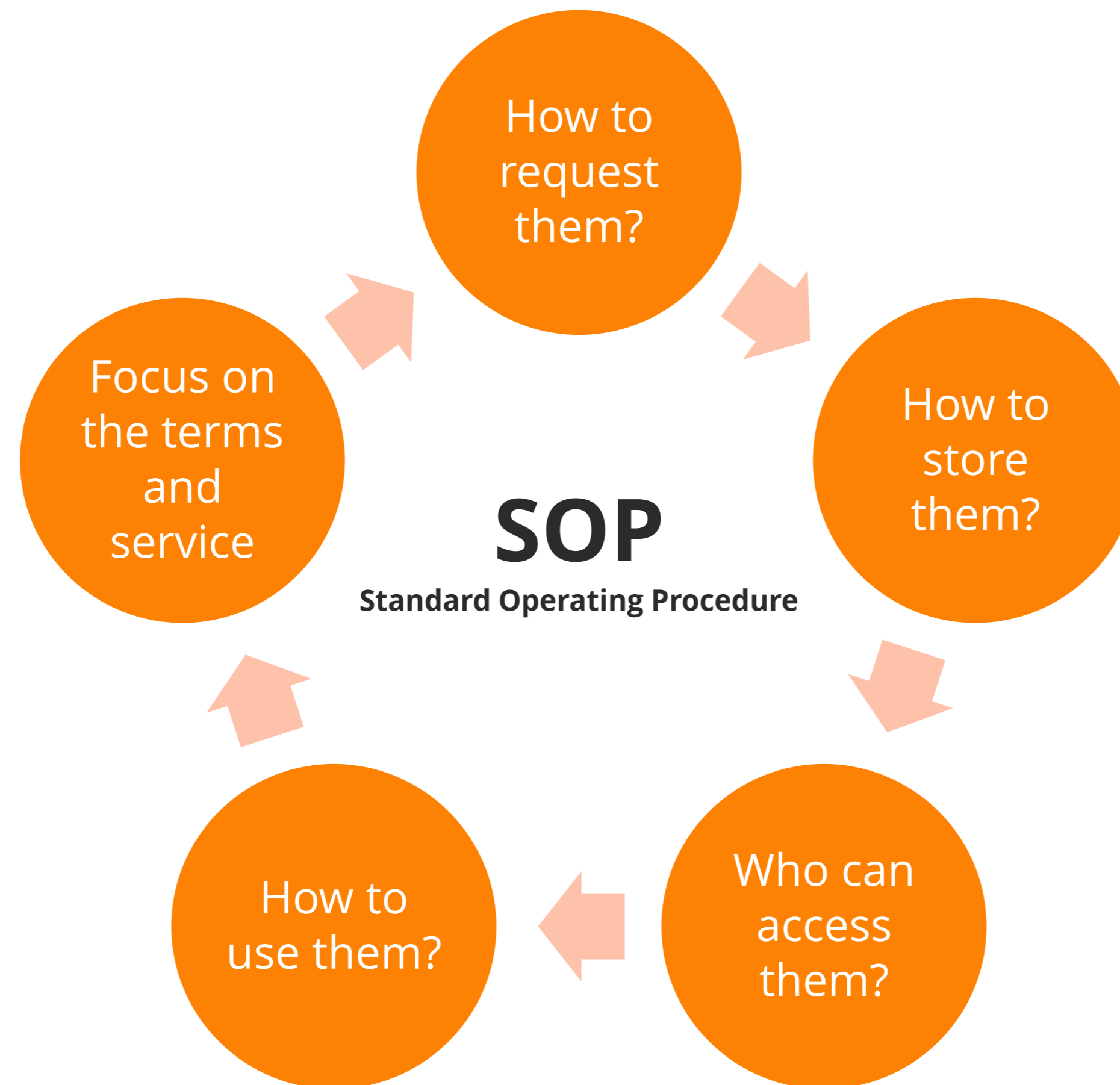


Best Practices for API Usage

An application programming interface (API) key is a unique identifier used to authenticate a user or developer. This means that (API) keys are linked to a user, and as a company, we HAVE TO prevent malicious use of them.

CONS:

- > Cost of Implementation;
- > Validation;
- > Training.



References

- What is an API (application programming interface)?, <https://www.ibm.com/topics/api>
- What is a REST API?, <https://www.redhat.com/en/topics/api/what-is-a-rest-api>
- Paper SAS3232-2019 “The ABCs of PROC HTTP”, Joseph Henry, SAS Institute



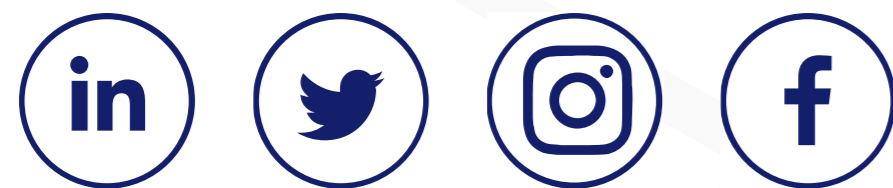
Thank You



LET'S KEEP IN TOUCH



davide.marinucci@alirahealth.com



NORTH AMERICAN OFFICES

Toronto | Canada
Boston | US
San Francisco | US

EUROPEAN OFFICES

Vienna | Austria
Paris, Bordeaux | France
Munich | Germany
Bologna, Milan, Verona | Italy

Zevenbergen | Netherlands
Barcelona | Spain
Basel | Switzerland
London | UK

ASIAN PACIFIC OFFICES

Sydney | Australia
Singapore