Patient Information Center iX

FHIR Implementation Guide

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# Background:

The HL7® (Health Level Seven) FHIR® (Fast Healthcare Interoperability Resources) standard defines how healthcare information can be exchanged between different computer systems regardless of how it is stored in those systems. FHIR is based on internet standards widely used by industries outside of healthcare.

Specifically, FHIR is a standard describing data formats and elements and an application programming interface for exchanging electronic health records. FHIR, is a standard describing data formats and elements (known as "resources") and an application programming interface (API) for exchanging Electronic Health Records (EHR).

Even though FHIR supports messaging like HL7 Verson-2 (HL7 v2), it also supports multiple options for facilitating data exchange among systems. The main difference between HL7 and FHIR lies in the fact that unlike HL7 v2, FHIR employs RESTful web services and open web technologies, such as JSON and RDF data formats.

FHIR is an excellent choice for interfacing because it combines the features of HL7 with the latest web standards. Increased interoperability in the healthcare system is the major benefit i.e., new information can be exchanged more securely between phone apps, electronic health records, on healthcare system's servers, and many other places.

A FHIR Server is capable of processing, validating, and storing healthcare data in an industry-standard format that can be used for running search and other reporting capabilities. FHIR is designed to support transferring patient data to these server(s) at sites intending to be a central repository accessible through RESTful interfaces.

Although FHIR servers are commonly used when implementing FHIR, it is also possible per the FHIR specification to issue FHIR messaging as self-referential e.g., no server required. Any references required e.g., to measuring device(s), for example, may be defined and referred to within each self-defining message.

FHIR further provides specific support for devices through Devices-on-FHIR, patient monitoring (Point of Care Devices e.g., POCD) currently in balloting approval stage, alarming (TBD future) and several other specific areas. iX falls within the POCD grouping specifically which is designed for patient monitoring.

Each product must develop an implementation guide defining how it’s messaging both complies with the FHIR spec and shows how messaging will be employed.

# Purpose:

Per the above Background, this document is written as the iX FHIR Implementation Guide. It must capture all FHIR messaging to be supported by the iX patient monitoring product.

It complies with the FHIR POCD specification and describes how iX will implement the standard for patient monitoring.

JSON is the chosen message format in implementing FHIR for iX - all examples and messaging in this document will be in JSON format. This is intending to be compatible with other Philips products and future cloud integration(s).

# FHIR Web Site References:

FHIR web sites to which iX FHIR messaging must be compliant will be commonly referenced within this document. A summary of these is provided below.

<https://hl7.org/fhir> - this is the parent FHIR website

<http://hl7.org/fhir/uv/pocd/2021Sep> - this is the current ballot version supporting FHIR POCD messaging.

FHIR is at it’s core a collection of resources for such items as Patient, Location, MessageHeader, Observation, Device, etc.

The collection of these resources is at the core what makes up a FHIR message.

The resource links referenced within this spec are as follows:

<https://www.hl7.org/fhir/resourcelist.html> - the overall FHIR resource list

and the resources specifically referenced with this guide are as follows:

<https://www.hl7.org/fhir/messageheader.html> - message header partial - akin to MSH segment in HL7 IHE

<https://www.hl7.org/fhir/messagedefinition.html> - message header partial – combined with mesageheader.html is equivalent to MSH segment in HL7 IHE

<https://www.hl7.org/fhir/patient.html> - equivalent to PID segment in HL7 IHE e.g. patient identification

<https://www.hl7.org/fhir/encounter.html> - patient resource above does not completely define patient id – this resource augments to define specific visits akin to VisitNumber in HL7 IHE

<https://www.hl7.org/fhir/location.html> - equivalent to PV1 segment in HL7 IHE e.g. patient location

<https://www.hl7.org/fhir/devicedefinition.html> - equivalent to OBX segment device definition in HL7 IHE \*partial\*.

<https://www.hl7.org/fhir/device.html> - equivalent to OBX segment device in HL7 IHE – combined with devicedefinition.html above completely defines device being used to take patient measurement(s)

<https://www.hl7.org/fhir/devicemetric.html> - every measurement is a deviceMetric and an Observation resource in FHIR

<https://www.hl7.org/fhir/observation.html> - every measurement is a deviceMetric and an Observation resource in FHIR where the two together make up an HL7 IHE OBX segment e.g. observation measurement.

<http://hl7.org/fhir/uv/pocd/2021Sep/Device-ECGVmdDevice.json.html> - TBD for ECG Specific measurements.

<http://www.hl7.org/fhir/bundle.html#references> Bundle references. These are used to encapsulate MDS/VMD/CHAN resource definitions

# FHIR Server vs Self Referential messaging:

FHIR servers are intended for use at site(s). These server(s) would receive messaging from each device in monitoring the patient(s) through the restful interface(s). The server(s) can later be queried for patient data by any FHIR compliant device.

Uploading by iX and subsequent querying specifics implemented by iX are TBD at this time. These, however, will follow the FHIR spec regarding resource queries allowed and the RESTful interface(s) chosen for use.

Patient resource, Location resource of the patient(s) and more importantly the specific device(s) used to take measurements are provided to the server through RESTful interface which then responds with a uniqueID for each device. That uniqueID is then used for each measurement to tie together for that measurement the exact device(s) used, the patient and the location for that measurement. This is critical as the messaging need not repeat resource definitions, once provided, and acknowledged by the server. Which requires a FHIR server to be installed at every site.

Self-referential messaging essentially defines each resource within the message itself. Thus, for a measurement of a patient the references to the Patient resource, Location resource, Device Definition resource, Device resources used, etc. all will be stated within each message and referred to internal to the message.

**Self-referential messaging and server-based messaging will be employed by iX. This is critical to note.**

**iX will not require a FHIR server to source FHIR compliant messaging. It is TBD that a FHIR configuration event be provided to allow iX to toggle between server or self-referential messaging. Should a FHIR server receive a self-referential message, it would simply process Patient, Location, Device, etc. resources each time for each message received. This is extra processing but would still correctly operate as the server would recognize the duplicates.**

**iX Support of both self-referential and server-based messaging allows for communications to Philips based cloud products and offerings and other Philips products directly equivalent to HL7 currently. This is an important benefit to supporting both.**

**This spec details iX FHIR self-referential messaging.**

**Server based messaging is TBD.**

# Philips Common Nomenclature:

Philips is centralizing all nomenclature codes assigned to each measurement and provide tooling in order that each product within Philips may benefit. TBD - integration statement – this is effort currently being addressed by Peter Kranich, BBN. - TBD

# HL7 IHE Direct Compatibility to FHIR POCD:

FHIR POCD specification has been developed specifically to be equivalent to HL7 IHE specifications. Further, future IHE and FHIR specifications intend to capture equivalent data as well. **No data content should be lost or gained when moving from output format or the other.**

**IHE compatibility: FHIR messages can be generated directly from HL7 IHE messages. This is critical to note. That allows for product(s) to natively generate FHIR POCD or simply convert existing HL7 IHE messages. This allows iX, for example, to convert HL7 IHE messaging into FHIR POCD.**

**iX will continue to offer both HL7 IHE messaging and equivalent FHIR messaging moving forward.**

**This implementation guide will detail how HL7 IHE messages can be directly converted into FHIR. It is necessary for a market share leading product such as iX to be able to convert back and forth between the 2 formats to interface with other products which cannot provide that same flexibility. This conversion capability will also support potential communication of parametric measurements to Philips cloud products in a standardized manner.**

**This implementation guide also details what the iX FHIR POCD messaging would require if done natively. The FHIR results are the same.**

Most important reason for this format equivalence is that HL7 IHE has many years of vendor support along with hospital integration(s) to its credit. The IHE specs support the patient data capture supporting hospital accreditation efforts through organizations such as JCAHO which has clear accreditation requirements.

Examples are to properly define a **minimum of 2 unique patient identifiers for each patient. Further, capturing the exact device(s) which provided the measurement are necessary for correct traceability. Patient measurements can be meaningless without such traceability.**

# HL7 IHE Message Conversion to FHIR POCD:

The following sections are intended to summarize the conversions from HL7 IHE V.2 messages to FHIR POCD directly.

Each is JSON format. Important to note that for each HL7 conversion segment that the mappings are detailed on the right side of each value presented.

Each individual HL7 segment is mapped to its FHIR equivalent – items in red in the HL7 segment either do not have a corresponding mapping in FHIR or are not necessary to re-map.

Lastly, if not converting from a previously known HL7 message as is shown below, it’s important to note that the FHIR results represent the minimum number of fields in the FHIR POCD message that are required for a complete message for FHIR POCD mappings for iX. Meaning, the fields filled in are the minimum required.

## FHIR POCD in steps:

FHIR POCD messaging, to be equivalent in content to HL7 IHE, must map all the noted fields in the following sections.

For other Philips products, cloud implementations and so forth - it’s important to note that complete compliance can be done in steps. Meaning, and Observation with its associated Device Metric which represents a measurement can be associated with a Patient resource – this would be an absolute minimum for each measured parameter to source. Those resources should be filled in as shown below, however, to the extent possible.

Program planning can be employed to eventually be equivalent to the FHIR messaging defined here.

Full compliance to this implementation guide can be done in steps.

Ideally, all Philips products would match that specified within this implementation guide.

**When that is achieved, full interoperability and consistent clinical content is achieved between all Philips products.**

# HL7 IHE Message Example For Conversion To FHIR POCD:

A straightforward HL7 IHE message is to be converted to FHIR POCD. It has a single device definition e.g. MDS/VMD/Chan. It has a PID patient identification segment and a Location PV1 segment. MSH MessageHeader is also included. Lastly, it has one Observation OBX segment.

MSH|^~\&| SendingApplication|SendingFacility|ReceivingApplication|ReceivingFacility |20210425230332.872-0400||ORU^R01^ORU\_R01|HP0425230332.872USDANRMMD1NBR488|D|2.6|||AL|NE||8859/1|EN^English^ISO639||IHE\_PCD\_001^IHE PCD^1.3.6.1.4.1.19376.1.6.1.1.1^ISO

PID|1||12345^^^Philips^MR~6789^^^Philips^VN ||LastName^FirstName^""^^^^L||19710108|U

PV1|2|I|My Unit^^Bed1^Institution||||||||||||||||23456

OBR|3||0009fbFFFF9b42b3^^^EUI-64|69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|||20210425230331.496-0400

OBX|4||69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|1.0.0.0|||||||X|||||||7f2586c7-0506-46cd-a612-d8e75b838faa-IntelliVue MX500 - 866064

OBX|5||70666^MDC\_DEV\_ECG\_RESP\_VMD^MDC|1.2.0.0|||||||X|||||||XW25200213

OBX|6||70739^MDC\_DEV\_CARD\_RATE\_CHAN^MDC|1.2.1.0|||||||X

OBX|7|NM|147842^MDC\_ECG\_CARD\_BEAT\_RATE^MDC|1.2.1.1|60|264864^MDC\_DIM\_BEAT\_PER\_MIN^MDC|50-120||||F

# MSH Message Header Segment Conversion:

Note: Items in red are not necessary to convert to FHIR.

MSH|^~\&|SendingApplication|SendingFacility|ReceivingApplication|ReceivingFacility|20210425230332.872-0400||ORU^R01^ORU\_R01|HP0425230332.872USDANRMMD1NBR488|D|2.6|||AL|NE||8859/1|EN^English^ISO639||IHE\_PCD\_001^IHE PCD^1.3.6.1.4.1.19376.1.6.1.1.1^ISO

## Example FHIR MSH conversion result:

{

"resourceType" : "MessageHeader",

"language" : "en-us” // Language of the resource content - <English:ISO639>"

"eventCoding" : “UTF8”,

"eventUri" : "<uri>", // ORU^R01^ORU\_R01 – Event workflow not done yet by FHIR. Placeholder for now.

"destination" :

[{ // Message destination application(s)

"name" : "ReceivingFacility”, // Name of receiving facility from HL7

"endpoint" : "hostname", // hostname from ConfigHost of configured HL7 target

"receiver" : “ReceivingApplication” // directly from ReceivingApplication of HL7

}],

"sender" : // FHIR -> { Reference(Practitioner|PractitionerRole|Organization) }, possible values

// sender folds into FHIR “source” field

"source" :

{ // R! Message source application

"name" : "SendingFacility", // Name of system

"software" : "SendingApplication", // PIC iX Name of software running the system

"version" : "4.0", // PIC iX version of software running

"endpoint" : " USDANRMMD1NBR488" // HP0425230332.872USDANRMMD1NBR488 - machine name - direct parse of HL7 msg unique id

},

"identifier" : "0425230332.872USDANRMMD1NBR488", // direct map of HL7 msg unique id field

},

"definition" : Implementation Guide reference: ) } // Implementation guide reference site. URL of this guide – TBD until released

}

TBD: P|D|T – D in the case of our MSH segment MSH.11 below translates to “MessageDefinition” resource in FHIR. Boolean “status” captures this “status” e.g. active, draft, etc.

# PID Segment Conversion:

Note: There will be 1 FHIR resource entry below for each patient identifier found in the HL7 message.

PID|1||12345^^^Philips^MR~6789^^^Philips^VN ||LastName^FirstName^""^^^^L||19710108|U

## Example FHIR PID conversion result:

{

"resourceType" : "Patient",

"identifier" : // An identifier for this patient resource – generic GUID to allow other devices, etc. to link to this patient

{

"type" : “Guid”, // type of identifier.

"value" : "12345PatientGuid", // Unique value - referenced by later segments for self-referential msg format. Otherwise

// has the value received from FHIR server response

},

"identifier" : // An identifier for this patient

{

"type" : “MR”, // Description of identifier MR = MRN. Note: FHIR does not have PI and several other identifiers.

"value" : "12345", // direct copy of MRN from PID segment above

},

"identifier" : // An identifier for this patient

{

"type" : “VN”, // Description of identifier VN = VisitNumber. Note: FHIR does not have PI and several other identifiers.

"value" : "6789", // direct copy of VisitNumber from PID segment above. Note: Legacy fields from HL7 of PV1.19 to be

// mapped. PID.18, PID.19, PID.20 legacy values if DriverLicense, etc. are not to be carried forward to FHIR.

},

"active" : true, // Whether this patient's record is in active use

"name" :

{

"use" : "official", // FHIR possible values: usual | official | temp | nickname | anonymous | old | maiden

"text" : "LastName, FirstName", // Text representation of the full name

"family" : "LastName", // Family name (often called 'Surname')

"given" : "FirstName", // Given names (not always 'first'). Includes middle names

}

"gender" : "unknown", // male | female | other | unknown

"birthDate" : "1971-01-08", // The date of birth for the individual

}

# PV1 Location segment:

Note: There will a separate, new resource for each location e.g. unit, bed, room institution in the FHIR result e.g. 3 separate resources for this example.

PV1|2|I|My Unit^^Bed1^Institution||||||||||||||6789

## Example FHIR PV1 conversion result:

{

“identifier” : “12345IdentifierGuid”, // Unique code or number identifying the location to its users

"resourceType" : "Location", // Unit first

"status" : "active”, // FHIR values - active | suspended | inactive

"operationalStatus" : “O”, // O for occupied

"name" : "My Unit", // Unit name direct from HL7 msg

"description" : "Clinical Unit", // Additional details about the location.

"mode" : "instance", // FHIR values – instance | kind

"type" : “HU” // Hospital Unit from: http://hl7.org/fhir/v3/ServiceDeliveryLocationRoleType/vs.html

"physicalType" : “wa”, // Physical form from: http://hl7.org/fhir/valueset-location-physical-type.html

}

{

“identifier” : “12345IdentifierGuid2”, // Unique code or number identifying the location to its users

"resourceType" : "Location", // Bed next

"status" : "active”, // FHIR values - active | suspended | inactive

"operationalStatus" : “O”, // O for occupied

"name" : "Bed1", // Bed name - Name of the location

"description" : "Bed", // Additional details about the location

"mode" : "instance", // FHIR values – instance | kind

"type" : “??” // Hospital Unit from: // http://hl7.org/fhir/v3/ServiceDeliveryLocationRoleType/vs.html

"physicalType" : “wa”, // Physical form from: http://hl7.org/fhir/valueset-location-physical-type.html

}

{

“identifier” : “12345IdentifierGuid3”, // Unique code or number identifying the location to its users

"resourceType" : "Location", // Institution next

"status" : "active”, // active | suspended | inactive

"operationalStatus" : “O”, // O for occupied

"name" : "Institution", // Institution name - Name of the location

"description" : "Institution", // Additional details

"mode" : "instance", // FHIR values - instance | kind

"type" : “HOSP” // Hospital Institution e.g. HOSP is from:

http://hl7.org/fhir/v3/ServiceDeliveryLocationRoleType/vs.html

"physicalType" : “[si](http://hl7.org/fhir/codesystem-location-physical-type.html#location-physical-type-si)”, // si = site: Physical form of the location from:

http://hl7.org/fhir/valueset-location-physical-type.html

}

TBD: Inpatient would be mapped to (new) Encounter resource under “classHistory” field. TBDL Caregiver would be filled into the “participant” field of encounter resource.

# OBR Segment Conversion:

OBR segments in HL7 are a higher-level device definition e.g., a bedside, infusion pump, etc. This translates loosely to a FHIR Bundle resource. So, for every OBR segment found within an IHE HL7 message, it becomes a FHIR Bundle resource.

OBR|3||0009fbFFFF9b42b3^^^EUI-64|69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|||20210425230331.496-0400

## Example FHIR Conversion of OBR segment to Bundle:

{

"resourceType" : "Bundle", // Every OBR is a Bundle definition

"identifier" : "0009fbFFFF9b42b3^^^EUI-64", // { Identifier } Persistent identifier for the bundle FROM OBR

// SEGMENT: “0009fbFFFF9b42b3” ^^^EUI-64 in this case

"type" : "message", // FHIR e.g. document | message | transaction | transaction-response | batch | batch-response

"timestamp" : "20210425230331.496-0400", // OBR timestamp from OBR.7. which is valid measurement time

}

# OBX Device Segments Discussion:

Every HL7 OBX segment containing a specific measurement has a FHIR DeviceMetric resource and an Observation resource. A DeviceMetric resource is essentially equivalent to a CHAN resource. A Channel CHAN in HL7 can have more than one measurement e.g. OBX segments against that FHIR DeviceMetric definition. So multiple or single OBX segment(s) e.g. Observation resource in FHIR points directly to a DeviceMetric resource. DeviceMetric resource then points to CHANNEL resource. CHAN then to VMD. VMD to MDS.

If sending self-referential FHIR messages iX FHIR will source all device resources anew each sending interval.

If sending using an emplaced FHIR server then device identifier resources are sent once to the FHIR server and the server responds with a uniqueId for each device e.g. MDS/VMD/CHAN resource. These values are then simply referenced within the DeviceMetric / Observation resource combination and don’t have to be resent each sending interval.

Example implementation below is of self-referential approach.

## Device References Discussion:

When sending self-referential messages: Reference identifiers for each MDS/VMD/CHAN are uniquely set each time. References are within the message only. Values are set as shown below and should use the direct copy value from the HL7 message which uniquely identifies the MDS/VMD/CHAN segments.

When sending with FHIR server availability: Below references are sent individually to the FHIR server which responds with unique id’s which are valid for the scope of server connection time. These returned values are used within the subsequent reported measurements.

FHIR Bundle resources are intended to parent the device definitions. A bundle resource encapsulates the device definition resources and is required.

The self-referential vs. server modes are identified by use of local identifiers for self-referential mode. Server mode uses returned “url” responses for device definitions. As such, operational mode is captured.

## OBX Device Definitions for FHIR conversion:

OBX|4||69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|1.0.0.0|||||||X|||||||7f2586c7-0506-46cd-a612-d8e75b838faa-IntelliVue MX500 - 866064

OBX|5||70666^MDC\_DEV\_ECG\_RESP\_VMD^MDC|1.2.0.0|||||||X|||||||XW25200213

OBX|6||70739^MDC\_DEV\_CARD\_RATE\_CHAN^MDC|1.2.1.0|||||||X

### OBX MDS specific definition conversion:

OBX|4||69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|1.0.0.0|||||||X|||||||7f2586c7-0506-46cd-a612-d8e75b838faa-IntelliVue MX500 - 866064

Note: TBDL UDI information from bedside and iX connected devices are necessary for FHIR. Recommend iX be enhanced to include

#### FHIR OBX MDS conversion result:

{

"resourceType" : "Device",

"identifier" : "7f2586c7-0506-46cd-a612-d8e75b838faa", // [{ Identifier }] // from MDS use guid: 7f2586c7-0506-46cd-a612-d8e75b838faa

// for VMD: don’t have a guid. CHAN does not have guid so just create one. Just link VMD device resource

// to MDS device resource.

"status" : "active", // FHIR - active | inactive | entered-in-error | unknown

"statusReason" : "online", // FHIR - online | paused | standby | offline | not-ready | transduc | discon | hw-discon | off

"serialNumber" : "866064 ", // Serial number assigned by the manufacturer

"deviceName" :

[{ // The name of the device as given by the manufacturer

"name" : "Philips", // ??? Philips default? ok for bedside..what of pumps, etc? R! The name of the device

"type" : "manufacturer-name" // FHIR udi-label-name | user-friendly-name | patient-reported-name | manufacturer-name

// | model-name | other

}],

"deviceName" :

[{ // The name of the device as given by the manufacturer

"name" : "MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS", // R! The name of the device

"type" : "user-friendly-name" // FHIR udi-label-name | user-friendly-name | patient-reported-name | manufacturer-name |

// model-name | other

}],

"modelNumber" : "MX500", // The model number for the device *Note: Check manufacturing for UDI as to model name, type, etc.*

"partNumber" : "<string>", // *Note: enhancement for UDI here – add as part of UDI update – if available*

"type" : "69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC", // use MDS definition - the kind or type of device

"patient" :

{

reference : "12345PatientGuid", // Patient reference to whom Device is affixed. See “identifier” in Patient resource

}

"owner" : "Philips", // Organization responsible for device - required - default "Philips" - MSH.3 receiving facility

"location" : "12345IdentifierGuid", // Reference(Location) - use "identifier" from Location resource

"url" : "<uri>", // TBD - Network address to contact device if available

"parent" : "0009fbFFFF9b42b3^^^EUI-64" // Always link UP in device hierarchy. For this MDS link to the Bundle!!!

}

### OBX VMD specific definition conversion:

OBX|5||70666^MDC\_DEV\_ECG\_RESP\_VMD^MDC|1.2.0.0|||||||X|||||||XW25200213

#### FHIR OBX VMD conversion result:

{

"resourceType" : "Device",

"identifier" : "12345VmdGuid", // NEW Guid [{ Identifier }] RE: VMD in the IHE msg doesn’t have a guid. CHAN does not have guid so

// just create one for self-referential messaging. Must link VMD device resource to MDS device resource.

"definition" : "MDC\_DEV\_ECG\_RESP\_VMD", // { Reference(DeviceDefinition) } cardinality is required 0..1 The reference to device definition

"udiCarrier" : // TBD Future. Once UDI is available from device within iX

[{ // Unique Device Identifier (UDI) Barcode string

"deviceIdentifier" : "<string>", // Mandatory fixed portion of UDI

"issuer" : "<uri>", // UDI Issuing Organization

"jurisdiction" : "<uri>", // Regional UDI authority

"carrierAIDC" : "<base64Binary>", // UDI Machine Readable Barcode String

"carrierHRF" : "<string>", // UDI Human Readable Barcode String

"entryType" : "<code>" // barcode | rfid | manual +

}],

"status" : "active", // FHIR - active | inactive | entered-in-error | unknown

"statusReason" : "online", // FHIR - online | paused | standby | offline | not-ready | transduc-discon | hw-discon | off

"serialNumber" : "XW25200213", // Serial number assigned by the manufacturer

"deviceName" :

[{ // The name of the device as given by the manufacturer

"name" : "MDC\_DEV\_ECG\_RESP\_VMD", // Use MDC from HL7 field, Name of the device

"type" : "model-name" // FHIR - udi-label-name | user-friendly-name | patient-reported-name | manufacturer-name | model-name |

// other

}],

"modelNumber" : "", // TBD - VMD does not have the model number for the device

"type" : "70666^MDC\_DEV\_ECG\_RESP\_VMD^MDC", // direct from HL7 segment kind or type of device

"patient" : "12345PatientGuid", // Patient reference to whom Device is affixed – see “identifier” in Patient resource

"owner" : "Philips", // Organization responsible for device - required - default "Philips" from MSH.3 receiving facility

"location" : "12345IdentifierGuid", // Reference(Location) - use "identifier" from Location resource

"url" : "<uri>", // TBD - Network address to contact device

"parent" : "7f2586c7-0506-46cd-a612-d8e75b838faa" // Always link UP!!! For VMD link to the MDS!! See reference notes above

}

### OBX CHAN specific definition conversion:

OBX|6||70739^MDC\_DEV\_CARD\_RATE\_CHAN^MDC|1.2.1.0|||||||X

#### FIHR OBX CHAN conversion result:

{

"resourceType" : "Device",

"identifier" : "12345ChannelGuid", // New id RE: HL7 CHAN does not have guid so just create one.

"definition" : "MDC\_DEV\_CARD\_RATE\_CHAN", // direct copy from HL7 field - definition of the device

"udiCarrier" : // TBD – UDI future enhancement. FHIR prefers UDI definitions

[{ // Unique Device Identifier (UDI) Barcode string

"deviceIdentifier" : "<string>", // Mandatory fixed portion of UDI

"issuer" : "<uri>", // UDI Issuing Organization

"jurisdiction" : "<uri>", // Regional UDI authority

"carrierAIDC" : "<base64Binary>", // UDI Machine Readable Barcode String

"carrierHRF" : "<string>", // UDI Human Readable Barcode String

"entryType" : "<code>" // barcode | rfid | manual +

}],

"status" : "active", // FHIR - active | inactive | entered-in-error | unknown

"statusReason" : "online", // FHIR - online | paused | standby | offline | not-ready | transduc-discon | hw-discon | off

"serialNumber" : "", // CHAN does not have serial number – so required but empty field

"deviceName" :

[{ // The name of the device as given by the manufacturer

"name" : "MDC\_DEV\_CARD\_RATE\_CHAN", // HL7 direct copy of device name. MDC code in this case.

"type" : "model-name" // FHIR - udi-label-name | user-friendly-name | patient-reported-name | manufacturer-name | model-name |

// other

}],

"modelNumber" : "", // CHAN does not have the model number for the device – empty field

"type" : "70739^MDC\_DEV\_CARD\_RATE\_CHAN^MDC", // HL7 direct copy from segment - type of device

"patient" : "12345PatientGuid", // Patient reference to whom Device is affixed

"owner" : "Philips", // Organization responsible for device - required - default "Philips" - MSH.3 receiving facility

"location" : "12345IdentifierGuid", // Reference(Location) - use "identifier" from Location resource

"url" : "<uri>", // TBD - Network address to contact device

"parent" : "12345VmdGuid" // Always link UP!!! For CHAN device link to the VMD!!!

}

# OBX Observation Discussion:

HL7 OBX segment observations require two FHIR resources each for singular measurements such as heart rate. This would be a DeviceMetric resource followed by an Observation resource.

HL7 OBX segment observations require multiple FHIR resources for multiple measurements within a device. An example would be blood pressure where there are 3 measurements systolic, diastolic and mean for each measurement. In this case there would be one FHIR DeviceMetric resource followed by three Observation resources to specify the blood pressure taken.

## OBX Observation Definition for FHIR DeviceMetric Resources Conversion:

OBX|7|NM|147842^MDC\_ECG\_CARD\_BEAT\_RATE^MDC|1.2.1.1|60|264864^MDC\_DIM\_BEAT\_PER\_MIN^MDC|50-120||||F

### FHIR OBX DeviceMetric conversion result:

{

"resourceType" : "DeviceMetric",

"identifier" : “12345DeviceMetricGuid” // Create new identifier for self-referential FHIR messages

"type" : "MDC\_ECG\_CARD\_BEAT\_RATE", // from OBX.3 - Identity of metric, for example Heart Rate or PEEP Setting

"unit" : // Unit of Measure for the Metric – direct from OBX segment. MDC encodings

{

"coding" : "147842", // [{ Coding }] Code defined by a terminology system e.g. MDC

"text" : "MDC\_DIM\_BEAT\_PER\_MIN" // Plain text representation of the concept – MDC mnemonic

}

"source" : "12345ChannelGuid", // Describes the link to the source Device

"parent" : "12345ChannelGuid", // Describes the link to the parent Device – always CHAN

"operationalStatus" : "on", // FHIR - on | off | standby | entered-in-error

"color" : "<code>", // TBD – Not currently in iX HL7. FHIR - black | red | green | yellow | blue | magenta | cyan | white

"category" : "measurement", // FHIR - measurement | setting | calculation | unspecified

"measurementPeriod" : “” // configured HL7 send interval – from iX ConfigHost settings - measurement repetition time

}

## OBX Observation Definition for FHIR Observation Resources Conversion:

OBX|7|NM|147842^MDC\_ECG\_CARD\_BEAT\_RATE^MDC|1.2.1.1|60|264864^MDC\_DIM\_BEAT\_PER\_MIN^MDC|50-120||||F

### FHIR OBX Observation conversion result:

{

"resourceType" : "Observation",

"status" : "final", // from OBX.11 - R! registered | preliminary | final | amended +

"category" : “vital-signs” // default value from https://www.hl7.org/fhir/valueset-observation-category.html

"code" :

{ // use MDC if FHIR doesn’t specify a LOINC code for measurement – small subset of common ones

"system" : "http://loinc.org",

"version" : "2.62",

"code" : "8867-4",

"display" : "147842^MDC\_ECG\_CARD\_BEAT\_RATE^MDC " // Copy from HL7 segment here

}, // usually MDC codes here. But FHIR has heart rate LOINC code preferred. See https://www.hl7.org/fhir/observation-vitalsigns.html

"subject" : "12345PatientGuid", // Patient resource reference

"performer": “”, // TBD – FHIR - Practitioner|PractitionerRole|Organization|CareTeam|Patient|RelatedPerson) }],

// Who is responsible for the observation – maps to our CareEvent assignments

"valueQuantity" :

{

"value" : “60”, // FHIR <decimal> Numerical value (with implicit precision)

"unit" : "MDC\_DIM\_BEAT\_PER\_MIN", // Unit representation

"system" : "<uri>MDC??", // TBD – need MDC url here for MDC codes definition e.g. Rosetta or Philips Nomenclature tables

"code" : "264864" // Coded form of the unit – MDC for philips messages

},

"valueDateTime" : "20210425230331.496-0400", // comes from OBR segment specifically OBR.7.

"bodySite" : “”, // FHIR { CodeableConcept }, - if available body site value in the IHE segment OBX.11 – observation body part

"device" : “12345DeviceMetricGuid“, // Reference to previously defined DeviceMetric

"referenceRange" : [{ // Provides guide for interpretation

"low" : "50", // { Quantity(SimpleQuantity) }, // C? Low Range, if relevant

"high" : "120", // { Quantity(SimpleQuantity) }, // C? High Range, if relevant

"type" : "-" // { CodeableConcept }, // Reference range qualifier

}],

}

# IHE Message Conversion Portions Combined Into FHIR POCD Compliant Message:

The following HL7 IHE message used for the example conversion is provided below:

MSH|^~\&| SendingApplication|SendingFacility|ReceivingApplication|ReceivingFacility |20210425230332.872-0400||ORU^R01^ORU\_R01|HP0425230332.872USDANRMMD1NBR488|D|2.6|||AL|NE||8859/1|EN^English^ISO639||IHE\_PCD\_001^IHE PCD^1.3.6.1.4.1.19376.1.6.1.1.1^ISO

PID|1||12345^^^Philips^MR~6789^^^Philips^VN ||LastName^FirstName^""^^^^L||19710108|U

PV1|2|I|My Unit^^Bed1^Institution||||||||||||||||23456

OBR|3||0009fbFFFF9b42b3^^^EUI-64|69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|||20210425230331.496-0400

OBX|4||69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|1.0.0.0|||||||X|||||||7f2586c7-0506-46cd-a612-d8e75b838faa-IntelliVue MX500 - 866064

OBX|5||70666^MDC\_DEV\_ECG\_RESP\_VMD^MDC|1.2.0.0|||||||X|||||||XW25200213

OBX|6||70739^MDC\_DEV\_CARD\_RATE\_CHAN^MDC|1.2.1.0|||||||X

OBX|7|NM|147842^MDC\_ECG\_CARD\_BEAT\_RATE^MDC|1.2.1.1|60|264864^MDC\_DIM\_BEAT\_PER\_MIN^MDC|50-120||||F

## Final FHIR Conversion Result:

What does the resulting FHIR converted message look like without all the annotations described above? And placed within the context of a proper FHIR format?

See below!

{

“type”: “transaction”,

“entry”:

[

{

"resourceType" : "MessageHeader",

"language" : "en-us”

"eventCoding" : “UTF8”,

"eventUri" : "<uri>",

"destination" :

[{

"name" : "ReceivingFacility”,

"endpoint" : "hostname",

"receiver" : “ReceivingApplication”

}],

"sender" :

"source" :

{

"name" : "SendingFacility",

"software" : "SendingApplication",

"version" : "4.0",

"endpoint" : " USDANRMMD1NBR488"

},

"identifier" : "0425230332.872USDANRMMD1NBR488",

},

"definition" : Implementation Guide reference: ) }

}

{

"resourceType" : "Patient",

"identifier" :

{

"type" : “Guid”,

"value" : "12345PatientGuid",

},

"identifier" :

{

"type" : “MR”,

"value" : "12345",

},

"identifier" :

{

"type" : “VN”,

"value" : "6789",

},

"active" : true,

"name" :

{

"use" : "official",

"text" : "LastName, FirstName",

"family" : "LastName",

"given" : "FirstName",

}

"gender" : "unknown",

"birthDate" : "1971-01-08",

}

{

“identifier” : “12345IdentifierGuid”,

"resourceType" : "Location",

"status" : "active”,

"operationalStatus" : “O”,

"name" : "My Unit",

"description" : "Clinical Unit",

"mode" : "instance",

"type" : “HU”

"physicalType" : “wa”,

}

{

“identifier” : “12345IdentifierGuid2”,

"resourceType" : "Location",

"status" : "active”,

"operationalStatus" : “O”,

"name" : "Bed1",

"description" : "Bed",

"mode" : "instance",

"type" : ‘’,

"physicalType" : “wa”,

}

{

“identifier” : “12345IdentifierGuid3”,

"resourceType" : "Location",

"status" : "active”,

"operationalStatus" : “O”,

"name" : "Institution",

"description" : "Institution",

"mode" : "instance",

"type" : “HOSP”,

"physicalType" : “[si](http://hl7.org/fhir/codesystem-location-physical-type.html#location-physical-type-si)”,

}

{

"resourceType" : "Bundle",

"identifier" : "0009fbFFFF9b42b3^^^EUI-64”,

"type" : "message",

"timestamp" : "20210425230331.496-0400",

}

{

"resourceType" : "Device",

"identifier" : "7f2586c7-0506-46cd-a612-d8e75b838faa",

"status" : "active",

"statusReason" : "online",

"serialNumber" : "866064 ",

"deviceName" :

[{

"name" : "Philips",

"type" : "manufacturer-name"

}],

"deviceName" :

[{

"name" : "MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS",

"type" : "user-friendly-name"

}],

"modelNumber" : "MX500",

"type" : "69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC",

"patient" :

{

reference : "12345PatientGuid",

}

"owner" : "Philips",

"location" : "12345IdentifierGuid",

"url" : "<uri>",

"parent" : "0009fbFFFF9b42b3^^^EUI-64"

}

{

"resourceType" : "Device",

"identifier" : "12345VmdGuid",

"definition" : "MDC\_DEV\_ECG\_RESP\_VMD",

"status" : "active",

"statusReason" : "online",

"serialNumber" : "XW25200213",

"deviceName" :

[{

"name" : "MDC\_DEV\_ECG\_RESP\_VMD",

}],

"modelNumber" : "",

"type" : "70666^MDC\_DEV\_ECG\_RESP\_VMD^MDC

"patient" : "12345PatientGuid",

"owner" : "Philips",

"location" : "12345IdentifierGuid",

"url" : "<uri>",

"parent" : "7f2586c7-0506-46cd-a612-d8e75b838faa"

}

{

"resourceType" : "Device",

"identifier" : "12345ChannelGuid",

"definition" : "MDC\_DEV\_CARD\_RATE\_CHAN",

"status" : "active",

"statusReason" : "online",

"serialNumber" : "",

"deviceName" :

[{

"name" : "MDC\_DEV\_CARD\_RATE\_CHAN

}],

"modelNumber" : "",

"type" : "70739^MDC\_DEV\_CARD\_RATE\_CHAN^MDC",

"patient" : "12345PatientGuid",

"owner" : "Philips",

"location" : "12345IdentifierGuid",

"url" : "<uri>",

"parent" : "12345VmdGuid"

}

{

"resourceType" : "DeviceMetric",

"identifier" : “12345DeviceMetricGuid”

"type" : "MDC\_ECG\_CARD\_BEAT\_RATE",

"unit" :

{

"coding" : "147842",

"text" : "MDC\_DIM\_BEAT\_PER\_MIN"

}

"source" : "12345ChannelGuid",

"parent" : "12345ChannelGuid",

"operationalStatus" : "on",

"color" : "<code>",

"category" : "measurement",

"measurementPeriod" : “”

}

{

"resourceType" : "Observation",

"status" : "final",

"category" : “vital-signs”

"code" :

{

"system" : "http://loinc.org",

"version" : "2.62",

"code" : "8867-4",

"display" : "147842^MDC\_ECG\_CARD\_BEAT\_RATE^MDC "

},

"subject" : "12345PatientGuid",

"performer": “”,

"valueQuantity" :

{

"value" : “60”,

"unit" : "MDC\_DIM\_BEAT\_PER\_MIN",

"system" : "<uri>MDC??",

"code" : "264864"

},

"valueDateTime" : "20210425230331.496-0400",

"bodySite" : “”,

"device" : “12345DeviceMetricGuid“,

"referenceRange" : [{

"low" : "50",

"high" : "120",

"type" : "-"

}],

}

]

}

# Enumeration Conversion Discussion:

For an example OBX segment as follows:

OBX|16|ST|184327^MDC\_ECG\_STAT\_RHY^MDC|1.2.4.20|MDC\_ECG\_PACED\_RHY||||||F

Or:

OBX|56|ST|67303713^NOM\_SETT\_VENT\_MODE^MDC|2.1.1.6|CMV||||||F

The previously defined Observation resource would be filled in with the "valueString" as internal value to the Observation FHIR resource.

Shorthand view of Enumeration conversion (using NOM\_SETT\_VENT\_MODE from above):

## Enumeration FHIR Conversion Result:

{

"resourceType" : "Observation",

"status" : "final", // from OBX.11 - R! registered | preliminary | final | amended +

"category" : “vital-signs” // default value from https://www.hl7.org/fhir/valueset-observation-category.html

"code" :

{ // use MDC if FHIR doesn’t specify a LOINC code for measurement – small subset of common ones

"system" : "MDC",

"version" : "", // TBD – Philips nomenclature version of MDC codes issued. By iX release?

"code" : "67303713",

"display" : "NOM\_SETT\_VENT\_MODE ^MDC" // Copy from HL7 segment here

}, // usually MDC codes here. But FHIR has heart rate LOINC code preferred. See https://www.hl7.org/fhir/observation-vitalsigns.html

"subject" : "12345PatientGuid", // Patient resource reference

"performer": “”, // TBD – FHIR - Practitioner|PractitionerRole|Organization|CareTeam|Patient|RelatedPerson) }],

// Who is responsible for the observation – maps to our CareEvent assignments

"valueString" :

{

"value" : “CMV”, // direct from HL7 OBX.5 value field

},

"valueDateTime" : "20210425230331.496-0400", // comes from OBR segment specifically OBR.7.

"bodySite" : “”, // FHIR { CodeableConcept }, - if available body site value in the IHE segment OBX.11 – observation body part

"device" : “12345DeviceMetricGuid“, // Reference to previously defined DeviceMetric

}

# IHE Message Example With All Possible Category Types (Different Device, Numeric, Enumerations):

What follows is an extension of the HL7 IHE message already processed in previous portions of this document. The message below therefore incorporates all other examples of device definition(s), numerics, enumerations, multiple devices monitoring single patient, different patient identifiers which can be seen within HL7 IHE messaging.

The concept is to convert this message to FHIR POCD within this document per the previously established guidelines so that every possible messaging concern can be demonstrated and shown how to convert.

Example message:

MSH|^~\&| SendingApplication|SendingFacility|ReceivingApplication|ReceivingFacility |20210425230332.872-0400||ORU^R01^ORU\_R01|HP0425230332.872USDANRMMD1NBR488|D|2.6|||AL|NE||8859/1|EN^English^ISO639||IHE\_PCD\_001^IHE PCD^1.3.6.1.4.1.19376.1.6.1.1.1^ISO

PID|1||12345^^^Philips^MR~6789^^^Philips^VN ||LastName^FirstName^""^^^^L||19710108|U

PV1|2|I|My Unit^^Bed1^Institution||||||||||||||||23456

OBR|3||0009fbFFFF9b42b3^^^EUI-64|69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|||20210425230331.496-0400

OBX|4||69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|1.0.0.0|||||||X|||||||7f2586c7-0506-46cd-a612-d8e75b838faa-IntelliVue MX500 - 866064

OBX|5||70666^MDC\_DEV\_ECG\_RESP\_VMD^MDC|1.2.0.0|||||||X|||||||XW25200213

OBX|6||70739^MDC\_DEV\_CARD\_RATE\_CHAN^MDC|1.2.1.0|||||||X

OBX|7|NM|147842^MDC\_ECG\_CARD\_BEAT\_RATE^MDC|1.2.1.1|60|264864^MDC\_DIM\_BEAT\_PER\_MIN^MDC|50-120||||F

OBX|8||69635^MDC\_DEV\_CHAN^MDC|1.2.3.0|||||||X

OBX|9||70671^MDC\_DEV\_ARRHY\_CHAN^MDC|1.2.4.0|||||||X

OBX|10|NM|148065^MDC\_ECG\_V\_P\_C\_CNT^MDC|1.2.4.18|0|264864^MDC\_DIM\_BEAT\_PER\_MIN^MDC|<10||||F|||||||||131330^MDC\_ECG\_ELEC\_POTL\_II^MDC~131331^MDC\_ECG\_ELEC\_POTL\_V1^MDC

OBX|11|ST|184326^MDC\_ECG\_STAT\_ECT^MDC|1.2.4.19|MDC\_ECG\_ECT\_ABSENT||||||F

OBX|12|ST|184327^MDC\_ECG\_STAT\_RHY^MDC|1.2.4.20|MDC\_ECG\_PACED\_RHY||||||F

OBR|13||0009fbFFFF062b68^^^EUI-64|70041^MDC\_DEV\_SYS\_ANESTH\_MDS^MDC|||20210425230331.496-0400

OBX|14||70041^MDC\_DEV\_SYS\_ANESTH\_MDS^MDC|3.0.0.0|||||||X|||||||6cf96a5d-0b4a-41eb-86a9-611868a3e608-Anesthesia Demo

OBX|15||69650^MDC\_DEV\_ANALY\_CONC\_GAS\_MULTI\_PARAM\_VMD^MDC|3.1.0.0|||||||X|||||||6322008

OBX|16||70703^MDC\_DEV\_O2\_CHAN^MDC|3.1.1.0|||||||X

OBX|17|NM|152440^MDC\_CONC\_AWAY\_O2\_ET^MDC|3.1.1.1|30|262688^MDC\_DIM\_PERCENT^MDC|||||F

OBX|18|NM|152196^MDC\_CONC\_AWAY\_O2\_INSP^MDC|3.1.1.2|33|262688^MDC\_DIM\_PERCENT^MDC|||||F

OBX|19||70002^MDC\_DEV\_SYS\_PT\_VENT\_VMD^MDC|3.2.0.0|||||||X|||||||6322008

OBX|20||70003^MDC\_DEV\_SYS\_PT\_VENT\_CHAN^MDC|3.2.1.0|||||||X

OBX|21|NM|67260450^NOM\_SETT\_VENT\_RESP\_RATE^MDC|3.2.1.1|15|264928^MDC\_DIM\_RESP\_PER\_MIN^MDC|||||F

OBX|22||69682^MDC\_DEV\_ANALY\_AWAY\_MULTI\_PARAM\_VMD^MDC|3.3.0.0|||||||X|||||||6322008

OBX|23||69667^MDC\_DEV\_ANALY\_FLOW\_AWAY\_CHAN^MDC|3.3.1.0|||||||X

OBX|24|NM|151586^MDC\_VENT\_RESP\_RATE^MDC|3.3.1.1|15|264928^MDC\_DIM\_RESP\_PER\_MIN^MDC|||||F

OBR|25||0009fbFFFF9b42b3^^^EUI-64|69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|||20210425231334.632-0400

OBX|26||69965^MDC\_DEV\_MON\_PHYSIO\_MULTI\_PARAM\_MDS^MDC|3.0.0.0|||||||X|||||||7f2586c7-0506-46cd-a612-d8e75b838faa-IntelliVue MX500 - 866064

OBX|27||69742^MDC\_DEV\_CALC\_VMD^MDC|3.1.0.0|||||||X|||||||XW25200213

OBX|28||69743^MDC\_DEV\_CALC\_CHAN^MDC|3.1.1.0|||||||X

OBX|29|NM|150037^MDC\_PRESS\_BLD\_ART\_ABP\_SYS^MDC|3.1.1.21|40|266016^MDC\_DIM\_MMHG^MDC|||||F|||20210425231000.000-0400|||||

OBX|30|NM|150038^MDC\_PRESS\_BLD\_ART\_ABP\_DIA^MDC|3.1.1.22|60|266016^MDC\_DIM\_MMHG^MDC|||||F|||20210425231000.000-0400|||||

OBX|31|NM|150039^MDC\_PRESS\_BLD\_ART\_ABP\_MEAN^MDC|3.1.1.23|50|266016^MDC\_DIM\_MMHG^MDC|||||F|||20210425231000.000-0400|||||

## IHE Message Example of all possible category types – converted to compliant FHIR POCD:

TBD

# FHIR Server Communications Discussion:

TBD

# iX Product - FHIR Server POCD Communications Sections Which Are Applicable:

## iX to FHIR Server Communications Examples:

TBD

# Philips Nomenclature Common Definitions

TBD – results from Peter Kranich effort as applies to iX, specifically

# Philips FHIR Waveform Support:

TBD – next core section of FHIR support to align with FHIR POCD spec

# Philips FHIR Alarm Support:

TBD – next core section of FHIR support to align with new Alarm resource in FHIR alarm support