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Implementing CDISC Standards for Device-Drug Studies

Karin LaPann, MS, and Wenying Tian, MS, MD
Takeda (formerly Shire), Lexington, MA USA

ABSTRACT

Devices can be part of a drug or biologic submission as a method to deliver drug. The regulatory agencies request that the device be either studied separately or as a drug-device combination product. The study teams are then able to apply these standards to create standardized collection forms and datasets beginning-to-end, from CDASH to ADaM.

In this case study of an implementation we will describe how we created ADaM device dataset standards using ADaM principles. The data standards at our company were developed using a "beginning to end" approach. That means we started by designing appropriate data collection forms using the CDISC CDASH principles. The device data collection forms were developed in 2012, for our CDASH forms library, and are still in use today. Then we created standards and guidance for mapping the seven SDTM device domains. These followed the guidance of SDTMIG-Medical Devices v1.0 of 2012-12-04.

Once the SDTM domains were available, the programming teams were able to develop custom specifications for the device analyses. These were not yet standardized for ADaM in an internal guidance until the CDISC ADaM team developed draft guidance. Using the lessons learnt from these first device-drug studies, we were able to standardize some templates and added examples to our internal ADaM standards Toolkit and Implementation Guide.

INTRODUCTION

At our company we have a history of device-drug combination studies. Due to the nature of rare diseases, sometimes special delivery systems are needed for study drug. Dependent upon the regulatory region and also whether the device is commercially available or considered to be investigational within that region there are different approaches on how to conduct the clinical investigations. For the clinical drug trial portion either two separate studies will be needed; a device study and a drug study, or a single device-drug combination study.

When the studies began, the device standards had just been developed for SDTM and were published as SDTMIG MD v1.0. There were no CDASH standards for collection, or ADaM standards for analysis. Therefore, the study teams had to 'invent' and develop these concepts along with the collaboration of medical reviewers, data management, and the standards governance team.

This paper is intended to provide a case study of how an organization can use the CDISC Standards to guide study teams on interpreting standards for new implementations. The case study shows examples of how we developed ADDL (similar to ADSL but for device information), ADAE and BDS structures of ADDPR for the device lifecycle. This represents three unique structures in ADaM. It is a follow-up to our paper on the challenges of implementing the SDTM and ADaM for a Device-Drug Study [1], and delves further into the development process of the standard governance and implementation guides.

Disclaimer: *The following case study is intended only as an example, and the standards described are not meant as an official CDISC standard. At the time of this article, the ADAMIG-MD v1.0 was still in draft form and subject to change.*

WHAT MAKES DEVICE DATA UNIQUE?

The use of devices is an important and growing part of medical care. They can be used on their own, or as a drug delivery method. When devices are used in clinical trials, there is the need to collect data about the devices. The CDISC SDS team has done a lot of work defining the types of data needed for collection, which is delivered in the SDTMIG MD v1.0. This IG was originally developed to support device-specific data that are needed for regulatory submissions and ancillary devices used in pharmaceutical clinical trials The document defines seven domains to store the device data to be

collected, as well as, data about the devices such as manufacturing date and transport information. The guide was developed to support device-specific data that are needed for regulatory submissions. This data may also be needed to answer questions posed in the protocol, provide safety data for the device/human interaction, and to keep track of which device was used for a patient. Devices may have events such as malfunctions which are also tracked separately from the patient data.

The CDISC CDASH model and IG were developed with the premise that data is collected on eCRF using an EDC system. This standard does not readily lend itself for data collection with a device, although a team can use the CDASH foundational principles. Some of the challenges in developing these forms will be described in the case study. Once the data has been collected on an eCRF it is time to organize it into tabulation datasets which are the SDTM domains.

Just as in other standards implementations, the analysis (ADaM) datasets are built from the SDTM domains. The foundational SDTM standards include all the domains needed to collect patient data, interventions data, findings and events. If a company has adopted the latest SDTMIG MD as part of the standards, then the seven domains plus other foundational SDTM domains are used to build the ADaM analysis datasets. Otherwise if a company has not adopted the SDTMIG MD, this data will be more difficult to map as it will be stored in many custom domains. The ADaMIG is the foundational standard used to create ADaM-compliant datasets. At the time of writing this paper, the current published version is ADaMIG v1.1. In addition, there is a draft guidance ADAMIG MD v1.0 which is under public review. It is still in draft, therefore there are risks associated with adopting such a standard as metadata details and concepts may change. This will be discussed later in the section where we describe how to mitigate those risks.

DEVICE DOMAINS

As described above, the 7 standard device domains are used to capture any and all device-specific data in addition to the foundational SDTMIG v3.2 standard. Since the SDTMIG MD is a supplement to the Foundational SDTM standard, whenever possible the variables should continue to be mapped to the foundational domains (e.g. AE, PR, EX domains). As a quick refresher, listed below are the device domains and how we used them. Note that there are special considerations for a device-drug combination study versus a pure device study. First we will describe how we used the current standards as they exist today.

SPECIAL PURPOSE DOMAINS

1. DI – Device Identifiers

This domain contains information about the device such as manufacturer, serial, model number. Its purpose is to create a unique key (SPDEVID) identifier variables listed in DIPARM, e.g. Serial Number, or a combination thereof. DI should not be used for device characteristics other than identifiers. (See SDTMIG MD for complete guidance)

2. DR – Device-Subject Relationships

There is a many-to-one relationship between devices and a subject. A subject may have one or more devices during the course of a study, but a device only has one subject. This domain acts as a lookup table between the device identifier (SPDEVID) and the subject identifier (USUBJID).

INTERVENTIONS GENERAL OBSERVATION CLASS (DEVICES)

3. DX – Device Exposure

The device exposure domain details the contact of the subject to the device. It includes USUBJID and SPDEVID. It can also contain dose information that is delivered by the device, similar to the EC domain. There are many devices (e.g., glucose meters) which do not deliver a drug. So, a subject can be exposed to a device (DX) without the device delivering a drug. In our case, since it is primarily a drug study, the dose information remained in EX.

EVENTS GENERAL OBSERVATION CLASS (DEVICES)

4. DE – Device Events

This domain captures events or activities that occur to or with the device, such as calibrations, parts replacement, or malfunctions. For our standards, there is a DECAT '<DEVICE> FAILURE' or '<DEVICE> MALFUNCTION', with the device name being replaced for the item in the carats (<>). This domain includes SPDEVID and USUBJID.

5. DT – Device Tracking and Disposition

This domain captures the tracking of the device as in its physical location prior to implant, as in the manufacturing to storage to site before implant. It is a source for Implant and Explant dates.

FINDINGS GENERAL OBSERVATION CLASS (DEVICES)

6. DU – Device-In-Use

This domain is used to capture the current state of the device at a certain timepoint. It contains measurements in tests that describe the settings or readings of that device in a point in time. These characteristics are not static, and may vary from device to device. For example, DUTEST contains machine settings, and software versions.

7. DO – Device Properties

This is a domain to capture the properties of the device that the sponsor wishes to represent, but that do not form the key for the device (Key variable is created in DI). This domain should not contain characteristics that change over time. It describes the device itself. It contains SPDEVID but not USUBJID.

Other standard SDTM domains may contain device related data. The variable SPDEVID may be added to these domains to capture which device was related to that observation. The variable should be placed immediately after USUBJID in the SDTM variable order. Other additions to the Events Observation class include –PARTY, --PRTYID (place in order after --LOC) and –ACNDEV (place in order after ACNOTH). These variables provide a link to device domains, and also data on the action taken in relation to the device. The use of these few variables enables us to extend the SDTM data while continuing to follow the foundational data standards. (Please see section 3.1 and 3.2 in the SDTMIG MD for details)

Variable Name	Variable Label	Type	Role	Abbreviated Description
SPDEVID	Sponsor Device Identifier	Char	Identifier	Sponsor-defined identifier for a device
--PARTY	Accountable Party	Char	Record Qualifier	Party accountable for the device or other object as a result of the activity performed in the associated --TERM variable.
PRTYID	Identification of specific accountable party	Char	Record Qualifier	Identification of the specific party accountable for the device after the action in --TERM is taken. Used in conjunction with --PARTY.
--ACNDEV	Action Taken with Device	Char	Record Qualifier	Action taken with respect to a device in a study, which may or may not be the device under study

Table 1 Additions and Modifications to SDTM Identifiers and Events observation class [1]

ADAM DATASETS

For any device-drug combination study the foundational standards should be used first. These are used in the safety and efficacy tables for the drug being studied. The additional device datasets in the AdaM Medical Device guidance extend the foundational standard. The ADaMIG MD standards v1.0 is still in draft, but there are some well-defined concepts that can be adopted. As it is in draft, use at your own risk until the standard eventually is finalized and possibly updated. The advantage of ADaM is that these are

considered custom datasets until the CDISC document is approved. As long as the basic ADaM principles are followed, they are considered compliant. The following datasets are described in the draft version section 3. Represented in the table are a device-level datasets, an occurrences dataset and a basic data structure dataset. Note that the class 'DEVICE-LEVEL ANALYSIS DATASET does not yet exist in the define standards, therefore you might have to use ADAM OTHER in the define XML until the standard is approved.

Dataset Name	Dataset Description	Dataset Structure	Key Variables	Class
ADDL	Device-Level Analysis Dataset	One record per subject per device	USUBJID, SPDEVID	DEVICE-LEVEL ANALYSIS DATASET
ADXXXXXX	<Dataset label>	One record per record in SDTM domain (optional: per coding path, per Analysis Period and/or Phase)	USUBJID SPDEVID, --SEQ	OCCURRENCE DATA STRUCTURE
ADXXXXXX	<Dataset label>	One record per subject, per device, per parameter	<USUBJID> SPDEVID, PARAM, <timepoint>	BASIC DATA STRUCTURE

Table 2. Examples of ADaM Dataset Metadata [2]

As in SDTM, the ADaMIG MD guide lists the metadata for acceptable naming conventions of variables to be used in creating ADaM-compliant datasets. The table below shows the study identifier variables for ADDL.

Variable Name	Variable Label	Type	Core	CDISC NOTES
STUDYID	Study Identifier	Char	Req	ADSL.STUDYID
USUBJID	Unique Subject Identifier	Char	Cond	ADSL.USUBJID
SPDEVID	Sponsor Device Identifier	Char	Req	DI.SPDEVID

Table 3. ADDL Identifier Variable

As mentioned in the paper ADaM for Medical Devices: Extending the Current ADaM Structures which was written and presented in PharmaSUG 2018 by the ADaM Devices sub-team members, the ADDL has multiple functions. It is a device-level analysis dataset which identifies each device by a unique identifier variable. In addition, it can be used directly to produce device-level analyses, such as device demographic summaries. Whenever a subject is involved in the study, then ADSL is also still required. [5]

STANDARDS GOVERNANCE

CREATING BEGINNING-TO-END STANDARDS

At our company, we had already adopted a rigorous beginning to end set of data standards (also known as end-to-end), starting with the protocol ensuring that it contains appropriate controlled terminology, then on to the CDASH collection forms, which feed into the SDTM device domains, then creating the ADaM analysis datasets, and finally a Table, Listing and Figures template library. Implementations of data standards at a company are for the most part company specific interpretations of the published CDISC standards found on the www.cdisc.org website. When a company has a dedicated Data Standards group, then they can assist in interpretation and expansion of these standards to meet the needs of the company's drug development programs. The CDISC organization also provides Therapeutic Area User Guides (TAUGs) which aid in that effort.

Shown below is our standards model. The Protocol is greyed out as it is still in development. The rest of the standards are developed by studying the CDISC foundational models, TA standards and even draft CDISC standards under public review in great detail. We also use various publications from PhUSE to build our interpretations (i.e. the SDRG, ADRG, SDSP, Define XML guidance).

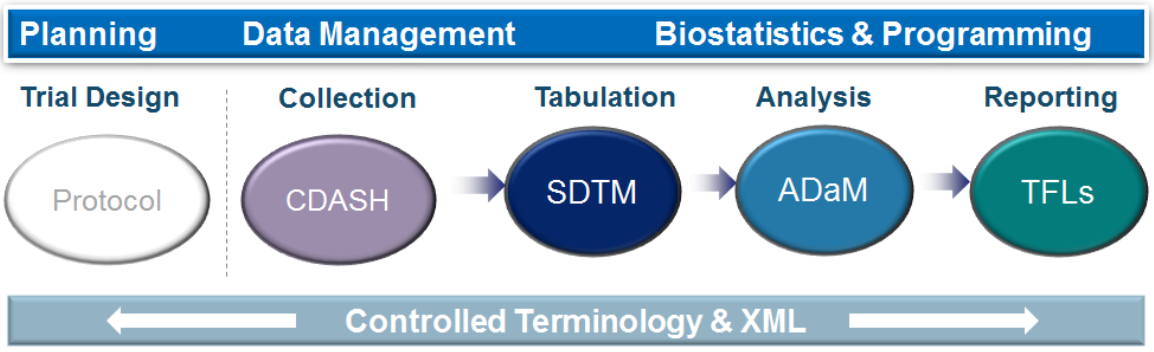

Figure 1 Beginning to End Standards Model

The development of data standards within our company is an iterative and collaborative process for each model. These groups are the standards governance teams, led by a standards professional for each model. The teams develop the metadata documentation and guidance documents for study team use. There is a conscious effort to make sure there is alignment between the different standards models for a particular biomedical concept. The evolution of these documents is careful and measured with incremental updates taking place each year. Each standards governance team provides the users with tools in the forms of interpretation guides, templates for implementation such as CDASH libraries, SDTMIG metadata and ADaMIG metadata to eliminate the guesswork for writing dataset specifications.

Once the standards have been described in this level of detail, then a governance model can be applied to ensure compliance. Even when a standard is new and ground-breaking such as for device-drug studies, the Standards Governance team works with the study teams to identify the needs and provide support.

The risk of using draft guidance from CDISC is mitigated by ensuring that the standard is revisited every year and that the team is kept current on updates and changes to a standard. For example, when the ADaMIG MD is finalized and published, then the internal standards are reviewed to ensure compliance to the published models.

Here is an example for ADaM of some recommended steps to follow in the standards development effort when creating or updating standards documents

1. Review the existing situation by reviewing actual completed study dataset structures
2. Compare custom datasets to the latest CDISC ADaM standard and update the company standard as need
3. Check for additional permissible variables not in the standard that are needed for analysis
4. Roll out the updated ADaM metadata toolkit and Standards Implementation Guide
5. Define start date when a new standard becomes required as part of internal governance
6. Provide training for new standard

Once a standard is developed and finalized then the Standards Governance team enforces compliance by the study teams. The standards for new studies must be followed after the date that the updated standard and metadata are r the paper on the ADaM waiver process. [2]

CASE STUDY

INTRODUCTION OF CASE

This case study is based upon a rare disease clinical trial which used a device to delivery study drug to patients. Therefore the regulatory agency (FDA) considered it a drug-device study and wanted to see safety information for the device as well as safety information for the drug. The device-only data was submitted separately to the FDA's Center for Devices and Radiological Health (CDRH) and is outside of the scope of this paper.

Our clinical trial used a surgical implanted device to deliver the treatment. Described in the protocol as part of the safety assessments, data was collected to monitor the device lifecycle. This lifecycle started with the initial implant, device function, device stopping and finally removal of the device. Therefore, the surgical procedures also were part of the data collection for safety and potentially Adverse Events. The analysis of the device implantation, device function, and device longevity were part of the study safety assessment. One thing that is unique in this type of trial is that a subject can have more than one device during the study period and one device can have multiple device events. A malfunction can happen on different parts of the device and the outcome of the malfunction can be ongoing, resolved or device failure. It is possible for device events to be related to a surgical procedure, and the surgical intervention might change the device status. [1]

The study began in 2012, around the time when the seven SDTM device domains were published as SDTMIG MD v1.0. However, there were no CDASH standards to support collection for these device domains. The Shire CDASH standards governance team had to work closely with the SDTM standards governance team to develop a library of CRF forms for this purpose. The first step was to gather expertise from the company device team, the data management team and others to define as much as possible, what data to collect. Then we used the feedback from the first such study to improve the CRF and modify it without impacting the current ongoing study, at the same time preparing the CRF library for future similar studies.

DESCRIPTION OF DEVICE DATA TO BE COLLECTED

There was an eCRF form for surgical procedure information. Collected in this CRF were the following items: time of the procedure, reason and type of procedure, the surgical procedure details (including the application location, and device component used during the procedure) and surgical procedure difficulties. Since these procedures involved the device, they were mapped to both the PR domain, and also to the device domains. The device component information went to the DU domain, and any surgical procedure difficulties to the DE domain.

SDTM DOMAIN CREATION

At the SDTM level the CDISC device standards existed so we added them to our SDTM metadata library. The study team's strategy was to map the information to fundamental SDTM domains first. If information was unique to device data, then those were mapped to device domains. We had the 7 device domains available as SDTMIG MD; we followed the IG and mapped them all for completeness, even though some domains were not necessary to support analyses of the study. However, from a standards viewpoint, it was better in general to have all domains available and populated when we were building the standard.

During the mapping process and while trying to follow the company's existing SDTM standards interpretation guidance, the study team noticed some issues. For example: device ID needed to be unique. We had used serial number from DI as the key, and the serial number had been applied to the entire bag holding all the parts for one device. However it may be necessary to replace one component of the device without replacing the entire device. Therefore, we needed a new way to identify the unique device ID. For this study, an additional key variable was added for part number. Then feedback went back to the medical devices team to package the device differently. This was added to the guidance. It was communicated in various ways to the study teams: in the quarterly standards newsletter, in updates to the standards guidance, and on the SharePoint standards website. In this manner, other study teams could have it in mind during the design period to avoid the same problem.

In our implementation, Device-related adverse events were captured in the AE form as well as drug-related AEs. Most of the device-related variables were mapped to the SUPPAE, One variable that is allowable in the SDTM AE domain is AE.AEACNDEV. In the previous releases (2017 or earlier) this variable was mapped in CDASH to the field AEACNSDV' (label = 'Action taken with Study Device'), and then to SDTM SUPPAE where SUPPAE.QNAM = 'AEACNSDV'.

Procedures (PR) Procedures that are device related, such as implants and explants were captured in this domain, and mostly mapped to custom variables found in SUPPPR.

The device SDTM domains are highly related to each other. Figure 2 is a graphic showing the relationships. Note how the standard PR domain relates to both the interventions and events domains. This is very important to note when building the ADaM datasets for analysis.

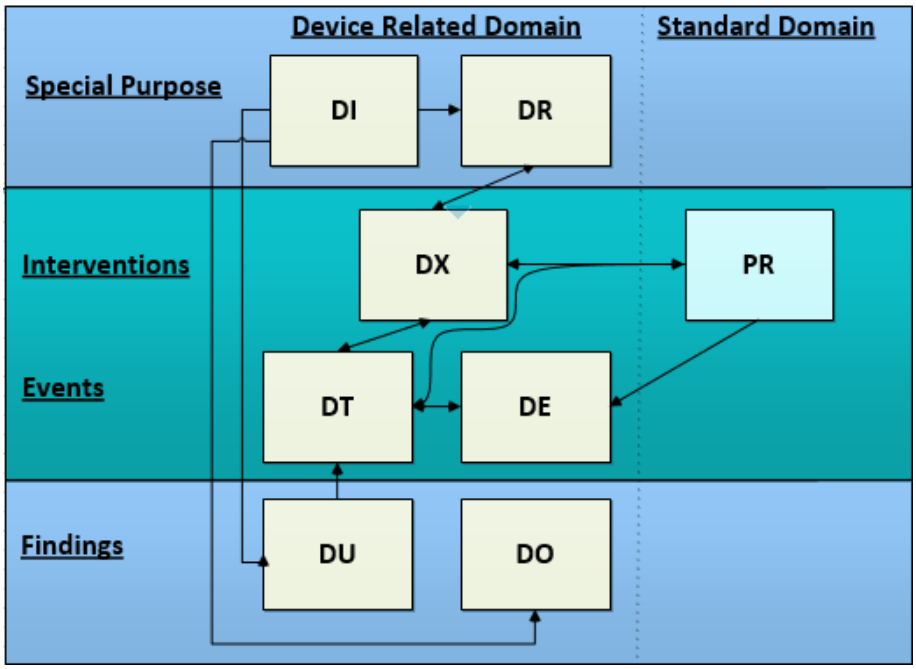

Figure 2 Relationships between SDTM domains [3]

ADAM DATASET CREATION

Finally, in 2015, the team was ready for analysis. It was time to develop the ADaM datasets. The study teams had already created custom ADaM datasets to support analyses using the ADaM foundational principles. The study team had expertise in the form of a devices team-member and programmers that had several years of programming the device data. The team soon found that there was a need for a dataset that would compile the device-level information from the seven SDTM domains. The team therefore invented this concept of the device identifier analysis dataset and called it ADIDDD. It contained one unique record for each device, and data unique to that device such as serial number, date implanted, date explanted, failure date, device status. It also included the USUBJID. Each device was unique and could only have one implant and explant date. However, one subject could have one or more devices associated to him or her. Most of the dates for ADIDDD were copied directly from the SDTM and remained in ISO 8601 format. There were no standardized flags, and a lot of ADSL variables found their way into ADIDDD. The other goal of the study team was to be as efficient as possible. The team found that it was more efficient to use the original foundational datasets whenever possible with just a few extra fields. In the example below there is only one ADAE dataset. By adding causality variables for the device, it was not necessary to create a separate AE dataset for device data.

At the point of analysis, the internal standards governance team for the ADaM standard had to catch up to the study teams, as the studies were on-going while the ADaMIG was being developed by the CDISC ADaM device sub-team. Once the ADaMIG MD was out for public review the ADaM standards governance team was able to compare the existing dataset structure and align it better to the ADDL. Surprisingly there was good alignment with the new standards, and only a few custom variables had to be added to the ADaM metadata for internal use to handle those situations. In addition, the new guidance provided great value to add the necessary variables to other existing datasets for analysis.

The new ADDL contained many more required date fields, so these were added. Time variables ending in --TM were added in ADaM wherever the date/time variable in SDTM contained hours and minutes. We added these extra variables instead of--DTM variables since time was not always collected in the SDTM character date field. These included date of implant, date of explant (from DE and PR); dates turned on or

off, date of device failure (from DE). Any extra variables from the former ADIDDD dataset were copied to the new standard. These were few, including only an extra flag and date for certain types of device failures.

Dataset Name	Dataset Description	Dataset Structure	Key Variables	Class
ADDL (formerly ADIDDDD)	Device-Level Analysis Dataset	One record per subject per device	USUBJID, SPDEVID	DEVICE-LEVEL ANALYSIS DATASET (or ADAM OTHER)
ADDPR	Device Related Procedures Analysis	One record per subject, per device, per parameter	USUBJID SPDEVID, PARAM	BASIC DATA STRUCTURE –TIME TO EVENT

Table 3 Device-Specific Analysis Datasets

In our device-drug study, only devices that were implanted into a subject were part of ADDL. The ADDPR was used to create a graph of the lifecycle of each device. It showed whether a device was implanted, adjusted or explanted any time during the study. Other foundational ADaM datasets were created for safety and efficacy outputs. The device-specific variables were added to these as needed. Shown in table 4 are the foundational datasets created that had a relationship to device data.

Dataset Name	Dataset Description	Dataset Structure	Key Variables	Class
ADSL	Subject-Level Analysis Dataset	One record per subject	USUBJID	SUBJECT-LEVEL ANALYSIS DATASET
ADAE	Adverse Events Analysis Dataset	One record per subject, per adverse event	USUBJID, AESEQ	OCCURRENCE DATA STRUCTURE
ADPR	Procedures Analysis Dataset	One record per subject, per procedure, per timepoint	USUBJID, PARAM, AVISIT	BASIC DATA STRUCTURE

Table 4 Foundational Drug analysis

The study teams created the ADDL dataset specification by either copying variables from multiple device SDTM domains, or by deriving new variables using these plus other standard SDTM domains. As noted in Figure 1 for SDTM domains, the key merging variable is SPDEVID from DI, and when merged with DR is used to identify the subject by USUBJID. There is one SPDEVID per device. A subject may have one or more devices, depending on whether the device had to be replaced during the study period. If a subject does not get a device, for example if discontinuation occurred prior to the visit where the device is implanted or used, then there is no record for that subject in ADDL. In addition to the key variable SPDEVID, there are grouping variables available in the ADaM ADDL standard by Device Type, Device Manufacturer and Device Model. These may be used to group like devices and should be driven by table and analysis needs.

The ADAE dataset specification contains additional variables from the device studies for ‘related to device’. When creating ADAE, we were sure to capture all the SUPPAE variables for device data. One variable AE.AERELDEV was promoted to AE domain from SUPPAE in the 2018 SDTM interpretation guide, and was used to identify whether a device was related to the AE. This was the only update needed for the SDTM standard, as the seven domains were well established as a standard. The SPDEVID was not required as generally the ADAE data is analysed by ‘Relationship to device event’ and not by an individual device. In the case of needing to identify the device by SPDEVID, a complex merging algorithm would have to be applied using date windows to identify which device was current at the time of AE.

The second new dataset specification created for the study was ADDPR. The dataset was derived from multiple device domains. This was created to provide an analysis of the device lifecycle. ADDPR is a dataset in BDS format for derived parameters for graphing the device lifecycle by USUBJID. There was no need to add SPDEVID to this dataset as it contained start/stop data across multiple devices per patient. A device can only be implanted, fail or be explanted once. The PR dataset did not collect SPDEVID, and for future studies we recommended to add as an allowable add-in field to be collected on the eCRF. Otherwise this variable would need to be derived in the ADPR dataset by using date-time windows to link the PR event to a single device record.

GOVERNANCE STEPS [4]

Our company has a rigorous standards governance process. We update our standards templates and supporting documents once yearly, In between the governance team reviews requests for digressions of the standards. This information is then used at the end of the year to assess any needed updates. For CDASH and SDTM the standards governance teams only had to make minor adjustments of adding permissible variables not currently in our templates. These were updated during the yearly standards release.

The ADaM standards governance team had a larger task as it was the first iteration of ADaM Device dataset standards. To create the templates in the ADaM toolkit, the team reviewed and compared to the CDISC draft ADaM MD and the completed ADaM datasets. The first step in updating the ADIDDD to the new standard was to compare to the ADDL in the ADAMIG MD and do an analysis of which variables were in one and not the other. Fortunately, there were few differences other than variable naming conventions. The other datasets were compared and updated as needed with the device-specific variable.

In this manner, future teams would use standardized variable and dataset naming conventions, and legacy teams were able to do their submission with the legacy variables. For ADaM, the biggest contribution by the teams was the creation of ADIDDD (a custom dataset) which was mapped to ADDL for future studies.

Once the datasets were developed for the first study, we went through the governance process to add them to our ADaM data standards. We only added ADDL and ADDPR to the ADaM standards template, which is part of our 'ADaM Toolkit'. Other datasets not shown here were created for the standard safety and efficacy outputs required in all drug studies. The AE domain also had the minor change to move the variable AEACNDEV from the SUPPAE to the AE domain. CDASH had no changes as all the fields necessary were being collected. Every year these standards will get revisited until the ADaM MD document is finalized. The standards are rolled out once yearly, so that study teams can re-use and save time and effort.

CONCLUSION

This case study showed how we built standards starting first with a business need and then, when they are at the point that they can be applied to other studies they can be rolled into an actual company standards template such as our ADaM Toolkit. First we used the foundational standards for SDTM and ADaM. Once all these were exhausted, we found the need to create an additional ADaM dataset for data related uniquely to the device. These data were captured in the seven medical device domains, but no ADaM standard was yet available to use as a model.

The study teams had to devise a solution to uniquely identify each device. They created the IDDDID dataset for this purpose. The dataset met the need to define one or more devices per subject, and were able to be merged to a standard ADSL with the common keys USUBJID + SPDEVID. Once the teams realized more studies would take place with the same kind of design, it was time to develop a standard and add to our governance model.

The steps we took were first to maximize the use of the CDISC foundational standards. Then we leveraged the draft guidance from CDISC to compare ideas. We found that our solution was similar to the CDISC guidance. With a few adjustments of metadata (i.e. variable names, labels and additional suggested dates) we were able to create analysis datasets to meet the analysis needs. These were further leveraged in many outputs in the form of tables, listings and figures that could also be standardized.

We accomplished the analysis of the complex drug-device study by independently coming up with the same concept as the CDISC Device ADaM sub-team. The case study supports this example and shows how we can leverage what we learned in the first device drug study into a standard that can be easily re-used for future studies.

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RECOMMENDED READING

Analysis Data Model (ADaM) v2.1, www.cdisc.org

Analysis Data Model Implementation Guide (ADaMIG) v1.1 www.cdisc.org

The SDTM Implementation Guide (SDTMIG) v3.2 www.cdisc.org

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the authors at:

Karin LaPann
Takeda Pharmaceutical Company Limited
300 Shire Way
Lexington, MA 02421
Email: karin.lapann@takeda.com

Wenying (Tiffany) Tian
Takeda Pharmaceutical Company Limited
300 Shire Way
Lexington, MA 02421
Email: wenying.tian@takeda.com