

## Referencing Medical Device Data in Standard SDTM domains

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### ABSTRACT

The seven new SDTM device domains capture the data describing patient exposure as well as all the details defining and identifying each device used in a medical device study. In order to provide continuity of device data across the entire SDTM model, some device-related data may also have to reside outside of the device domains. Examples of this are the AE domain which can contain information on device-related AEs and the PR domain which may need to accommodate a large amount of detailed information on device-related procedures such as implantation. We will discuss the integration of device data in the overall SDTM model and provide examples of methods for including device-related information in Findings domains outside of the device SDTM using the Findings About construct.

### INTRODUCTION

In the SDTM model, a set of seven device domains (CDISC SDTM, 2012) are responsible for receiving device-related data. These newly-added domains (Smoak, 2008) can accommodate a variety of information: identifiers for each device in the study, characteristics of devices and settings used, tracking, exposure and device events. While one domain (DX) is homologous to a domain in the main SDTM and describes the exposure of a subject to a study device, other domains capture information which is unique to medical device studies.

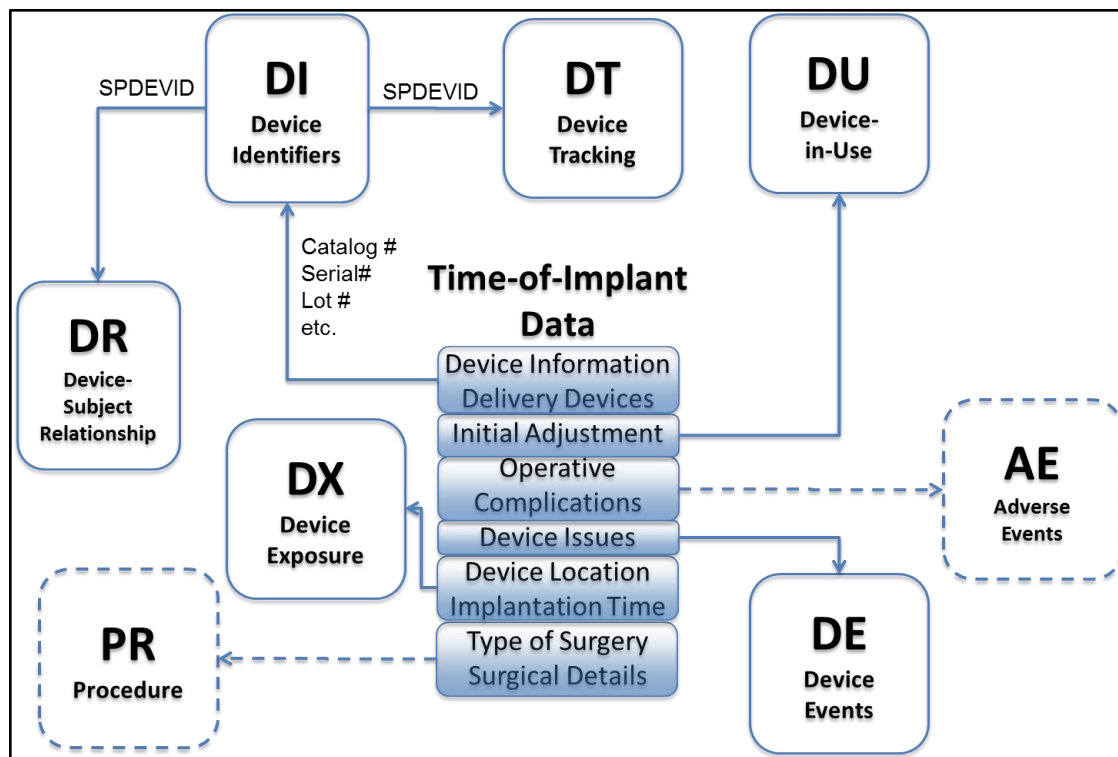


Figure 1. Mapping of Device Data Generated at Time-of-Implant to the SDTM. Six of the Seven SDTM Device Domains and Two Main SDTM Domains (Dotted Lines) are Shown.

Previous descriptions have covered the modeling of device-specific data into the new domains (CDISC SDTM, 2012 & Bullock *et al*, 2013). For instance, six of the seven device domains are used to capture data generated during implantation (see Figure 1.). We have found that some of this device-related data is more appropriate for domains in the main SDTM model (Note PR and AE domains in Figure 1.). This paper aims to describe methods to include

device related data into the main SDTM to provide continuity between both types of domains, device and non-device.

Device studies differ from Pharmaceutical studies in fundamental ways including Dosing and Exposure, Surgery and Procedure-related safety data (for implantable devices), the absence of PK/PD data, and local AEs. Each of these aspects of device studies changes the overall scheme data found in the Main SDTM domains. This paper will go through some of the unique aspects of implantable device studies that need to be addressed within the main SDTM.

## MODELING MEDICAL DEVICE–ASSOCIATED DATA USING THE PROCEDURE (PR) AND FINDINGS ABOUT (FA) DOMAINS

Implantable devices require a surgery or other procedure, such as injection, to introduce the device into the body. These invasive procedures can lead to adverse events, normally local to the implantation site, which need to be described in the AE domain (see below). Since implantation is carried out by different physicians, in different settings and sometimes using different tools, all procedural details need to be recorded fully. This is the first step to establishing a possible correlation between the implantation technique and any resulting AEs. Here, we employ both the Procedure (PR) and Findings About (FA) domains to capture the data necessary to fully describe surgeries, procedures and adverse events associated with medical devices.

### USING THE PR DOMAIN TO CAPTURE SURGERY AND PROCEDURAL DATA

The SDTM Implementation Guide v3.2 (CDISC SDTM, 2013) introduces a Procedure (PR) domain designed to capture all procedural data during a study. According to the guide, PR is appropriate for disease screening, endoscopic examinations, diagnostic tests, therapeutic procedures and surgery. This domain is also ideal for the placement procedures used in implantable medical device studies. Currently, the PR domain has 1 Topic, 8 Identifier, 17 Qualifier and 17 Timing Variables.

The following example gives the PR records for two device-related procedures in one patient:

*PR.xpt*

Row	STUDYID	DOMAIN	USUBJID	PRSEQ	PRTRT	PRCAT	PRSCAT	PRINDC
1	BD02	PR	BD02-1001	1	IMPLANTATION	Device Placement	Primary	Primary Device
2	BD02	PR	BD02-1001	2	EXPLANTATION	Device Removal		EOS Removal

Row	PRROUTE	PRLOC	PRLAT	VISITNUM	PRSTDTC	PRENDTC	PRDUR
1 (cont.)	Laparoscopy	Abdomen	L	3	2005-10-17T10:15	2005-10-17T11:47	92m
2 (cont.)	Laparoscopy	Abdomen	L	11	2006-10-25T09:08	2006-10-25T10:03	55m

**Table 1. Procedure (PR) Records for a Device Placement and Removal.**

The PR domain covers the basic description of the procedure, patient and visit. Indication, bodily location and duration are fundamental features of the procedure which are captured in the permitted variables of PR. It is not necessary to include PRDOSE and PRDOSU populated as '1' and 'Implant', respectively, since these values are captured in the device domain variables, DXDOSE and DXDOSEU.

In addition to these basic features, there are a variety of surgical details in a device procedure which may be related to safety reporting and are necessary to record. Factors such as needle size, incision type, technique used, surgical tools and accessories, irrigation, anaesthetic, and antibiotic cannot be accommodated by the standard variables of the PR domain. The following section describes the use of Findings About (FA) to associate unique surgical details with a procedure.

### USING THE FA DOMAIN TO DESCRIBE INTERVENTIONS

FA, the "Findings About Events or Interventions" domain, can capture qualifiers for an Event or Intervention that do not appear in its respective domain. The SDTMig v. 3.2 (CDISC SDTM, 2013) illustrates the relationship between the FA domain and the AE domain using the examples of rash and migraine. The rash or migraine appear as events with start and end date/times in the AE domain. However, data that is extraneous to the AE domain, such as the size of the rash or the symptoms of the migraine, appear in FA.

Generally, FA records supplement the descriptors of an Event in ways that are not possible within an Event domain. According to the SDTMig (CDISC SDTM, 2013), FA records can serve purposes such as modulating the severity of

an AE over time or indicating non-occurrence of a pre-specified AE (see SDTMig). FA records can be grouped together to provide multiple pieces of information for a single Event.

In this paper, we give an example of FA applied to surgical implantation. This surgery example demonstrates the utility of the FA domain in describing important details of a potentially complicated Intervention.

*CRF*

5) Implant Device Serial Number: _____
12) Incision Length: _____ <input type="checkbox"/> cm <input type="checkbox"/> inch
20) Type of Anaesthetic: <input type="checkbox"/> general <input type="checkbox"/> local
23) Drains Placed? <input type="checkbox"/> yes <input type="checkbox"/> no
Reduction Sleeve (cm)
25) Inner Diameter: _____
26) Outer Diameter: _____

**Figure 2. Selected lines from the Surgical Implantation CRF associated with the PR Entry of Table 1**

*FA.xpt*

Row	STUDYID	DOMAIN	USUBJID	FASEQ	FASPID	FATESTCD	FATEST	FAOBJ
1	BD02	FA	BD02-1001	1	5	SERNO	Serial Number	Device
2	BD02	FA	BD02-1001	2	12	LENGTH	Length	Incision
3	BD02	FA	BD02-1001	3	20	TYPE	Type	Anaesthetic
4	BD02	FA	BD02-1001	4	23	OCCUR	Occurrence	Drains Placed
5	BD02	FA	BD02-1001	5	25	INDIAM	Inner Diameter	Reduction Sleeve
6	BD02	FA	BD02-1001	6	26	OUTDIAM	Outer Diameter	Reduction Sleeve

Row	FACAT	FAORRES	FAORRESU	FASTRESC	FASTRESU	VISITNUM
1 (Cont.)	Surgical Details	BD-A005		BD-A005		3
2 (Cont.)	Surgical Details	5	cm	5	cm	3
3 (Cont.)	Surgical Details	General		General		3
4 (Cont.)	Surgical Details	Yes		Yes		3
5 (Cont.)	Surgical Details	10	cm	10	cm	3
6 (Cont.)	Surgical Details	15	cm	15	cm	3

**Table 2. FA Records Associated with Surgical Implantation**

The device serial number is included in these FA records because it is normally documented at the time-of-implant on the same CRF as the surgical information. Capturing the device-identifying information here is somewhat redundant because it will normally also be present in the device domains, Device-Subject Relationship (DR) and Device Tracking (DT). However, FA for Intervention allows for a direct association between the device-identifier and its implantation procedure.

RELREC can be used to uniquely associated FA domain records with an intervention. The following example shows the RELREC records that would relate the FA entries above to the implantation procedure in Table 1:

*RELREC*

Row	STUDYID	RDOMAIN	USUBJID	IDVAR	IDVARVAL	RELTYPE	RELID
1	BD02	PR	BD02-1001	PRSEQ	1		1
2	BD02	FA	BD02-1001	FASEQ	1		1
3	BD02	FA	BD02-1001	FASEQ	2		1
4	BD02	FA	BD02-1001	FASEQ	3		1
5	BD02	FA	BD02-1001	FASEQ	4		1
6	BD02	FA	BD02-1001	FASEQ	5		1
7	BD02	FA	BD02-1001	FASEQ	6		1

**Table 3. Usage of RELREC to Associate FA and PR Records.**

## USING THE FA DOMAIN TO HELP DESCRIBE DEVICE-RELATED ADVERSE EVENTS

The FA domain can be used to supplement the SDTM AE domain with features unique to device studies. This can provide a direct connection with the Device SDTM domains and the device identifiers and device event information therein. It can also add specificity to the relation-to-treatment, indicating whether the AE is device- or procedure-related or if the AE is a common response or a local complication.

If an AE occurs at a device implantation site, adverse event information should be captured which can establish the relation to treatment. In a device study, this information may take the form of whether the AE occurred at time-of-implantation, whether it is a common or pre-specified response to a procedure, whether it is considered a local complication and whether it is considered to be related to device or solely procedure related. In addition, in order to make the connection to a specific device in a bilateral study or a multi-device study, the laterality or, possibly, device-identifiers may need to be captured.

Some of the parameters above, such as the start time of the AE relative to implantation or the location of the AE, are accounted for in the current AE model. The FA domain can be implemented to keep track of the others. The following examples illustrate how treatment-related information can be modeled using records in the AE and FA domains.

Note: FA records can distinguish between relation to device and relation to procedure using FAOBJ= 'Device' or 'Procedure', respectively, and FATEST = 'Cause'. The primary cause variable, AEREL (relation to treatment), resides in the AE domain.

*AE.xpt*

Row	STUDYID	DOMAIN	USUBJID	AESEQ	AETERM	AESTDTC	AEENDTC
2	BD02	AE	BD02-1002	1	BACK PAIN FOR 2 DAYS	2006-01-05	2005-01-07
3	BD02	AE	BD02-1005	1	BLEEDING DURING SURGERY	2005-10-15T09:05	2005-10-13T09:15

Row	AEMODIFY	AEDECOD	AESEV	AESER	AEREL	AELOC
2 (cont)	BACK PAIN	Back pain	MODERATE	N	POSSIBLY RELATED	Back
3(cont)	BLEEDING	Bleeding	SEVERE	N	RELATED	Abdomen

*FA.xpt*

Row	STUDYID	DOMAIN	USUBJID	FASEQ	FASPID	FATESTCD	FATEST	FAOBJ
1	BD02	FA	BD02-1002	1	3	CAUSE	Cause	Device
2	BD02	FA	BD02-1002	2	3	CAUSE	Cause	Procedure
3	BD02	FA	BD02-1005	1	3	CAUSE	Cause	Device
4	BD02	FA	BD02-1005	2	3	CAUSE	Cause	Procedure

Row	FACAT	FAORRES	FASTRESC
1 (Cont.)	Treatment Relation	Possibly	Possibly
2 (Cont.)	Treatment Relation	Not Related	Not Related
3 (Cont.)	Treatment Relation	Not Related	Not Related
4 (Cont.)	Treatment Relation	Related	Related

**Table 4. Records for AE's which are either procedure- or device- related.**

In device studies, AEs can occur as local complications at the implantation site. There may also be AEs that are commonly encountered at the site of treatment (eg itching, swelling, etc.). These can be pre-specified on a CRF. The following AE and FA records address local complications and pre-specified treatment site AEs. Note that pre-specified AEs that did not occur are shown in the FA domain but not in the AE domain since AE records must correspond to actual events. Table 5 illustrates a method to handle local complications and pre-specified treatment site AE's using a combination of AE, FA and RELREC.

*AE.xpt*

Row	STUDYID	DOMAIN	USUBJID	AESEQ	AETERM	AESTDTC	AEENDTC
1	BD05	AE	BD05-1005	1	SWELLING	2005-10-12	2005-10-15
2	BD05	AE	BD05-1007	1	BRUISING	2005-10-12	2005-10-13
3	BD05	AE	BD05-1007	2	ITCHINESS AT TREATMENT SITE	2005-10-12	2005-10-13

Row	AEMODIFY	AEDECOD	AESEV	AESER	AEREL	AELOC
1 (cont)	SWELLING	Swelling	MODERATE	N	RELATED	Arm
2 (cont)	BRUISING	Bruising	MODERATE	N	RELATED	Arm
3 (cont)	ITCHINESS	Itchiness	MILD	N	RELATED	Arm

*FA.xpt*

Row	STUDYID	DOMAIN	USUBJID	FASEQ	FASPID	FATESTCD	FATEST	FAOBJ
1	BD05	FA	BD05-1005	1	8	OCCUR	Occurrence	Swelling
2	BD05	FA	BD05-1005	2	2	LOCOMP	Local Complication	Swelling
3	BD05	FA	BD05-1005	3	9	OCCUR	Occurrence	Redness
4	BD05	FA	BD05-1005	4	10	OCCUR	Occurrence	Bruising
5	BD05	FA	BD05-1007	1	8	OCCUR	Occurrence	Swelling
6	BD05	FA	BD05-1007	2	9	OCCUR	Occurrence	Redness
7	BD05	FA	BD05-1007	3	10	OCCUR	Occurrence	Bruising
8	BD05	FA	BD05-1007	4	1	LOCOMP	Local Complication	Bruising
9	BD05	FA	BD05-1007	5	2	LOCOMP	Local Complication	Itchiness

Row	FACAT	FAORRES	FASTRESC	FALAT
1 (Cont.)	Pre-Specified Local Complication	Yes	Yes	
2 (Cont.)	Local Complication	Yes	Yes	R
3 (Cont.)	Pre-Specified Local Complication	No	No	
4 (Cont.)	Pre-Specified Local Complication	No	No	
5 (Cont.)	Pre-Specified Local Complication	No	No	
6 (Cont.)	Pre-Specified Local Complication	No	No	
7 (Cont.)	Pre-Specified Local Complication	Yes	Yes	
8 (Cont.)	Local Complication	Yes	Yes	L
9 (Cont.)	Local Complication	Yes	Yes	L

*RELREC*

Row	STUDYID	RDOMAIN	USUBJID	IDVAR	IDVARVAL	RELTYPE	RELID
1	BD05	AE	BD05-1005	AESEQ	1		1
2	BD05	FA	BD05-1005	FASEQ	2		1
3	BD05	AE	BD05-1007	AESEQ	1		2
4	BD05	FA	BD05-1007	FASEQ	4		2
5	BD05	AE	BD05-1007	AESEQ	2		3
6	BD05	FA	BD05-1007	FASEQ	5		3

**Table 5. AE, FA, and RELREC Records for AE's which are local complications.**

Note that in addition to local complication designation, bilateral implant studies may require information on the laterality or side of occurrence for AEs in order to associate an AE with one device. This can be easily obtained as shown in Table 5 using the FA variable, FALAT.

## CONCLUSION

We recently presented a paper (Bullock *et al*, 2013) describing an exercise in modeling implantable device data to the seven newly-developed device domains. We found that, in general, these domains accommodate device data quite well. However, we did encounter a small amount of device-related data which seemed more appropriate for location within the main SDTM model. The purpose of this paper was to determine how best to model this residual device data so that it would comply with the main SDTM domain structure and, at the same time, provide continuity to the device domains.

The Procedure domain (PR), which is new to the SDTM implementation guide, version 3.2, is a necessity in implantable device studies. Some sort of medical procedure is always required for implantation and can easily generate as much safety data as the device itself. This is especially true during and right after device placement. Medical events that occur at the site of implantation are known as local complications. An FDA guidance (FDA, 2006) may direct that these complications be reported and they may be so common as to be pre-specified on a CRF. We found that the Procedure domain captures many basic features such as location in the body and duration of surgery which are potentially medically important.

In general, we relied on the Findings About (FA) domain to add device-related data to standard SDTM Events and Interventions domains. The SDTM implementation guide, v3.2, was immensely helpful in accomplishing this task. Multiple examples of Findings About Events define the usage of FA, in combination with RELREC, to modify and supplement an Event domain. There are, however, currently no practical examples for the usage of Findings About (FA) with an Intervention.

We found that the Procedure (PR) domain is one intervention that benefits greatly by enhancement with FA records. In addition to the basic features of an implantation procedure found in PR, there are a variety of surgical details that need to be recorded. Factors such as needle size, incision type, technique used, surgical tools and accessories, irrigation, anaesthetic, and antibiotic are all potentially causative in procedure-related adverse events. Using FA, one can model these details easily.

FA can also be employed to help supplement an event in the AE domain with device-related information. Local complication, procedure-relation, device-relation, and even a device-identifier are important pieces of information that can be added to the description of an AE. FA handles these features well and has a domain-specific variable for laterality which is especially important in bilateral device studies.

One question that remains is whether device-identifiers, such as UDEVID, should be included in the main SDTM records. As we have seen, this can be easily accomplished using FA records with AE or PR domains. Although it does not seem absolutely necessary given the completeness of the device domain SDTM model, there may be some potential benefits to providing this direct connection between the primary domains and the device domains. Adverse event data that is related to a procedural technique or to a device event could be tracked more easily. Similarly, adverse event reporting in bilateral or multiple implant studies might be more accurate. Finally, adding a device identifier in the implantation procedure may add redundancy to the inventory of devices in study and possibly reduce error.

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## **RECOMMENDED READING**

- Regulatory Submissions for Medical Devices and Diagnostics: The Basics, C.G. Smoak CDISC Journal, October 2011.

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