Integrating the Healthcare Enterprise

IHE Patient Care Device
Technical Framework Supplement

Infusion Pump Event Communication (IPEC)

Trial Implementation

Date: June 26, 2014

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Please verify you have the most recent version of this document. See here for Trial Implementation and Final Text versions and here for Public Comment versions.

Foreword

This is a supplement to the IHE Patient Care Device Technical Framework 3.0. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

This supplement is published on June 26, 2014 for trial implementation and may be available for testing at subsequent IHE Connectathons. The supplement may be amended based on the results of testing. Following successful testing it will be incorporated into the Patient Care Device Technical Framework. Comments are invited and can be submitted at http://www.ihe.net/PCD_Public_Comments.

This supplement describes changes to the existing technical framework documents.

"Boxed" instructions like the sample below indicate to the Volume Editor how to integrate the relevant section(s) into the relevant Technical Framework volume.

Amend section X.X by the following:

Where the amendment adds text, make the added text **bold underline**. Where the amendment removes text, make the removed text **~~bold strikethrough~~**. When entire new sections are added, introduce with editor's instructions to "add new text" or similar, which for readability are not bolded or underlined.

General information about IHE can be found at: www.ihe.net.

Information about the IHE Patient Care Device domain can be found at: ihe.net/IHE_Domains.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at: http://ihe.net/IHE_Process and http://ihe.net/Profiles.

The current version of the IHE Patient Care Device Technical Framework can be found at: http://ihe.net/Technical_Frameworks.

CONTENTS

EDITORS NOTE: *With the specification of Device Specialization – Infusion Pump profiles, it is anticipated that the pump-specific content of this IPEC Profile will be migrated to these infusion pump content specifications. As a result, in a future cycle, this profile shall be generalized to Event Communication (EC) and will provide a general capability – using the defined PCD-10 transaction – to support all device EC*

Introduction

This Supplement adds sections to the PCD Technical Framework Volume 1 describing the content associated with communicating Infusion Pump device events, and to Volume 2 describing data content and constraints.

Profile Abstract

The Infusion Pump Event Communication (IPEC) Profile specifies methods for communicating significant clinical and technical events from a Patient Care Device such as infusion pump to an information system which may present it to a clinical user, acts on it in some way or records it. The information is communicated in a data format similar to that of Device Enterprise Communications (DEC) Profile, but differs in that DEC is mainly used for sampled physiological and technical data at timed, equal intervals, while IPEC is used to communicate significant occurrences which happen at unscheduled times. Infusion Pump Event Communications is also related to the Alert Communication Management (ACM) Profile, except that ACM is designed to communicate alarms (physiological and technical) and advisories to a human actor via portable devices, where IPEC is designed for system-to-system communication for automated recording or tracking occurrences which do not necessarily require urgent attention from a person.

Open Issues and Questions

- For future consideration:
  - Include a unique event identifier in order to help in associating related events (delivery starts and delivery stops). Since there are many different use cases in pump operation, it may be that this is not feasible. Further analysis is needed. In the meantime this can be accomplished using patient, device and order identifiers that are present in the PCD-10 message.
  - Support for subscription option for event messages.
  - Harmonize Patient ID Change event with the Point of Care Identity Management (PCIM) work group.
  - Possible alignment with the Pharmacy domain through the use of the RAS^O17 message instead of ORU^R42

Closed Issues

Containment level defined for all events.

Volume 1 – Content Profiles

1.7 History of Annual Changes

Add the following bullet to the end of the bullet list in section 1.7

- Added the Infusion Pump Event Communication Profile which specifies the transmission of event information from infusion pumps to other information systems.
- November 2013 – updated profile to reflect the revisions to the 11073-10101a infusion pump model; additional corrections and clarifications made.

1.n Copyright Permission

No new information.

2.1 Dependencies among Integration Profiles

Add the following to Table 2-1

Integration Profile	Depends On	Dependency Type	Purpose
Infusion Pump Event Communication	Consistent Time	Each actor implementing IPEC shall be grouped with the Time Client Actor.	Required for consistent time-stamping of event data.

Add the following section to Section 2.2

2.2.X Infusion Pump Event Communication Integration Profile

This document introduces a new profile - Infusion Pump Event Communication. This profile is based on the general observation reporting in the Device Enterprise Communication (DEC) Profile. Infusion Pump Event Communication uses the same general form of interactions among Device Observation Reporter and Device Observation Consumer Actors.

The principal intended uses of IHE Device Enterprise Communication in acute care are to communicate device data to enterprise information systems for:

- Reporting, charting and trending physiological data to assist clinicians in tracking the patients physiological state for situational awareness and care planning
- Near-real-time response to clinically or technically actionable events and situations
- Provision of information for an archival record of device observations, possibly including events, that are clinical, technical, or both

Device Enterprise Communications (DEC) is chiefly designed for the first goal listed based on periodic observation reporting, but has always provided for episodic and event reporting as a subtype of general event reporting.

This Infusion Pump Event Communication Integration Profile is designed to address the second goal of reporting events, specifically infusion pumps events. It defines a means for communicating significant events in medication administration by infusion pumps.

Add section X

X Infusion Pump Event Communication (IPEC) Integration Profile

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Events in Medical Device Communications

An event, in the context of medical device communications, is an occurrence about which it is desired to communicate information between devices and information systems. Events are communicated as soon after their occurrence as is technically feasible, in contrast to other observation reporting from devices to information systems which capture the trend of continuously-varying physiological characteristics indicating the patient's clinical status by communicating observations at regular time intervals. These characteristics are usually then displayed to clinical users in a spreadsheet-like grid or on a trend graph.

One special sort of event is an episodic measurement, that is, one that is not automatically initiated on a regular, timed basis, such as a spot blood pressure cuff reading, or a non-continuous cardiac output measurement. These are initiated manually and the receiving information system has no foreknowledge of when they will occur.

Another special case is an alarm or advisory, where the key outcome of the alert is meant to be some action by a person. The IHE PCD Alert Communication Management (ACM) Profile is focused on the human notification aspect of this.

Relation of Infusion Pump Event Communication to Alert Communication Management (ACM) Profile

See the Glossary in Volume 1 of the PCD Technical Framework (PCD TF-1) *for definitions of the terms Advisory, Alarm, and Alert.*

Alert Communication Management has provided expanded formats with additional attributes for alarms and advisories, with emphasis on transmitting the information to specific individuals who need to be notified at the point of care via portable devices. For purposes of this discussion, a distinction is made between events and alerts.

- Events are operational milestones and key parameter changes. For example, during normal execution of an infusion therapy, non-alarm conditions such as start of delivery, change of rate, switchover from piggyback to primary drug, completion of delivery, transition to KVO, etc. are important to full recording or state awareness for the therapeutic process.
- Alerts, which are distinct from events and are intended to engage a response from the clinician, are supported by the Alert Communication Management Profile.

Clinical information systems must communicate, for real-time high-reliability review and action, and record for documentation purposes:

- Exception Events – physiological or technical, which may indicate conditions either in the patient or in the equipment in use by those caring for the patient, which need attention at stated levels of urgency. These include alarms, appropriately processed for human notification using the Alert Communication Management Profile, but may in addition need to be communicated to information systems for other purposes than immediate notification of persons, such as documentation.
- State transitions – operationally significant changes between discrete states of physiological or technical conditions (for example, “modes” and “settings” for a device, “warning or alarm limit” or “action limit” for a measured physiological parameter).
- Priority may be evaluated by the original sending device or by business rules and clinical protocols in downstream systems. Sources for raw and derived data and interpretations of priority must be documented for audit/forensic purposes, potentially by additions to content of message.

X.1 Actors/Transactions

Figure X.1-1 shows the actors directly involved in the Infusion Pump Event Communication Integration Profile and the relevant transactions between them. Other actors that may be indirectly involved due to their participation in Device Enterprise Communications (DEC) or Point-of-care Infusion Verification (PIV), etc., are not necessarily shown.

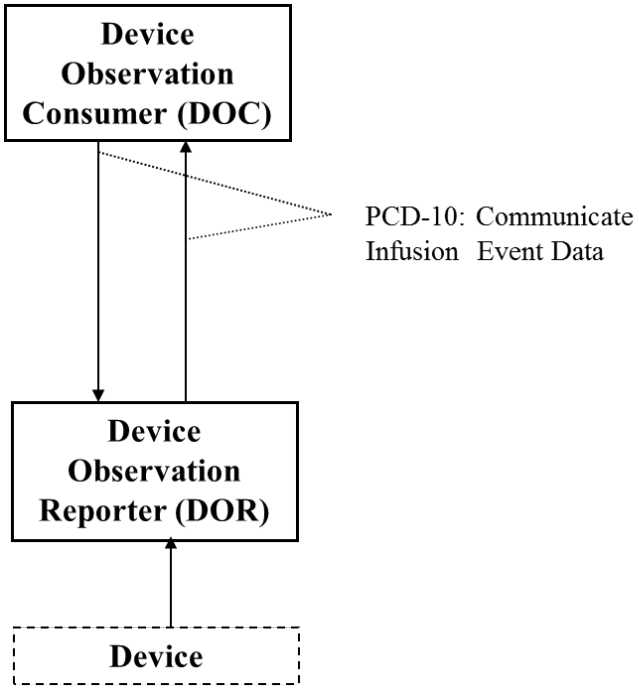


Figure X.1-1: Infusion Pump Event Communication Actor Diagram

Table X.1-1 lists the transactions for each actor directly involved in the Infusion Pump Event Communication Profile. In order to claim support of this Integration Profile, an implementation must perform the required transactions (labeled "R"). Transactions labeled "O" are optional.

Table X.1-1: Infusion Pump Event Communication Integration Profile - Actors and Transactions

Actors	Transactions	Optionality	Section in Vol. 2
Device Observation Reporter	Communicate Infusion Event Data	R	Z.1
Device Observation Consumer	Communicate Infusion Event Data	R	Z.1

X.2 IPEC Options

The IHE PCD Infusion Pump Event Communication Profile does not define any options.

X.3 IPEC Actor Groupings and Profile Interactions

None

X.4 Infusion Pump Event Communication Process Flow

X.4.1 Standard Use Cases

X.4.1.1 Case IPEC-1: Communicate event data to EMR/EHR

Data from all of the patient care devices associated with a particular patient is communicated by a Gateway, Device or Clinical Information System (CIS) implementing the DOR Actor to an EMR/EHR, implementing the DOC Actor. This document only covers event data received from infusion pumps. Discrete parameters representing the device's state at or near the time of the event are included. The data is time stamped with a consistent time across the data from the respective patient care devices.

The primary intent is communication of structured data; however provisions are made for inclusion of unstructured data. The application provides facilities to bind an authoritative enterprise patient identifier required for inclusion of the PCD data in the patient record. The workflow for associating the authoritative enterprise patient identifier to the PCD data is outside the scope of the current PCD TF.

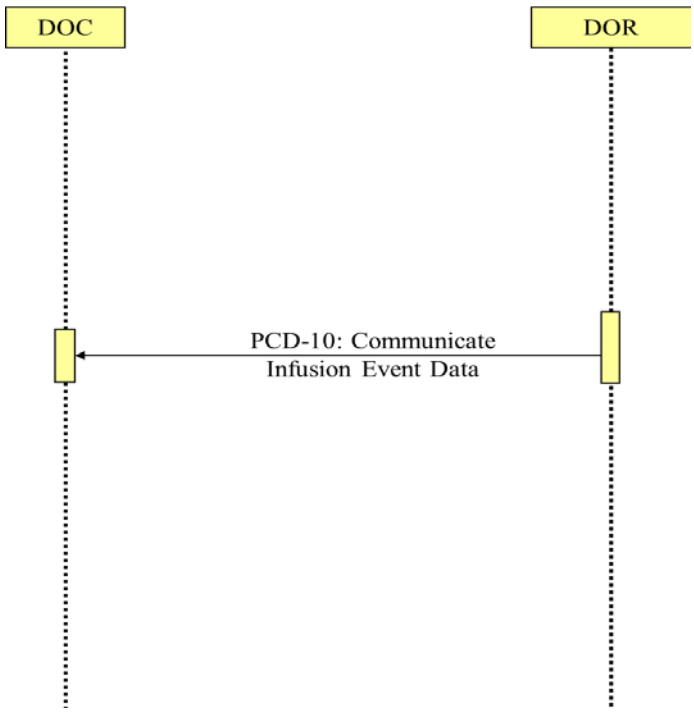


Figure X.4.1.1-1: Basic Process Flow in Infusion Pump Event Communication Profile

X.5 IPEC Security Considerations

The IPEC Profile does not address issues of privacy, security, and confidentiality associated with cross-enterprise communication of PCD data. The assumption is made that the IPEC Profile is implemented in a single enterprise on a secure network.

Appendix A Actor Summary Definitions

This integration profile will not add any new actors.

Appendix B Transaction Summary Definitions

Infusion Pump Event – An event, in the context of infusion pump device communications, is an occurrence about which it is desired to communicate information between Infusion Pump devices and Clinical Information Systems. For example, during normal execution of an infusion therapy, non-alarm conditions such as start of delivery, change of rate, switchover from piggyback to primary drug, completion of delivery, transition to KVO, etc., are important to full documentation of the IV administration.

Glossary

Add the following terms to the Glossary:

Event: an occurrence about which it is desired to communicate information between devices and information systems. Events include operational milestones and key parameter changes. Alarms are considered to be a subset of events.

Program: Settings used to control the operation of the pump. A program typically initiated by the clinician and entered manually on the device. Once the settings are confirmed, the clinician can then start the infusion.

Auto Program: A pump program in which some or all settings are received from another system such as an eMAR or BCMA system. When an auto-program is received on the pump, the clinician will enter any additional required settings, confirm them, and start the infusion.

Delivery: The infusion pump mechanism for moving fluid into a patient is engaged.

KVO: Keep Vein Open. A fluid delivery mode that may occur once the programmed volume has been infused.

Volume 2 - Transactions

Add Section 3.10

3.10 Communicate Infusion Event Data

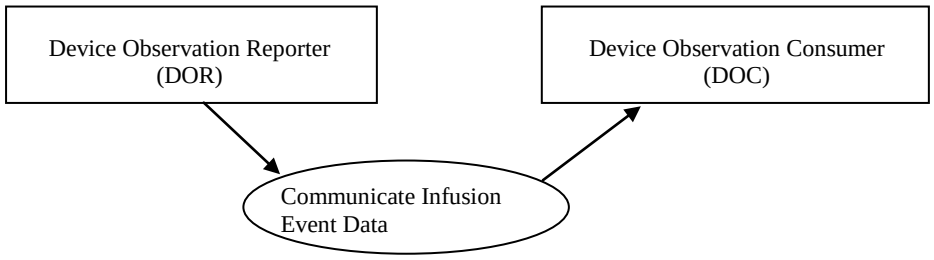
This section corresponds to the Communicate Infusion Event Data transaction of the IHE Technical Framework. Communicate Infusion Event Data is used by the DOR and DOC Actors.

3.10.1 Scope

This transaction is used to communicate infusion event data from:

- A Device Observation Reporter (DOR) to a Device Observation Consumer (DOC).

3.10.2 Use Case Roles



Actor: Device Observation Reporter

Role: Sends infusion event data to DOC

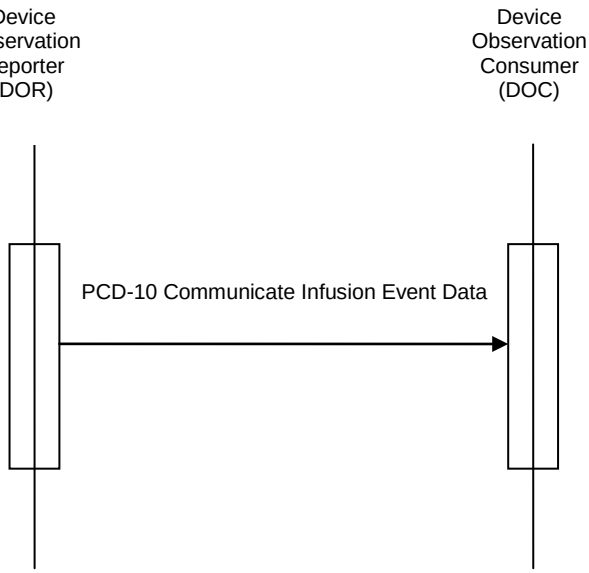
Actor: Device Observation Consumer

Role: Receives infusion event data from DOR

3.10.3 Referenced Standard

- HL7 - Health Level 7 Version 2.6 Ch7 Observation Reporting
- ISO/IEEE 11073-10101 Nomenclature

3.10.4 Interaction Diagram



3.10.4.1 Communicate Infusion Event Data

Event messages are generated by the infusion pump or Gateway during normal execution of an infusion therapy. Example of such events are start of infusion delivery, rate change or transition from piggyback to primary or transition to KVO. This information is sent from a DOR to a DOC.

Note that while a system is off-line, all events should be buffered and then communicated when communication is established again. Event time stamps should indicate when the event occurred, not when it was communicated.

3.10.4.1.1 Trigger Events

The ORU^R42^ORU_R01 message is an unsolicited update initiated by the Device Observation Reporter. The ORU^R42 can be sent with or without a preceding order, since it is common in a clinical setting for device data to be reported without a specific order having been transacted in the information system (that is, the reporting is the result of a "standing order" for monitoring in a particular clinical situation).

3.10.4.1.2 Message Semantics

Refer to the HL7 standard for the ORU message of HL7 2.6 Chapter 7 and the general message semantics.

The ORU^R42^ORU_R01 message structure provides the mechanism for mapping the hierarchical structure of an IEEE 11073 containment tree to a series of OBX segments. See the discussion of how the containment is represented using a "dotted notation" in field OBX-4 Observation Sub-ID in the PCD Technical Framework Vol. 2 Rev. 3.0 Appendix B, Section B.8.

See “ISO/IEEE Nomenclature mapping to HL7 OBX-3” in the PCD Technical Framework Vol. 2 Rev. 3.0, Appendix A, Section A.1 for further information on the mapping rules.

3.10.4.1.3 Expected Actions

The ORU^R42^ORU_R01 message is sent from the DOR to the DOC. Upon receipt the DOC validates the message and responds with an acknowledgement as defined in PCD Technical Framework Vol. 2 Rev. 3.0 Appendix G.1.1 Acknowledgment Modes.

Appendix X Infusion Pump Events

This appendix is intended to provide background information to support a mechanism for the transmission of event information for large volume (general purpose) infusion pumps. Common infusion modalities for these pumps may include continuous, piggyback, bolus, multi-step, and intermittent functionality. Support for patient-controlled analgesia (PCA) pumps and other types of pumps will be addressed at a later date.

A major challenge in reporting infusion pump events is that although pumps are able to report programmed and operational parameters, they are typically not "aware" of how or why they are being used clinically. In medical environments there are an enormous number of use cases for administering an infusion using a pump. Even a routine delivery of an amount of fluid may involve several instances where the infusion is paused or stopped and then restarted (either within seconds or after several hours or more). The infusion rate may be changed, or an alarm may cause the infusion to stop until the alarm is addressed. For various practical and clinical reasons, the values programmed on the pump by the clinician may not relate to the volume that the physician ordered, the actual volume of the fluid container that was hung, or the rate at which the infusion was ordered.

All current pump systems do not report event information the same way. The same information may be represented differently, or a different set of information may be reported. Information may be reported periodically or episodically, but not in accordance with a common specification.

As a result, a decision has been made to standardize a small number of basic operational events. In combination with pump mode and status information, these can be used to express the various key operational components of an infusion over time. Systems that receive event information, such as eMAR or BCMA systems, have the clinical/medication order information and will need to reconcile the reported operational events with this information.

X.1 Basic Infusion Events

It may be helpful to think of an infusion as a series of delivery segments, each of which is bounded by one of the following events:

- Delivery Start
- Delivery Stop
- Delivery Complete

There are also several other operational events not related to fluid delivery:

- Communication Status Change – communication between pump and gateway is lost or resumed
- Program Cleared – pump settings are cleared (indicating that a new program will be initiated)

- Auto-Program Cleared – an auto-program was received on the pump but the programmed settings were cleared on the pump prior to starting delivery
- Patient ID Change
- Patient Weight Change

The following diagram illustrates a typical scenario where a bag of fluid is infused and a rate change is made:

- An infusion is started at 75 mL/hr. A volume to be infused is programmed (not shown).
- After a period of time the infusion is stopped (paused), perhaps in order to move the patient.
- The infusion is resumed at 100 mL/hr.
- The programmed volume to be infused is met (delivery is complete).
- Pump switches to KVO (keep vein open) mode.
- Pump is stopped.

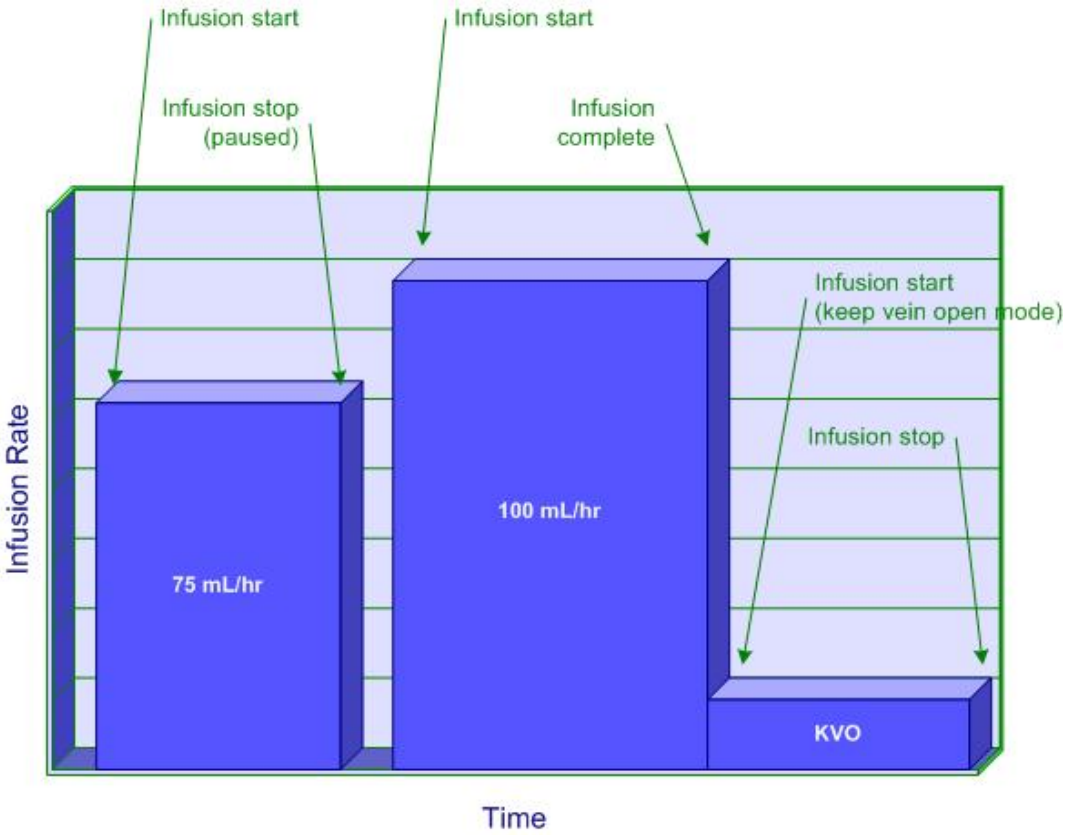


Figure X.1-1: Infusion with a Rate Change

X.1.1 Event Message – PCD-10 Communicate Infusion Event Data

The structure of the message differs from the PCD-01 message (ORU^R01) in the following ways

- MSH-9.2 contains a new trigger event code (R42) assigned for infusion event data.
- MSH-21.3 contains the PCD-10 unique profile identifier. The OID identifier assigned to PCD-10 is "1.3.6.1.4.1.19376.1.6.1.10.1".

Each PCD-10 message contains only information relevant to the specific device and channel on which the event occurred. Each PCD-10 message contains a single event. Only information pertinent to the event is included.

X.1.2 Infusion Pump Events

Table X.1.2-1: Infusion Pump Events

Event	MDC Code	Required by Profile
Delivery Start	MDC_EVT_PUMP_DELIV_START	Yes
Delivery Stop	MDC_EVT_PUMP_DELIV_STOP	Yes
Delivery Complete	MDC_EVT_PUMP_DELIV_COMP	Yes
Communication Status Change	MDC_EVT_COMM_STATUS_CHANGE	No
Program Cleared	MDC_EVT_PUMP_PROG_CLEARED	No
Auto-Program Cleared	MDC_EVT_PUMP_AUTO_PROG_CLEARED	No
Patient Change	MDC_EVT_PATIENT_CHANGE	No
Patient ID Change	MDC_EVT_PATIENT_ID_CHANGE	No
Patient Weight Change	MDC_EVT_PATIENT_WEIGHT_CHANGE	No

X.1.2.1 Infusion Event Parameters

Infusion Event Parameters are defined in separate Infusion Pump Model and Infusion Pump Terms documents. Current versions of these documents can be found on the IHE Patient Care

Devices Wiki page entitled “PCD Reference Pages” (http://wiki.ihe.net/index.php?title=Category:PCD_Reference_Pages).

425 The following tables outline the required and optional attributes for each event.

Table X.1.2.1-1: Infusion Pump Delivery Event Attributes

ATTRIBUTE	MDC_EVT_PUMP_ DELIV_START	MDC_EVT_PUMP_ DELIV_STOP	MDC_EVT_PUMP_ DELIV_COMP
Drug Name	R	R	R
Concentration	O	O	O
Current Mode	R	R	R
Pump Status	R	R	R
Rate (delivery)	R	R	R
Rate (non-delivery)	O	O	O
Dose Rate	O	O	O
Volume Programmed	O	O	O
Volume Remaining	R[1]	R[1]	R[1]
Current Segment Volume Delivered	O	R[2]	R[2]
Cumulative Volume Delivered	O	R[2]	R[2]
Time Remaining	O	O	O
Patient Height	O	O	O
Patient Weight	O	O	O
BSA (Body Surface Area)	O	O	O

[1]Volume Remaining is Optional when Volume to be infused is not programmed by the user; e.g., for certain infusions using a syringe pump

430 [2]Either Current Segment Volume Delivered or Cumulative Volume Delivered is required

Table X.1.2.1-2: Infusion Pump Miscellaneous Events Attributes

ATTRIBUTE	MDC_EVT_ COMM_STATUS_ CHANGE	MDC_EVT_PUMP_ PROG_CLEARED	MDC_EVT_PUMP_ AUTO_PROG_ CLEARED
Drug Name	N/A	O	O
Concentration	N/A	O	O

ATTRIBUTE	MDC_EVT_ COMM_STATUS_ CHANGE	MDC_EVT_PUMP_ PROG_CLEARED	MDC_EVT_PUMP_ AUTO_PROG_ CLEARED
Pump Mode	N/A	O	O
Pump Status	N/A	O	O
Rate (delivery)	N/A	O	O
Rate (non-delivery)	N/A	O	O
Dose Rate	N/A	O	O
Volume Programmed	N/A	O	O
Volume Remaining	N/A	O	O
Current Segment Volume Delivered	N/A	O	O
Cumulative Volume Delivered	N/A	O	O
Time Remaining	N/A	O	O
Patient Height	N/A	O	O
Patient Weight	N/A	O	O
BSA (Body Surface Area)	N/A	O	O
Communication Status	R	N/A	N/A

The following table describes the mapping of clinical scenarios to pump events. The term "delivery segment" refers to the period between a MDC_EVT_PUMP_DELIV_START event and the next MDC_EVT_PUMP_DELIV_STOP or MDC_EVT_PUMP_DELIV_COMP event.

Note: Additional clinical scenarios will be added to this table as they are identified.

Table X.1.2.1-3: Clinical Scenarios

Clinical Scenario	PCD-10 Event	Parameters	Discussion
New infusion start, followed by eventual transition to KVO, followed by transition from KVO to paused	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-* Status=pump-status-infusing Rate(non-delivery)=programmed rate Rate(delivery)=programmed rate Dose Rate=programmed dose rate Volume Programmed=volume programmed Volume Remaining=volume programmed Current Segment Volume Delivered=0 Cumulative Volume Delivered=0 Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	Depending on pump make/model, Rate may not be specific to KVO rate and volume infused may continue to increase after the transition to KVO even though the VTBI has been met
	MDC_EVT_PUMP_DELIV_COMP	Current Mode=pump-mode-* Status=pump-status-not-infusing Rate(non-delivery)=programmed rate Rate(delivery)=0 Dose Rate=programmed dose rate Volume Programmed=volume programmed Volume Remaining=0 Current Segment Volume Delivered= volume programmed Cumulative Volume Delivered= volume programmed Time Remaining=0	
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-kvo Status=pump-status-infusing Rate(non-delivery)=KVO rate Rate(delivery)=KVO rate Dose Rate=n/a Volume Programmed=0 Volume Remaining=0 Current Segment Volume Delivered=0 Cumulative Volume Delivered=volume programmed Time Remaining=0	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-kvo Status=pump-status-not-infusing Rate(non-delivery)=KVO rate Rate(delivery)=0 Dose Rate=n/a Volume Programmed=0 Volume Remaining=0 Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=volume programmed plus the amount delivered during KVO Time Remaining=0	
Start/restart an infusion, followed by pausing the running infusion	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-* Status=pump-status-infusing Rate(non-delivery)=programmed rate Rate(delivery)=programmed rate Dose Rate=programmed dose rate Volume Programmed=volume programmed Volume Remaining=volume remaining Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery prior to this one Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-* Status=pump-status-not-infusing Rate(non-delivery)=programmed rate Rate(delivery)=0 Dose Rate=programmed dose rate Volume Programmed=volume programmed Volume Remaining=volume remaining Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery, including the one just completed Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Rate Change (NOTE: events associated with the start of the infusion at original rate and pausing or completion at the new rate are not shown)	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-* Status=pump-status-not-infusing Rate(non-delivery)=old programmed rate Rate(delivery)=0 Dose Rate=old programmed dose rate Volume Programmed=volume programmed Volume Remaining=volume remaining Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery, including the one just completed Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-* Status=pump-status-infusing Rate(non-delivery)=new programmed rate Rate(delivery)=new programmed rate Dose Rate=new programmed dose rate Volume Programmed=volume programmed Volume Remaining=volume remaining Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery prior to this one Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Piggyback start, followed by piggyback end, followed by resumption of the primary infusion (this assumes the pump will revert to the primary rate once piggyback VTBI is achieved) (Note: events associated with the start of the primary infusion prior to the piggyback and completion of the primary infusion after the piggyback are not shown)	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-* Status=pump-status-not-infusing Rate(non-delivery)=primary rate Rate(delivery)=0 Dose Rate=primary dose rate Volume Programmed=primary volume programmed Volume Remaining=primary volume remaining Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the primary delivery, including the one just completed Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	DELIV_STOP – Used if the pump is switching from primary to piggyback. Not needed if starting piggyback from a pause or stop. .
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-piggyback Status=pump-status-infusing Rate(non-delivery)=piggyback programmed rate Rate(delivery)=piggyback programmed rate Dose Rate=piggyback dose rate Volume Programmed=piggyback volume programmed Volume Remaining=piggyback volume programmed Current Segment Volume Delivered=0 Cumulative Volume Delivered=0 Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
	MDC_EVT_PUMP_DELIV_COMP	Current Mode=pump-mode-piggyback Status=pump-status- not-infusing Rate(non-delivery)=piggyback programmed rate Rate(delivery)=0 Dose Rate=piggyback dose rate Volume Programmed=piggyback volume programmed Volume Remaining=0 Current Segment Volume Delivered=volume delivered since last piggyback DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the piggyback delivery, including the one just completed Time Remaining=0	
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-* Status=pump-status-infusing Rate(non-delivery)=primary rate Rate(delivery)=primary rate Dose Rate=primary dose rate Volume Programmed=primary volume programmed Volume Remaining=primary volume remaining Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the primary delivery Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Bolus start, followed by bolus end, followed by resumption of continuous rate after the bolus (this assumes the pump will revert to the continuous rate once the bolus VTBI is achieved) (NOTE: events associated with the start of the continuous infusion prior to the bolus and completion of the continuous infusion after the bolus completes are not shown)	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-* Status=pump-status-not-infusing Rate(non-delivery)=continuous rate Rate(delivery)=0 Dose Rate=continuous dose rate Volume Programmed=continuous volume programmed Volume Remaining=continuous volume remaining Current Segment Volume Delivered=continuous volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the continuous delivery, including the one just completed Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	DELIV_STOP – Used if the pump is switching from continuous to bolus. Not needed if starting bolus from a pause or stop.
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-clinician-dose Status=pump-status-infusing Rate(non-delivery)=bolus programmed rate Rate(delivery)=bolus programmed rate Dose Rate=bolus dose rate Volume Programmed=bolus volume programmed Volume Remaining=bolus volume programmed Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the continuous delivery and any previously completed boluses Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-clinician-dose Status=pump-status-not-infusing Rate(non-delivery)=bolus programmed rate Rate(delivery)=0 Dose Rate=bolus dose rate Volume Programmed=bolus volume programmed Volume Remaining=0 Current Segment Volume Delivered=bolus volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the bolus, including the one just completed, plus the sum of the "Current Segment Volume Delivered" values across all segments for the continuous delivery Time Remaining=0	
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-* Status=pump-status-infusing Rate(non-delivery)= continuous rate Rate(delivery)= continuous rate Dose Rate= continuous dose rate Volume Programmed= continuous volume programmed Volume Remaining= continuous volume remaining Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the continuous delivery and any boluses Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Multi-step start, followed by multi-step transition, followed by multi-step stop	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-multi-step Status=pump-status-infusing Rate(non-delivery)=programmed rate for step 1 Rate(delivery)=programmed rate for step 1 Dose Rate=programmed dose rate for step 1 Volume Programmed=volume programmed for step 1 Volume Remaining=volume programmed for step 1 Current Segment Volume Delivered=0 Cumulative Volume Delivered=0 Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	The transition is handled like a rate change
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-multi-step Status=pump-status-not-infusing Rate(non-delivery)= programmed rate for step n Rate(delivery)=0 Dose Rate= programmed dose rate for step n Volume Programmed=volume programmed for step n Volume Remaining=0 Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of “Current Segment Volume Delivered” values across all segments for the delivery, including the one just completed Time Remaining=0	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-multi-step Status=pump-status-infusing Rate(non-delivery)=programmed rate for step n+1 Rate(delivery)=programmed rate for step n+1 Dose Rate=programmed dose rate for step n+1 Volume Programmed=volume programmed for step n+1 Volume Remaining=volume programmed for step n+1 Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery prior to this one Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-multi-step Status=pump-status-not-infusing Rate(non-delivery)= programmed rate for current step Rate(delivery)=0 Dose Rate= programmed dose rate for current step Volume Programmed=volume programmed for current step Volume Remaining=0 Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery, including the one just completed Time Remaining=0	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Intermittent step start, followed by intermittent step stop	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-multi-dosing Status=pump-status-infusing Rate(non-delivery)=programmed rate for step n Rate(delivery)=programmed rate for step n Dose Rate=programmed dose rate for step n Volume Programmed=volume programmed for step n Volume Remaining=volume programmed for step n Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery prior to this one Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-multi-dosing Status=pump-status-not-infusing Rate(non-delivery)= programmed rate for current step Rate(delivery)=0 Dose Rate= programmed dose rate for current step Volume Programmed=volume programmed for current step Volume Remaining=0 Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery, including the one just completed Time Remaining=0	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Loading dose start, followed by loading dose end, followed by start of continuous (this assumes the pump will start at the continuous rate once the loading dose VTBI is achieved) (NOTE: the event associated with the completion of the continuous infusion after the bolus completes is not shown)	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-loading-dose Status=pump-status-infusing Rate(non-delivery)=loading dose programmed rate Rate(delivery)=loading dose programmed rate Dose Rate=loading dose dose rate Volume Programmed=loading dose volume programmed Volume Remaining=loading dose volume programmed Current Segment Volume Delivered=0 Cumulative Volume Delivered=0 Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-loading-dose Status=pump-status-not-infusing Rate(non-delivery)=loading dose programmed rate Rate(delivery)=0 Dose Rate=loading dose dose rate Volume Programmed=loading dose volume programmed Volume Remaining=0 Current Segment Volume Delivered=loading dose volume delivered since last DELIV_START Cumulative Volume Delivered=sum of “Current Segment Volume Delivered” values across all segments for the loading dose, including the one just completed Time Remaining=0	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-* Status=pump-status-infusing Rate(non-delivery)=continuous rate Rate(delivery)=continuous rate Dose Rate=continuous dose rate Volume Programmed=continuous volume programmed Volume Remaining=continuous volume remaining Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the loading dose Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
Infusion Stopped Due to Alarm			Same as "Pause a running infusion" scenario
Auto-restart after alarm resolved			e.g., occlusion resolved or AIL Same as "Start/restart an infusion" scenario
Nurse restart after alarm resolved			Same as "Start/restart an infusion" scenario
Nurse changes VTBI			e.g., bag change, hourly check, etc. Same as "Pause a running infusion" case followed by "Start/restart an infusion" case

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Ramp/taper start, followed by ramp/taper rate change, followed by ramp/taper stop	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-ramp-taper Status=pump-status-infusing Rate(non-delivery)=programmed rate for step 1 Rate(delivery)=programmed rate for step 1 Dose Rate=programmed dose rate for step 1 Volume Programmed=volume programmed for entire ramp/taper delivery Volume Remaining=volume programmed for entire ramp/taper delivery Current Segment Volume Delivered=0 Cumulative Volume Delivered=0 Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-ramp-taper Status=pump-status-not-infusing Rate(non-delivery)= programmed rate for step n Rate(delivery)=0 Dose Rate= programmed dose rate for step n Volume Programmed=volume programmed for entire ramp/taper delivery Volume Remaining=volume remaining for entire ramp/taper delivery Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of “Current Segment Volume Delivered” values across all segments for the delivery, including the one just completed Time Remaining=0	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-ramp-taper Status=pump-status-infusing Rate(non-delivery)=programmed rate for step n+1 Rate(delivery)=programmed rate for step n+1 Dose Rate=programmed dose rate for step n+1 Volume Programmed=volume programmed for entire ramp/taper delivery Volume Remaining=volume remaining for entire ramp/taper delivery Current Segment Volume Delivered=0 Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery prior to this one Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-ramp-taper Status=pump-status-not-infusing Rate(non-delivery)= programmed rate for step n Rate(delivery)=0 Dose Rate= programmed dose rate for step n Volume Programmed=volume programmed for entire ramp/taper delivery Volume Remaining=volume remaining for entire ramp/taper delivery Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the delivery, including the one just completed Time Remaining=0	
Patient ID Change	MDC_EVT_PATIENT_ID_CHANGE	New Patient ID=PID.3	
New Weight (same patient)	MDC_EVT_PATIENT_WEIGHT_CHANGE	Weight=New Patient Weight	e.g., when weight changed during an active weight-based infusion

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Switch to library-based infusion (NOTE: events associated with the start of the non-library infusion and the completion of the library-based infusion are not shown)	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-* Status=pump-status-not-infusing Rate(non-delivery)=rate of non-library infusion Rate(delivery)=0 Dose Rate=dose rate of non-library infusion Volume Programmed=volume programmed for non-library infusion Volume Remaining=volume remaining of non-library infusion Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the non-library delivery, including the one just completed Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	The library-based infusion is considered a new delivery
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-* Status=pump-status-infusing Rate(non-delivery)=rate of library-based infusion Rate(delivery)=programmed rate of library-based infusion Dose Rate=dose rate of library-based infusion Volume Programmed=volume programmed for library-based infusion Volume Remaining=volume programmed for library-based infusion Current Segment Volume Delivered=0 Cumulative Volume Delivered=0 Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	

Clinical Scenario	PCD-10 Event	Parameters	Discussion
Switch from library-based infusion (NOTE: events associated with the start of the library-based infusion and the completion of the non-library-based infusion are not shown)	MDC_EVT_PUMP_DELIV_STOP	Current Mode=pump-mode-* Status=pump-status-not-infusing Rate(non-delivery)=rate of library infusion Rate(delivery)=0 Dose Rate=dose rate of library infusion Volume Programmed=volume programmed for library infusion Volume Remaining=volume remaining of library infusion Current Segment Volume Delivered= volume delivered since last DELIV_START Cumulative Volume Delivered=sum of "Current Segment Volume Delivered" values across all segments for the library delivery, including the one just completed Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	
	MDC_EVT_PUMP_DELIV_START	Current Mode=pump-mode-* Status=pump-status-infusing Rate(non-delivery)=rate of non-library-based infusion Rate(delivery)=programmed rate of non-library-based infusion Dose Rate=dose rate of non-library-based infusion Volume Programmed=volume programmed for non-library-based infusion Volume Remaining=volume programmed for non-library-based infusion Current Segment Volume Delivered=0 Cumulative Volume Delivered=0 Time Remaining=calculated from Volume Remaining and Rate(non-delivery)	

X.1.2.2 Infusion Event Sample Message

Delivery Start Event

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MSH|^~\&|PAT_DEVICE_PUMPVENDOR^0003B10000000001^EUI-64|PAT_DEVICE_PUMPVENDOR^0003B10000000001^EUI-
64|||20100706154719-0800||ORU^R42^ORU_R01|PCD10_20100706154719|P|2.6|||AL|NE|||en^English^ISO639||IHE_PCD_010^IHE
PCD^1.3.6.1.4.1.19376.1.6.1.10.1^ISO
PID|||HO60002^^^PAT_DEVICE_PUMPVENDOR^MR||Darwin^Charles^^^^^L||19620101000000+0000|M
PV1||I|3 West ICU^3002^1
OBR|1|AB12345^PCD-03|CD12345^HL7^ACDE48234567ABCD^EUI-64|2222^Dopamine|||20100706154704-0800
OBX|1|CWE|188773^MDC_DEV_EVENT_COND^MDC|1.1.1.100|680^MDC_EVT_PUMP_DELIV_START^MDC||||||R
OBX|2||69985^MDC_DEV_PUMP_INFUS_MDS^MDC|1.0.0.0|||||||X|||||||Pump002^^0003B10000000001^EUI-64
OBX|3||70050^MDC_DEV_PUMP_INFUS_LVP_VMD^MDC|1.1.0.0|||||||X
OBX|4||70067^MDC_DEV_PUMP_INFUS_CHAN_DELIVERY^MDC|1.1.1.0|||||||X
OBX|5|CWE|184508^MDC_PUMP_STAT^MDC|1.1.1.101|^pump-status-infusing||||||R
OBX|6|CWE|184512^MDC_PUMP_MODE_CURRENT^MDC|1.1.1.102|^pump-mode-drug-dosing||||||R
OBX|7|NM|157784^MDC_FLOW_FLUID_PUMP^MDC|1.1.1.103|24.9|265266^MDC_DIM_MILLI_L_PER_HR^MDC^mL/h^mL/h^UCUM|||||R
OBX|8||70071^MDC_DEV_PUMP_INFUS_CHAN_PRIMARY^MDC|1.1.2.0|||||||X
OBX|9|ST|184514^MDC_DRUG_NAME_LABEL^MDC|1.1.2.201|Dopamine||||||R
OBX|10|NM|157760^MDC_CONC_DRUG^MDC|1.1.2.202|1.6|264306^MDC_DIM_MILLI_G_PER_ML^MDC^mg/mL^mg/mL^UCUM|||||R
OBX|11|NM|157924^MDC_RATE_DOSE^MDC|1.1.2.203|7|265619^MDC_DIM_MICRO_G_PER_KG_PER_MIN^MDC^ug/kg/min^ug/kg/min^U
CUM|||||R
OBX|12|NM|157784^MDC_FLOW_FLUID_PUMP^MDC|1.1.2.204|24.9|265266^MDC_DIM_MILLI_L_PER_HR^MDC^mL/h^mL/h^UCUM|||||R
OBX|13|NM|157884^MDC_VOL_FLUID_TBI^MDC|1.1.2.205|250|263762^MDC_DIM_MILLI_L^MDC^mL^mL^UCUM|||||R
OBX|14|NM|157872^MDC_VOL_FLUID_TBI_REMAIN^MDC|1.1.2.206|250|263762^MDC_DIM_MILLI_L^MDC^mL^mL^UCUM|||||R
OBX|15|NM|157992^MDC_VOL_FLUID_DELIV_SEGMENT^MDC|1.1.2.207|0|263762^MDC_DIM_MILLI_L^MDC^mL^mL^UCUM|||||R
OBX|16|NM|157993^MDC_VOL_FLUID_DELIV_TOTAL^MDC|1.1.2.208|0|263762^MDC_DIM_MILLI_L^MDC^mL^mL^UCUM|||||R
OBX|17|NM|68063^MDC_ATTR_PT_WEIGHT^MDC|1.1.2.209|95|263875^MDC_DIM_KILO_G^MDC^kg^kg^UCUM|||||R
OBX|18|NM|157916^MDC_TIME_PD_REMAIN^MDC|1.1.2.210|602|264352^MDC_DIM_MIN^MDC^min^min^UCUM|||||R
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