HL7 Conformance Statement

syngo Dynamics

VA43

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1. Introduction

1.1 Purpose

This document gives a compact view to the HL7 interface provided by *syngo* Dynamics. The HL7 interface of *syngo* Dynamics is based on the requirements and suggestions of the IHE Framework [1], regarding supported message types.

Hint: Messages, that do not 100% comply to the definition of IHE but contain the minimum required information as per definition of *syngo* Dynamics, are nevertheless processed. Please refer to Chapter 6, "Required attributes" for the list of mandatory information.

1.2 Audience

This document is intended for hospital staff, health system integrators, software designers or implementers. It is assumed that the reader has a working understanding of HL7 and IHE.

1.3 Definitions, terms and abbreviations

1.3.1 Abbreviations

Definitions, terms, and abbreviations used in this document are defined within the different parts of the HL7 standard.

Additional Abbreviations and terms are as follows:

API	Application Programming Interface
CDA	Clinical Document Architecture
EHR	Electronic Health Record
FHIR	Fast Healthcare Interoperability Resource
HIS	Hospital Information System (HIS).
HL7	Health Level Seven
IHE	Integrating the Healthcare Enterprise
JSON	JavaScript Object Notation
MPI	Master Patient Index
PHI	Patient Health Information
RESTful	Service or system that adheres to the Representational State Transfer (REST) principles
RIS	Radiology Information System.
sD	*syngo* Dynamics
TLS	Transport Layer Security
UML	Unified Modelling Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
V2	Health Level Seven Version 2
WB	White Board
XML	Extensible Markup Language

1.3.2 Definition and terms

- **CDA:** It is a document markup standard that specifies the structure and semantics of a clinical document for the purpose of exchange. A CDA document is a defined and complete information object that can include text, images, sounds and other multimedia content. It can be transferred within a message, and can exist independently, outside the transferring message.
- **FHIR:** Fast Healthcare Interoperability Resources (FHIR) is a healthcare information exchange standard that makes use of an HL7-defined set of "resources" to support information sharing by a variety of means, including documents, messages, services and RESTful interfaces. FHIR aims to simplify implementation without sacrificing information integrity. It leverages existing logical and theoretical models to provide a consistent, easy to implement, and rigorous mechanism for exchanging data between healthcare applications.
- **FHIR Broker:** Acts like an interface between the FHIR server (EMR) and the application which interacts with it.
- **FHIRcast:** FHIRcast is an HL7 specification designed to provide a lightweight, inexpensive and http-based application context synchronization standard. The FHIRcast specification describes the APIs used to synchronize disparate healthcare applications' user interfaces in real time, allowing them to show the same clinical content to a user (or group of users).
- **HL7:** It is a standard for information exchange between medical applications. It is an abbreviation of "Health Level Seven", 7th OSI layer protocol for the health environment. (OSI = Open Systems Interconnect, a model to describe defined layers in a network operating system). The HL7 protocol defines the format and the content of the messages that applications must pass to one another under various conditions (e.g., to pass the message between applications/systems that a patient has been admitted in a hospital).
- **HL7** Version 2: HL7's Version 2.x (V2) messaging standard is the workhorse of electronic data exchange in the clinical domain and the most widely implemented standard for healthcare in the world. This messaging standard allows the exchange of clinical data between systems. It is designed to support a central patient care system as well as a more distributed environment where data resides in departmental systems.
- **OpenLink:** Is an interface used to exchange data between *syngo* Dynamics application and external HIS system.

1.4 References

[1] Vendor's IHE information, ↗ **siemens-healthineers.com/ihe**

[2] HL7 Standard, chapter 2 "Control", ↗ **hl7.org**

[3] Vendor's DICOM Conformance Statements for the Implementation, ↗ **siemens-healthineers.com/services/it-standards/dicom-conformance-statements-cardiology-solutions**

[4] HL7 FHIR Standard current version – see ↗ **hl7.org/fhir**

2. General information

syngo Dynamics is a multimodality, vendor agnostic Cardiology image and information system intended for medical image management and processing that provides capabilities relating to the review and digital processing of medical images.

syngo Dynamics supports clinicians by providing image post-processing functions for image manipulation, and/or quantification that are intended for use in the interpretation and analysis of medical images for disease detection, diagnosis, and/or patient management within the healthcare institution's network.

syngo Dynamics is not intended to be used for display or diagnosis of digital mammography images in the U.S.

3. Overview

syngo Dynamics supports the following HL7 message types and event triggers, FHIR and FHIRcast:

- Patient Update/Merge ADT^A01, ADT^A02, ADT^A04, ADT^A06, ADT^A07, ADT^A08, ADT^A36, ADT^A40
- Order ORM^O01
- Report Export ORU^R01
- Financial transaction DFT^P03
- FHIR versions DSTU2 and STU3
- FHIRcast protocol version STU2

For the definition of these interfaces, the IHE standards were utilized. Consequently, *syngo* Dynamics requires that the Patient Update and Merge messages from the Information System conform to IHE semantics.

Additionally, the structure of the Report Export message sent by *syngo* Dynamics is aligned with these definitions at ↗ **siemens-healthineers.com/services/it-standards/ihe-cardiology-solutions.**

4. HL7 configuration

4.1 Minimal Lower Layer Message Transport Protocol (MLLP)

The *syngo* Dynamics HL7 interface uses HL7's Minimal Lower Layer Protocol (MLLP) over TCP/IP to receive and send messages. Briefly, message body is encapsulated using transaction framing with a 0xB start and a 0x1C+0xD end.

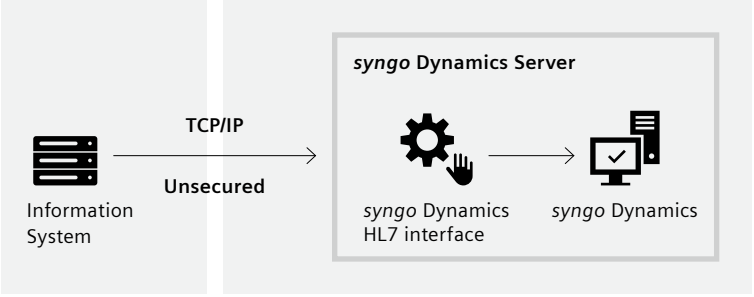
Such encoded transactions are then sent to (or received from) a TCP/IP port at the *syngo* Dynamics HL7 interface.

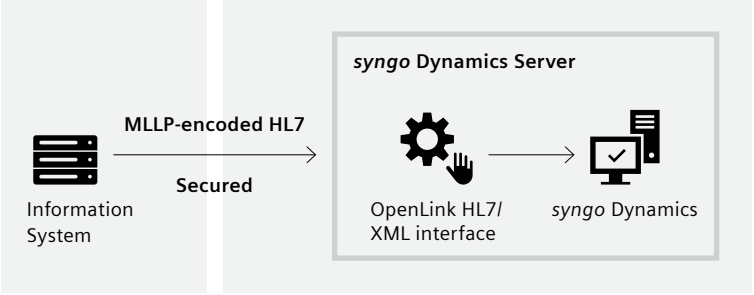
Encoding message using MLP

TXS	TX Body											TXE	
0xB	A	B	C	D	E	...						0x1C	0xD

4.2 Sending messages to product

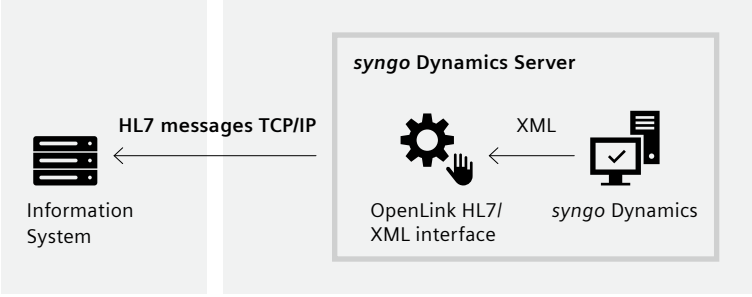
HL7 messages shall be sent to any available port which is configurable at the *syngo* Dynamics HL7/XML interface. Note that the TCP/IP connection to the port configured for *syngo* Dynamics is permanent and the interface port is blocked as long as the Information System is connected to it (dedicated connection).





4.3 Sending messages out of product

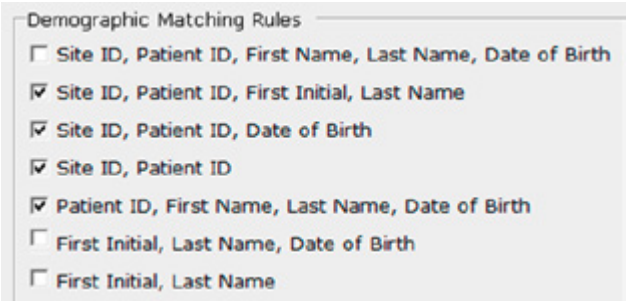
HL7 messages are sent to receiving IP address and port of the Information System. Both parameters need to be configured within the *syngo* Dynamics HL7/XML interface. Note that the TCP/IP connection is permanent, and the interface port is blocked as long as the Information System (IS) connected to it (dedicated connection).



4.4 Demographic reconciliation and order association

On arrival of a HL7 message to *syngo* Dynamics Server from the Electronic Health Record System (EHR), the HL7 message is cached and queued. The queue is continuously processed for reconciliation.

When DICOM images arrived in the Cardiology PACS, *syngo* Dynamics tries to find a matching HL7 record. If it finds the matching record of that, it performs demographic reconciliation. There is a matching rule defined in SysAdmin application.



syngo Dynamics also tries to find matching HL7 order message to associate the incoming study. The patient information from the images is associated and reconciled to a matching order (ORM) based on the Study Instance UID or ORM matching rules configuration in the Site IDs tab in SysAdmin. For order association, a study must undergo successful demographic reconciliation. An order message can be used for both demographic reconciliation and order association. If Master Patient Index is selected then it match for MPI id in the HL7 message.

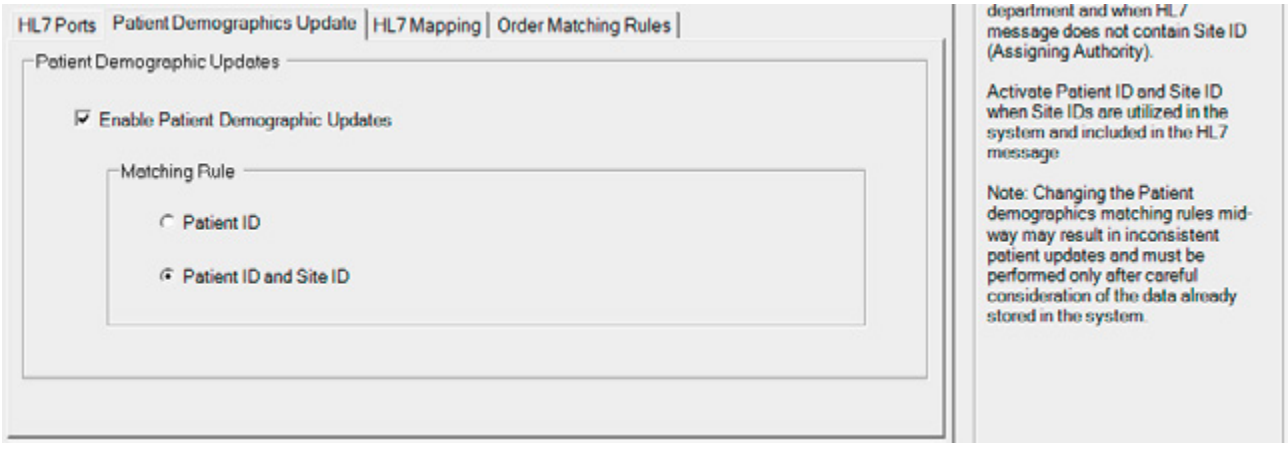
If an HL7 message arrives after the study, automatic demographic reconciliation and order association will not be performed. In such cases, users can utilize the Manual HL7 Reconciliation tool available in the Workplace application. This tool can also be used to resolve failed demographic reconciliations or studies with failed order associations.

4.5 Continuous patient update and merge

On arrival of a HL7 message with patient update segment to *syngo* Dynamics Server from the Electronic Health Record System (EHR), the HL7 message is processed and if matching studies found on *syngo* Dynamics server then it updates the PHI data.

To match studies for continuous patient updates of already reconciled studies, the following configuration is used:

- Patient ID
- Patient ID and Site ID (Assigning Authority)



Matching criteria can be Patient ID and Site ID/Patient ID only. The Site ID should be configured for a department in SysAdmin. By default, the matching rule "Patient ID and Site ID" set to be used for patient identification. On successful processing of the HL7 message, PHI data of the study updated from the HL7 message.

During updates, patient-level demographics are updated for both current and prior studies. When reports are opened in the Reporting component or images are viewed in the Image Review component, the demographic updates are indicated by an amber-colored exclamation icon on the patient icon. For locked reports, users must unlock the report to view the updated demographics.

The following fields are updated as part of HL7 ADT update: Last Name, First Name, Middle Name, Prefix, Suffix, Gender, Date of Birth. If the A08 update message includes a Master Patient Index (MPI), the corresponding matched study will be updated with MPI.

Upon receiving an HL7 message with a patient merge segment in *syngo* Dynamics, the message is processed. If studies related to the merge segment are found based on the matching rules, their PHI data is updated with the source patient's demographic information. When reports or images are opened, the demographic updates are indicated by an amber-colored exclamation icon on the patient icon.

Note: Assigning authority and site ID are synonyms.

4.6 Supported character sets

We support only characters from the ISO 8859-1 character set. HL7 messages can be encoded in either UTF-8 or ISO 8859-1. If any segment used for patient identification contains characters outside the ISO 8859-1 set, reconciliation will fail.

4.7 Security and authentication

The Security and Authentication section of this HL7 conformance statement delineates the protocols and mechanisms in place to safeguard data integrity, confidentiality, and user identity within the system. This includes:

1. **Data integrity:** *syngo* Dynamics ensures the data integrity of the patient data from receiving to persist in the Data Base. Since HL7 is the source of truth the received HL7 message are reconciled when received and persisted.
2. **Confidentiality:** *syngo* Dynamics uses OpenLink interface which allows the secured transfer protocol (TLS) to send the PHI on the wire to protect sensitive information of the patient.
3. **Auditing and logging:** *syngo* Dynamics audit and logs the following events occurs:
   1. HL7 reconciliation broken.
   2. Order association broken.
4. **Compliance:** Adherence to relevant regulatory requirements, standards, and organizational policies pertaining to security and privacy in healthcare information systems.

By default, *syngo* Dynamics does not secure HL7 messages – both inbound and outbound communication occurs in plain text. However, security can be enforced by enabling TLS (Transport Layer Security) within the OpenLink protocol configuration, ensuring encrypted transmission of HL7 data.

5. HL7 Version 2 (V2)

HL7 Version 2 (V2) is a widely adopted messaging standard in healthcare informatics, defining the format and content of messages exchanged between healthcare applications. It provides a framework for the seamless transmission of clinical and administrative data across disparate systems, facilitating interoperability and continuity of care.

HL7 Version 2 serves as a foundational framework for integrating diverse healthcare applications and systems, promoting data interoperability, efficiency, and patient safety across the healthcare continuum.

5.1 Versions supported

syngo Dynamics supporting HL7 version 2.5.1.

5.2 Implementation details

5.2.1 Supported messages

Overview of supported HL7 messages

Message	Description	Segment grouping
Inbound messages		
ADT^A01	Admit/Visit notification	MSH, EVN, PID, [PV1], [AL1], [DG1], [NK1]
ADT^A02	Transfer a patient	MSH, EVN, PID, [PV1]
ADT^A04	Register a Patient	MSH, EVN, PID, [PV1]
ADT^A06	Change the outpatient to inpatient	MSH, EVN, PID, [PV1]
ADT^A07	Change the inpatient to outpatient.	MSH, EVN, PID, [PV1]
ADT^A08	Update patient information	MSH, EVN, PID, [PV1]
ADT^A36	Merge patient information – Patient ID and account number	MSH, EVN, PID, MRG, [PV1]
ADT^A40	Merge patient – internal id	MSH, EVN, PID, MRG [,PV1]
ORM^O01	General Order	MSH, [NTE], PID, [PV1], [PV2], [ORC], OBR, OBX, [ZDS], ZSU, [AL1]
Outbound messages		
ORU^R01	Unsolicited transmission of an observation message	MSH, [NTE], PID, [PV1], [ORC], OBR, OBX
DFT^P03	Message containing detailed financial transactions	MSH, EVN, PID, [PV1], [PV2], [DB1], [OBX], FT1, PR1, [ROL], IN1, [IN2], [IN3], [DG1], [DRG], [GT1], [ACC]

All messages without MRG segment are used for insert/update.
All messages with MRG segment are used for merge.

5.2.2 ACK/NACK behavior

ACK –ACK messages are sent when the message is successfully received. An ACK does not guarantee that a message will be fully processed (e.g., a duplicate ADT^A01 may return an ACK means that the message was received, not necessary that it was processed).

MSH|^~\&|*syngo* Dynamics server||||||ACK|T|2.5.1|||||||||

MSA|AA|20180322132200|||||

NACK message is also displayed in ACK message format.

If the Mandatory Fields are absent in the message, then the system sends NACKS or Positive ACKs based on the sanity check. It is advised to configure the interface engine appropriately to receive or to ignore NACKS.

5.2.3 Allergy information

Allergy information is communicated in the optional Allergy segment, AL1.

The AL1 segment contains information on a single allergy and is repeated for each allergy that is recorded for the patient. Within the AL1 segment, the allergy type and allergy description may be repeated, as required. Allergy information is imported only from ORM and ADT^A01 (Admit) messages.

AL1 segment contains the allergy type and allergy description. Refer to section 5.2.5.1.9 for detailed information.

Allergy information from HL7 ADT and ORM messages, imported into study data, are displayed on the *syngo* Dynamics worksheet and report. Allergy information is imported into a study when the order is associated with the study. The allergy information is purged when the order association is broken.

5.2.4 Order Messages (ORM) Mapping

When *syngo* Dynamics is integrated with an Electronic Health Record System (EHR), the following information is extracted from the inbound HL7 ORM messages: Patient demographics, Visit details, Allergy details. The details are mapped in the *syngo* Dynamics database and the values pertaining to these are updated in the *syngo* Dynamics worksheet and report.

This information is required to complete pre-procedural documentation and reporting.

Prerequisites to ensure that the mapping works are given as follows:

- HL7 interface (ADT/ORM) is enabled in the **Server Configuration Tool.**
- ORM matching rule (Filler Order Number vs Study Accession Number) is configured in SysAdmin.
- Site ID & Patient ID is configured in the ADT matching rules in SysAdmin.
- Master Patient Index is configured in the ADT matching rules in SysAdmin.
- Fields mentioned in the table below are configured in the report and worksheet template.

5.2.4.1 DFT^P03 – Detailed Financial Transaction (DFT) Messages

Most healthcare environment will bill their services provided in a timely fashion. Automating clinical data delivery through HL7 interfaces provides accurate information quickly to the billing department. Delivery of billing information needs to happen periodically – most often on a daily basis – and can be accomplished through an off-hours batch method. This is done using the DFT message.

The DFT message describes a financial transaction that is sent to a billing system and is used for patient accounting purposes. This message is used to send charges from *syngo* Dynamics to a Hospital Information System (HIS) or a Radiology Information System (RIS).

5.2.5 Message semantics and chapters

Message semantics of ADT and ORU according to IHE

Segment	Segment name	Chapter in HL7
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1/PV2	Patient Visit	3
ORC	Order Control	4
OBR	Observation Request	7
OBX	Observation Result	7
MRG	Merge Patient Information	3
DG1	Diagnosis	3
AL1	Allergy	3
NK1	Next of Kin	3
ZDS	Customized segment	N/A
ZSU	Customized segment	N/A

The following fields will be used by *syngo* Dynamics.

5.2.5.1 Field definitions for Message segments used in *syngo* Dynamics

5.2.5.1.1 MSH segment

Field	Field name	Required/ optional	Comment	Example value
MSH-1	Field Separator	N/A	|	N/A
MSH-2	Encoding Characters	N/A	^~\& Supported Currently	^~&
MSH-3	Sending Application	Optional	N/A	SENDINGAPP
MSH-4	Sending Facility	Required	The MSH4 is Sending Facility (Configuration) becomes MSH6 Receiving Facility as per Inbound. For outbound ORM it will be vice versa.	SENDINGFACILITY
MSH-5	Receiving Application	Optional	Configurable	RECEIVINGAPP
MSH-6	Receiving Facility	Optional	N/A	RECEIVINGFACILITY
MSH-7	Date/Time of Message	Optional	N/A	20230719153000+0530
MSH-8	Security	Optional	N/A	
MSH-9	Message Type	Required	MSH 9.1 Message Type MSH 9.2 Trigger Event	ADT^A01
MSH-10	Message Control ID	Optional	Order ID is used as Message control ID in Outbound ORMs	123456
MSH-11	Processing ID	Optional	No validation	P
MSH-12	Version ID	Required	HL7 version being used (e.g., 2.1, 2.3, 2.5, etc.)	2.5

5.2.5.1.2 EVN segment

Field	Field name	Required/ optional	Comment	Example value
EVN-1	Event Type Code	Optional	N/A	A01
EVN-2	Recorded Date/Time	Optional	Date and Time of the Event	20230719153000+0530

5.2.5.1.3 PID segment

Field	Field name	Required/optional	Example value
PID-3	Patient Identifier List	Optional	987654321, DL123456
PID 3.1	Patient Identifier	Required	123456789
PID 3.4	Assigning Authority	Optional	CCH
PID 3.5	Identifier Type	Optional	MR/MPI
PID-4	Alternate Patient ID	Optional	PATIENT-001
PID-5	Patient Name	Optional	Doe^John^^Mr.
PID-6	Mother's Maiden Name	Optional	Smith
PID-7	Date/Time of Birth	Optional	19800101
PID-8	Administrative Sex	Optional	M
PID-9	Patient Alias	Optional	Johnny
PID-10	Race	Optional	White
PID-11	Patient Address	Optional	123 Main St^ Springfield^IL^ 62701^USA
PID-13	Phone Number – Home	Optional	(555) 555-1234
PID-14	Phone Number – Business	Optional	(555) 555-5678
PID-15	Primary Language	Optional	English
PID-16	Marital Status	Optional	Single
PID-17	Religion	Optional	Christian
PID-18	Patient Account Number	Optional	1234567890
PID-19	SSN Number – Patient	Optional	123-45-6789
PID-20	Driver's License Number	Optional	DL123456
PID-21	Mother's Identifier	Optional	987654321
PID-22	Ethnic Group	Optional	Hispanic
PID-23	Birthplace	Optional	Springfield, IL
PID-24	Multiple Birth Indicator	Optional	N
PID-25	Birth Order	Optional	2
PID-26	Citizenship	Optional	USA
PID-27	Veterans Military Status	Optional	Veteran

Field	Field name	Required/optional	Example value
PID-28	Nationality	Optional	American
PID-29	Patient Death Date and Time	Optional	20250610143000
PID-30	Patient Death Indicator	Optional	N

5.2.5.1.4 PV1 segment

Field	Field name	Required/optional
PV1-2	Patient Class	Required
PV1-3.1, 3.2, 3.3	Assigned Patient Location	Optional
PV1-4	Admission Type	Optional
PV1-5	Pre-admit No	Optional
PV1-6.1, 6.2, 6.3	Prior Patient Location	Optional
PV1-7	Attending Doctor	Optional
PV1-8	Referring Doctor	Optional
PV1-9	Consulting Doctor	Optional
PV1-10	Hospital Service	Optional
PV1-14	Admit Source	Optional
PV1-15.1	Ambulatory Status	Optional
PV1-16	VIP Indicator	Optional
PV1-17.1, 17.2	Admitting Doctor	Optional
PV1-18	Patient Type	Optional
PV1-19	Visit Number	Required
PV1-19.4	Visit Assigning Authority	Required
PV1-20.1	Financial Class	Optional
PV1-44	Admit Date	Required
PV1-45	Discharge Date	Optional

5.2.5.1.5 ORC segment

Field	Field name	Required/optional
ORC-1	Order Control	Required
ORC-2	Placer Order Number (PON)	Required
ORC-3	Filler Order Number (FON)	Required
ORC-5	Order Status	Optional
ORC-7	Quantity and Timing	Optional
ORC-12	Order Provider Name	Optional
ORC-15	Order Effective Date/Time	Optional

5.2.5.1.6 OBR segment

Field	Field name	Required/optional
OBR-1	Observation Request ID	Optional
OBR-2.1	Placer Order Number	Required
OBR-3.1	Filler Order Number	Optional
OBR-4 4.1 – Identifier 4.2 – Text 4.3 – Name of the Coding System	Universal Service ID	Required (only 4.1)
OBR-5	Priority	Optional
OBR-6	Requested Date and Time	Optional
OBR-7	Observation Date and Time	Required
OBR-16	Order Provider Time	Optional
OBR-18	Placer Field 1	Optional
OBR-19	Placer Field 2	Optional
OBR-27.4	Start Date and Time	Optional
OBR-27.6	Priority	Optional
OBR-44	Procedure Code	Optional
OBR-45	Procedure Code Modifier	Optional

5.2.5.1.7 MRG segment

Field	Field name	Required/optional
MRG-1.1	Source Patient ID	Required
MRG-1.4	Assigning Authority	Optional
MRG-1.5	Identifier Code	Optional
MRG-1.6	Assigning Facility	Optional
MRG-3.1	Prior Patient AccountNumber	Optional
MRG-5.1	Prior Patient Visit Number	Optional

5.2.5.1.8 DG1 segment

Field	Field name	Required/optional
DG-1.3.2	Diagnosis Code Text	Optional
DG-1.4	Diagnosis Description	Optional

5.2.5.1.9 AL1 segment

Field	Field name	Required/optional
AL1-3	Allergy Code, Mnemonic or Description	Optional

One AL1 segment is sent for each separate patient allergy. Therefore, a series of (none, 1 or more) AL1 segment(s) may be included in ADT messages, or in pharmacy order (RDE) messages. Refer to the table below for detailed information on the contents of the AL1 segment.

Sequence	Length	Format	Field Type	Element Name
0	3		Required	Segment ID = “AL1”
1	4	SI	Optional	Set ID – Internal
2	2	IS	Optional	Allergy type The values and description are as follows: • DA – Drug Allergy • FA – Food Allergy • MA – Miscellaneous Allergy
3	60	CE	Required	Allergy description This field consists of several components as follows: <Allergy identifier>^<Text>^<Coding system>
4	2	IS	Optional	Allergy severity
5	15	ST	Optional	Allergy reaction
6	8	DT	Optional	Identification date

5.2.5.1.10 NK1 segment

Field	Field name	Required/optional	Comment
NK1.1	ID	Optional	Supported
NK1.2	Name	Optional	Supported
NK1.3	Relationship	Optional	Supported
NK1.4	Address	Optional	Supported
NK1.5	Phone No	Optional	Supported
NK1.6	Business Phone No	Optional	Supported

5.2.5.1.11 ZDS (customized segment)

Field	Field name	Required/optional
ZDS 1	Study ID	Optional

5.2.5.1.12 ZSU segment

Field	Field name	Required/optional	Comment
ZSU 1	Study instance ID (old)	Required	ORM message containing the old study UID for the study that warrants a study UID correction
ZSU 2	Study instance ID (old)	Required	ORM message containing the new study UID for the study that warrants a study UID correction

5.2.5.1.13 FT1 segment

Field	Field name	Required/ optional	Comment	Example value
FT1-1	Set ID – FT1	Optional	Sequence number for ordering (1-n)	1
FT1-2	Transaction ID	Optional	Unique transaction ID	TRX12345
FT1-3	Transaction Batch ID	Optional	Batch number for transaction	BATCH-2024-07-20
FT1-4	Transaction Date	Required	Transaction date/time	2024-07-20T 10:00:00Z
FT1-5	Transaction Posting Date	Optional	Transaction Posting Date	
FT1-6	Transaction Type	Required	Type of transaction (e.g., CHARGE, ADJUSTMENT)	CHARGE

Field	Field name	Required/ optional	Comment	Example value
FT1-7	Transaction Code	Required	Code specifying the transaction	123456
FT1-8	Transaction Description		Description of the transaction	Consultation fee
FT1-9	Transaction Description – Alt		Alternative description of the transaction	
FT1-10	Transaction Quantity	Optional	Quantity of transaction	1
FT1-11	Transaction Amount	Optional	Monetary amount of transaction	100
FT1-12	Transaction Unit Cost	Optional	Cost per unit of service/item	100
FT1-13	Department Code	Optional	Code identifying department responsible for transaction	1234
FT1-14	Insurance Plan ID	Optional	Insurance plan ID	INS1234
FT1-15	Insurance Amount	Optional	Amount covered by insurance	80
FT1-16	Assigned Patient Location	Optional	Assigned patient location	Room 101
FT1-17	Fee Schedule	Optional	Fee schedule	FS1234
FT1-18	Patient Type	Optional	N/A	
FT1-19	Diagnosis Code	Optional	From *syngo* Dynamics Diagnosis library	
FT1-20	Performed By Code	Optional	Billing ID & name of physician reading study	
FT1-21	Ordered By Code	Optional	N/A	
FT1-22	Unit Cost	Optional	N/A	
FT1-23	Filler Order Number	Optional	N/A	
FT1-24	Entered By Code	Optional	N/A	
FT1-25	Procedure Code	Optional	From *syngo* Dynamics Procedure library	
FT1-26	Procedure Code Modifier	Optional	N/A	

5.2.5.1.14 PR1 segment (optional)[1]

Field	Field name	Required/ optional	Comment	Example value
PR1-1	Set ID – PR1	Required	Sequence number for ordering (1-n)	1
PR1-2	Procedure Coding Method		Method used to code the procedure	ICD-10
PR1-3	Procedure Code	Required	Code representing the procedure	12345
PR1-4	Procedure Description		Description of the procedure	Appendectomy
PR1-5	Procedure Date/Time	Required	Date/time the procedure was performed	2024-07-20T14: 30:00Z
PR1-6	Procedure Functional Type	Optional	Functional type of the procedure	A – Admission Procedure
PR1-7	Procedure Minutes	Optional	Duration of the procedure in minutes	120
PR1-8	Anesthesiologist		Name of the anesthesiologist	Dr. Johnson
PR1-9	Anesthesia Code	Optional	Code representing the type of anesthesia	1
PR1-10	Anesthesia Minutes	Optional	Duration of anesthesia in minutes	180
PR1-11	Surgeon		Name of the surgeon	Dr. Smith
PR1-12	Procedure Practitioner		Name of the practitioner performing the procedure	Dr. Brown
PR1-13	Consent Code	Optional	Code representing patient consent	Y
PR1-14	Procedure Priority	Optional	Priority of the procedure	1
PR1-15	Associated Diagnosis Code	Optional	Diagnosis code associated with the procedure	I10
PR1-16	Procedure Code Modifier	Optional	Modifier associated with the procedure code	A1
PR1-17	Procedure DRG Type	Optional	Type of Diagnosis Related Group (DRG)	MAJ
PR1-18	Tissue Type Code	Optional	Code representing the type of tissue	1
PR1-19	Procedure Identifier		N/A	
PR1-20	Procedure Action Code		N/A	

[1] *This segment is not enabled by default.*

5.2.5.1.15 Fields Definition OBX

5.2.5.1.15.1 OBX – Impressions

Field	Field name	Required/optional	Comment
OBX-1	Set ID		
OBX-2	Value Type		Default value depending on the report section. CE = Impression
OBX-3	Observation Identifier		OpenLink to concatenate and add Subcomponents Separator.
OBX-5	Observation Value		Contains *syngo* Dynamics Impressions Text. OpenLink to concatenate and add Subcomponent Separator. Text valueshould be “HL7 Safe”
OBX-11	Observation Result Status		Same as OBR-25 (F, P, C)

5.2.5.1.15.2 OBX – Report Text

Field	Field name	Required/optional	Comment
OBX-1	Set ID		
OBX-2	Value Type		Default value depending on the report section. FT = Report or Addendum
OBX-3	Observation Identifier		OpenLink to concatenate and add Subcomponents Separator.
OBX-5	Observation Value		Contains *syngo* Dynamics Report Text. Text value should be “HL7 Safe”.
OBX-11	Observation Result Status		Same as OBR-25 (F, P, C)

5.2.5.1.15.3 OBX – Addendum

Field	Field name	Required/optional	Comment
OBX-2	Value Type		
OBX-3	Observation Identifier		DICOM Accession Number & ADT
OBX-5	Observation Value		Contains *syngo* Dynamics Addendum Text
OBX-11	Observation Result Status		Same as OBR-25 (F, P, C)

5.3 HL7 Mapping against *syngo* Dynamics attributes

HL7 Field	*syngo* Dynamics DB Name/Reporting Model	Context Name	Report/Worksheet Display Field	Comments
PID-3.1 ID	PATIENT_ID	Study	Pt. ID	None
PID-3.4 Assigning Authority	SiteID/ MultiMRNSiteID	Study	Site ID	None
PID-5 Patient Name	PATIENT_NAME	Study	Pt. Name	None
PID-7 Date of Birth	PATIENT_BIRTH_ DATE	Study	Pt. Birth Date	UTC will not be considered
PID-8 Sex	PATIENT_SEX	Study	Pt. Sex	None
PID-18.1 Patient Account Number	Department_Visit_ Number	Study	Admission ID	pt acct no = (0038, 0010) Admission ID
ORC-1 Order Control	Used For Processing	–	–	None
ORC-2 Placer Order Number	PlacerOrderNumber-ImagingService-RequestLO	Study	Placer Order Number	None
ORC-3 Filler Order Number	ACCESSION_ NUMBER	Study	Accession Number	None
ORC-5 Order Status	Used For Processing	–	–	None
ORC-12 Ordering Provider	Ordering-ProviderName	Study	Ordering Provider Name	None
OBR-2 Placer Order Number	PlacerOrderNumber-ImagingService-RequestLO	Study	Placer Order Number	None
OBR-3 Filler Order Number	ACCESSION_ NUMBER	Study	Accession Number	None
OBR-4 Universal Service Identifier	UniversalServiceId	Study	Universal Service Identifier	None
OBR-5 Priority	Used For Processing	–	–	None
OBR-7 Observation Date/Time	Study Date/Time (for pre-procedure)	Study	Study Date/ Study Time	None
OBR-16 Ordering Provider	Ordering-ProviderName	Study	Ordering Provider Name	None
OBR-20 Filler Field 1	ACCESSION_ NUMBER,	Study	Accession Number	None
	Used for Processing (HNA_ACCN)	Study		

HL7 Field	*syngo* Dynamics DB Name/Reporting Model	Context Name	Report/Worksheet Display Field	Comments
OBR-31.2 Reason for Study	Indications	Study	Indications	Indications = (0032, 1030) Reason for Study
PV1-1.2 Patient Class	PatientClass	Study	Patient Class	None
PV1-1.8 Referring Doctor	REFERRING_ PHYSICIAN	Study	Referring Physician	None
MRG-1.1 ID	Used For Processing	–	–	None
MRG-1.4 Assigning Authority	Used For Processing	–	–	None
AL1-2 Allergy Type	Allergy_Type_obs	Allergies_ctx	Allergy Type	Imported only for Pre-procedure study
AL1-3 Allergy Code/ Mnemonic/ Description	Allergy_Description_ txt	Allergies_ctx	Allergy Description	Imported only for Pre-procedure study
AL1-4 Allergy Severity	Allergy_Severity_obs	Allergies_ctx	Allergy Severity	Imported only for Pre-procedure study
AL1-5 Allergy Reaction	Allergy_Reaction_txt	Allergies_ctx	Allergy Reaction	Imported only for Pre-procedure study
AL1-6 Identification Date	Allergy_Identification_ Date_dt	Allergies_ctx	Allergy Identification Date	Imported only for Pre-procedure study

5.4 Examples

5.4.1 ORM-O01 message

MSH|^~\&|7EDIT|HL7EDIT|SDIS|SIEMENS|20240826160426||ORM^O01|MSGID202405122028|P|2.3.1

PID|||PS4234241^^^CVIS^MR||John^Doe^^^Mr.||20140826160411|M|||123 West St.^^MICHIGAN^CO^80020^USA||2498652892|2304972374||||

PV1||O|OP^20A^||||2342^Demo^Phy|||CAR|||||||||239668^^^CVIS|||||||||||||||||||||20240826160426|

ORC|NW|2024825122028

OBR|1|20240825160426||003038^AdultEcho^L|Elective|20110826160358|20240826160404|||||||||||||||||||

5.4.2 ADT-A01 message

MSH|^~\&|7edit|1|CVIS|7edit|20240826110607||ADT^A01|599102|P|2.3.1

EVN|A01|202408181123

PID|1||10016604^^^CVIS^MR||Jane^Doe^D||19391010|F||2106-3|111 Helm ST^^NoMansland^CA^54321^USA^P|1|(888)534-51212|(888)555-1212|EN|S||4047716^^^7edit^VN||123561234|||||||||N

PV1|1|I|PREOP^101^1^1^S|||37^Ben^Mike^^^^^7edit^CI|33337^Physician^Demo|||CAR||||1|||37^John^Michel^^^^^7edit^CI|2|41047334^^^CVIS^VN|4|||||||||||||||||||1||G|||20110826115152|20110826115156

DG1|1|I9|71596^CMP^I9|CMP Diagnosis||A

5.4.3 ADT-A40 message (merge identifier)

MSH|^~\&|ADT1|GOODHEALTH|ELR|DOH|20061101102700||ADT^A40|2024280000002|T|2.3.1

EVN|A40|20061101102700

PID|1||PID0700^5^M11^ADT1^MR^GOOD HEALTH HOSPITAL||Doe^Jane^D||19300101|F|||Road^^City^State^DI^12345^USA||^PRN^PH^^^123^5551212~^PRN^PH^^^123^5551213|||||345678901|||U

PV1|1|N|OP^20A^1^MainCampus|||5101^Kell^Don^P^Dr|||||||||||||||||||||||||20240223150551

MRG|PID0701^5^M11^ADT1^MR^GOOD HEALTH HOSPITAL

5.4.4 ADT-A08 message (PHI update)

MSH|^~\&|7EDIT|1|ER|AL|20240826110607||ADT^A08|599102|P|2.3.1

EVN|A08|202408181123

PID|1||10016604^^^CVIS^MR~ABC789^^^HOSP2^MR~998877^^^NATIONAL^MPI||Doe^Jane^D||19391010|F|||111 Helm ST^^NoMansland^CA^54321^USA^P|^PRN^PH^^^888^53451212~^PRN^PH^^^888^5551212|||4047716^^^7EDIT^VN^1|123561234||||||||||N

PV1|1|I|PREOP^101^1^1^^^S|3|||37^John^Michel^^^^^^7EDIT^^^^CI|33337^Physician^Demo||CAR||||1|||37^ John^Michel^^^^^^7EDIT^^^^CI|2|41047334^^^CVIS^VN|4|||||||||||||||1||G|||20110826115152|20110826115156

DG1|1|I9|71596^CMP^I9|CMP||A

5.4.5 ZSU segment in ORM message

When a study UID correction is warranted, the ZSU segment contains the old and the new study UID.

MSH|^~\&|ASYNC_QUEUEING_SERVICE|ASYNC_QUEUEING_FACILITY|RECEIVER_APP|RECEIVER_FAC|20170728133912-0500||ORM^O01|1|P|2.6

PID|1||347823^^^10.30.20.50.45.23|347823|APACHETEST^CRAWLER^MIDDLE||19820508|F

ZSU|2.16.840.1.113669.632.2.262686709563223956.75697023171777487 53|1.2.840.113970.1.2.840.113970.2280106.20170727.1124721

ORC|OP|||||||20170728125959-0400

OBR|1|00000CV170000169||ECHO TEE 3RD PARTY

5.4.6 ORU^R01 message – Outbound report upload

MSH|^~\&|KinetDx|Ann Arbor Lab|Broker|Connectivity Lab|20030305105716||ORU^R01|00002455|P|2.2

PID|||M555||Doe^John^H||19680212|M

OBR|1||275|^Adult Heart|||20030305120744|||||||||||||20030305162300|||F||||||Welby^Marcus^T

OBX|1|CE|275^IMP||^Acute MI unspecified site, initial episode of care-410.91||||||F

OBX|2|FT|275^GDT||Ann Arbor Medical Center\.br\ Echocardiography Laboratory\.br\Telephone: (734)-555-1234 Fax: (734)-555-1235\.br\\.br\ECHO REPORT\.br\ Patient Name: John Doe Patient ID: M555\.br\Exam Date: March 5, 2003 Patient DOB: February 12, 1968\.br\Date of Report: March 5, 2003 Height: \.br\Referring Phys.: YEVES Demo Physician Weight: \.br\Referring Diag.: Acute MI unspecified site, initial episode of care – 410.91 \.br\ Resting BP: / \.br\Indication: Kinet, Acute MI anterolateral, subsequent episode of care – 410.02\.br\\.br\M-mode Data\.br\LVDD: AO: \.br\LVSD: EPSS: \.br\Fract. Shortn: PW: \.br\RVDD: EDV Teichholz: \.br\IVSTD: ESV Teichholz: \.br\ IVSTS: SV: \.br\Fract. Change: EF: \.br\LAD: \.br\\.br\2D Study\.br\There is mild left atrial enlargement. \.br\There is apical akinesis with wall thinning compatible with scar. \.br\The distribution suggests a distal left anterior descending coronary artery distribution. \.br\\.br\ Doppler\.br\There is trivial aortic regurgitation present. \.br\\.br_____\.br\Marcus T Welby\.br\||||||F

5.4.7 DFT^P03 Message – Detailed financial transaction

MSH|^~\&|BillingSystem|FACILITY|EMR|FACILITY|20250711120000||DFT^P03|MSG00001|P|2.3.1

EVN|P03|20250711115900

PID|1||123456^^^FACILITY^MR||Doe^John^A||19800101|M|||123 Main St^^Metropolis^NY^10001||555-1234|||S||987654321

PV1|1|I|ICU^101^1^B^^^FACILITY||||1234^Smith^John^A^^^Dr||||||||||1234567^^^FACILITY^VN|||||||||||||||||||||||||20250711110000

FT1|1|20250711113000|20250711113000||CG|12345^Chest X-Ray|||1|150.00|USD

FT1|2|20250711113500|20250711113500||CG|67890^US-Echo|||1|45.00|USD

ZXT|Transaction submitted successfully

5.4.8 ACK/NACK messages

ACK –ACK messages are sent when the message is successfully received. An ACK does not guarantee that a message will be fully processed (e.g., a duplicate ADT^A01 may return an ACK but may not be fully processed).

MSH|^~\&|<SendingApp>|<SendingFacility>|<ReceivingApp>|<ReceivingFacility>|<DateTime>|<Security>|ACK|<MessageControlID>|<ProcessingID>|<Version>

MSA|AA|<MessageControlID>

NACK message is also displayed in ACK message format.

MSH|^~\&|<SendingApp>|<SendingFacility>|<ReceivingApp>|<ReceivingFacility>|<DateTime>|<Security>|ACK|<MessageControlID>|<ProcessingID>|<Version>

MSA|AE or AR|<MessageControlID>|<ErrorMessageText>

5.4.9 ACK scenarios currently handled

NACK message is also displayed in ACK message format.

6. Fast Healthcare Interoperability Resource (FHIR) implementation

The purpose of this section is to provide an overview of the resources utilized by *syngo* Dynamics.

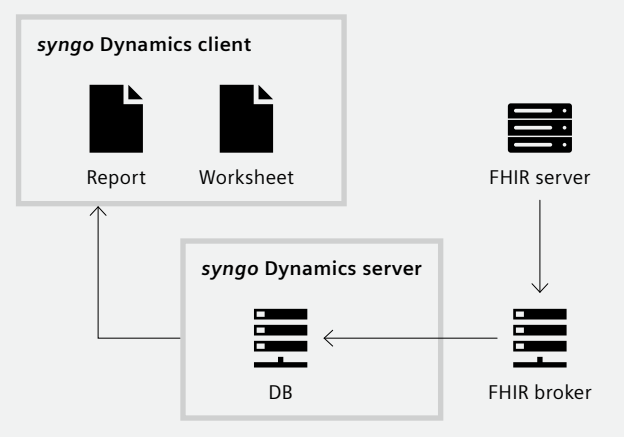
6.1 Overview

FHIR: Fast Healthcare Interoperability Resources is a standard for exchanging healthcare information electronically.

The FHIR broker service interfaces with a FHIR server to retrieve patient data, including height, weight, and blood pressure (systolic and diastolic). Patient identification is based on MRN and Assigning Authority or MPI.

Upon loading a study, the patient's height, weight, and blood pressure values are automatically retrieved in the background and saved to the study for the first time. Users can also manually trigger a retrieval to update these values with the latest data from the FHIR server.

The FHIR service utilizes the FHIR broker library from the inner-source repository of Siemens Healthineers.



Real-time data import from FHIR server into *syngo* Dynamics

6.2 Versions supported

syngo Dynamics supports FHIR versions are DSTU2 and STU3.

6.3 Supported resources

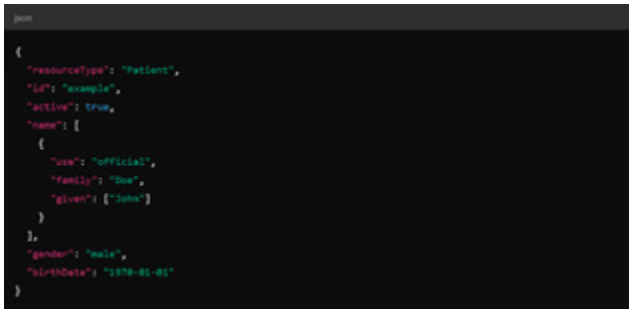
List of resources

Name of the resource	Type	Description	Constraints
Patient Resource	Patient	Finding the latest study record based on the visit date	MRN and Site ID, or MPI
Observation Resource	Observation	Fetching observation values of Height, Weight, Systolic BP, and Diastolic BP. Also, extensible to fetch other observations using LOINC or SNOMED code.	None

6.4 Formats supported

JSON (JavaScript Object Notation):

- **Description:** JSON is a lightweight data-interchange format that is easy for humans to read and write, and easy for machines to parse and generate.
- **Usage:** JSON is widely used in modern web applications and APIs due to its simplicity and flexibility.



6.5 Interactions

This section specifies the list of interactions supported by *syngo* Dynamics.

Read, Search.

Supported interactions per resource

Name of the resource	Interaction type								
Patient, Observation	Read	Version Read	Update	Patch	Delete	History-instance	History-type	Create	Search-type
	Yes	No	No	No	No	No	No	No	Date

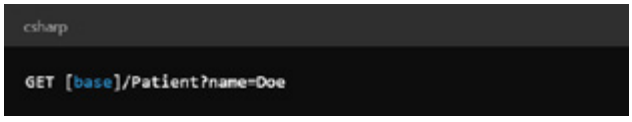
6.6 Operations

Read (GET):

- **Description:** Retrieves the current state of a resource from the server
- **HTTP method:** GET
- **Example:** Retrieving a patient resource by its ID: GET [base]/Patient/example-id

Search (GET with parameters):

- **Description:** Searches for resources based on specified criteria
- **HTTP method:** GET
- **Example:** Searching for all patient resources with a specific name:



6.7 Client-server type

Import patient data stored in the FHIR server that is interfaced with the *syngo* Dynamics server. Patient data such as Patient Height, Patient Weight, Blood Pressure (Systolic, Diastolic) for a study is fetched from the FHIR server based on either MPI (Master Patient Index) or MRN and Assigning Authority.

6.8 Implementation guides

None.

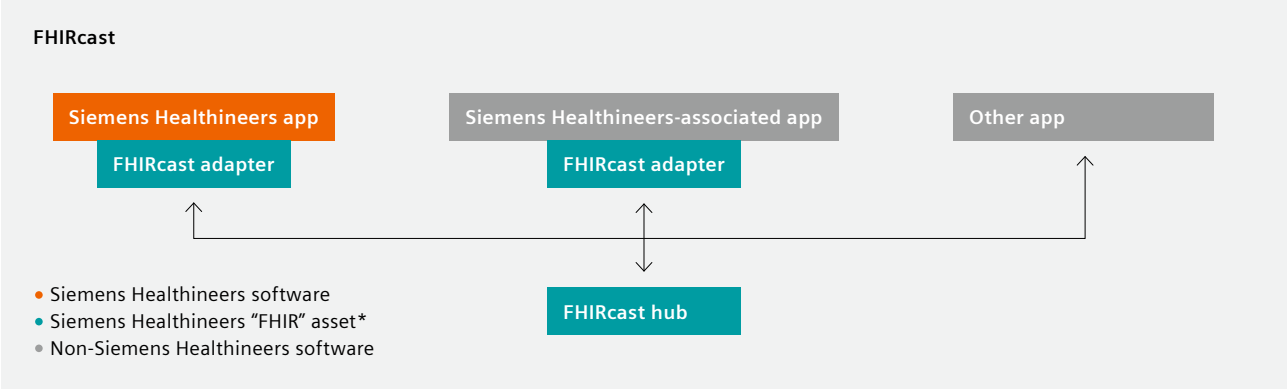
7. FHIRcast

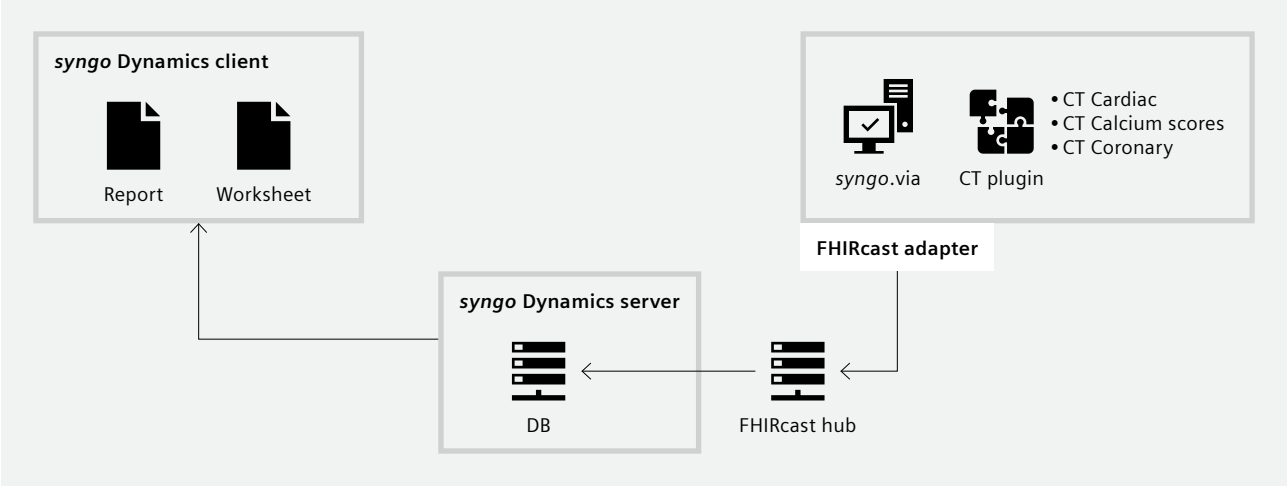
This section aims to describe the role of FHIRcast in relevance to the *syngo* Dynamics.

7.1 Overview

FHIRcast is a specification developed by HL7 (Health Level Seven International) that enables real-time event notification and subscription management in healthcare systems. It focuses on providing a standardized approach for sending and receiving notifications about clinical events and changes in healthcare information.

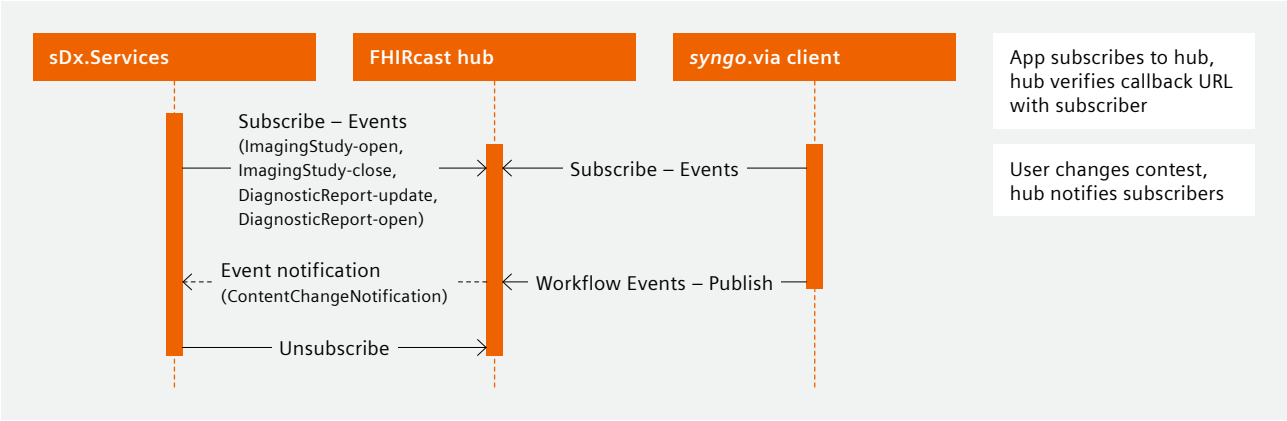
FHIRcast represents a significant advancement in healthcare interoperability by standardizing the way real-time event notifications are managed and delivered across healthcare IT ecosystems. It enhances the ability of healthcare providers to deliver timely and informed care by ensuring that relevant stakeholders receive updates promptly when significant events occur.





Real-time data import from *syngo*.via into *syngo* Dynamics

** Assets are in the inner-source repository.*



7.2 FHIRcast version

syngo Dynamics supports FHIRcast protocol version is STU2.

7.3 Subscribing and unsubscribing

A subscription to the FHIRcast Hub is created when a study in a supported third-party application is opened at a *syngo* Dynamics client. This subscription allows the client to send and receive messages to and from the FHIRcast Hub so that data specified prior to opening the study, or while the study is open, is sent and persisted in *syngo* Dynamics.

When study opened in *syngo* Dynamics a subscription is sent to the FHIRcast hub in *syngo* Dynamics with the context as study UID. When data is received from any other Siemens Healthineers application supporting FHIRcast data transfer to the *syngo* Dynamics FHIRcast Hub then the data is validated against the common context (study UID) and published in the *syngo* Dynamics reporting and persisted in *syngo* Dynamics database.

When study is getting closed in *syngo* Dynamics it is unsubscribed from the *syngo* Dynamics Hub. Similarly, when the study is closed in the external application the un-subscription is triggered to *syngo* Dynamics Hub.

Subscription Request
Subscription Request is used by a subscriber system to establish or modify a subscription for receiving event notifications from a publisher system. Here is an overview of the components and structure of a FHIRcast.

Subscription Response
In the context of FHIRcast, a Subscription Response is the message sent by a publisher system in response to a Subscription Request from a subscriber system. This response acknowledges the subscription request and provides confirmation of its status.

Subscription Denial
In the context of FHIRcast, a Subscription Denial refers to the response sent by a publisher system to reject or deny a Subscription Request from a subscriber system. This denial could occur due to varied reasons, such as invalid criteria, insufficient permissions, or system constraints.

Subscription Confirmation
In FHIRcast, a Subscription Confirmation refers to the response sent by a publisher system to acknowledge and confirm the successful establishment or modification of a subscription requested by a subscriber system.

Un-subscription
In the context of FHIRcast, an Un-subscription refers to the process where a subscriber system requests to terminate or cancel an existing subscription for receiving event notifications from a publisher system.

7.4 Event notifications

FHIRcast Event Notifications refer to real-time messages that convey specific healthcare events or changes in patient data from a publisher system to one or more subscriber systems. This mechanism facilitates immediate communication of critical information across different healthcare applications and systems that support the FHIR (Fast Healthcare Interoperability Resources) standard.

Event Notification Response
FHIRcast Event Notification Response plays a critical role in confirming receipt and processing of event notifications, ensuring effective communication and coordination among healthcare systems and applications. It enhances operational efficiency and supports timely decision-making in clinical settings by providing feedback on critical events and updates.

Event Notification Request
FHIRcast Event Notification Request enables efficient and standardized communication of critical healthcare events, supporting improved care coordination, decision support, and workflow automation in clinical settings.

7.5 Event notification errors

If there is a communication failure between the FHIRcast subscriber (External Siemens Healthineers application connect to *syngo* Dynamics Hub) and the Hub, an intimation is provided to the user stating the failure.

7.6 Request context change

syngo Dynamics supports only context is Study UID. Context change request is not applicable in *syngo* Dynamics.

7.7 Events

The following events are sent from *syngo* Dynamics:
- DiagnosticReport-open
- DiagnosticReport-close

The following events are processed by *syngo* Dynamics:
- DiagnosticReport-update
- ImagingStudy-open
- ImagingStudy-close

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